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Early Childhood Education

Edited by Donna Farland-Smith

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Published in London, United Kingdom







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http://dx.doi.org/10.5772/intechopen.73467
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First published in London, United Kingdom, 2019 by IntechOpen
eBook (PDF) Published by IntechOpen, 2019
IntechOpen is the global imprint of INTECHOPEN LIMITED, registered in England and Wales, registration number: 11086078, The Shard, 25th floor, 32 London Bridge Street
London, SE19SG – United Kingdom
Printed in Croatia

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Additional hard and PDF copies can be obtained from orders@intechopen.com

Early Childhood Education
Edited by Donna Farland-Smith
p. cm.
Print ISBN 978-1-78985-521-0
Online ISBN 978-1-78985-522-7
eBook (PDF) ISBN 978-1-83962-142-0

Meet the editor

Donna Farland-Smith received her EdD in Science and Mathematics Education from the University of Massachusetts, MA, USA, in 2003. Her dissertation was titled "The Effect of Historical, Non-fiction, Trade Books on Third Grade Students' Perceptions of Scientists." In 2012, she began her career at Ohio State University, School of Teaching and Learning, OH, USA, and currently holds the position of Associate Professor of Science Education. She has authored numerous books, journal articles, and book chapters on the topic of early childhood education. She is the coauthor of the *Eureka! Science Activities and Stories Series* (K-2, 3-5) with National Science Teachers Association Press.

Contents

Preface

"*There can be no keener revelation of a society's soul than the way in which it treats its children.*"—Nelson Mandela, Former President of South Africa

In today's world, early childhood education is more important than ever before, because we have never raised children in more advanced societies across the globe. However, even with the knowledge base and advances we have today, gaps remain in relation to early childhood education. Some countries have very advanced societies, while other societies do not enjoy those luxuries. Researchers from early childhood education, literacy, science, technology, mathematics, science, and special education have all contributed to this special volume so that all these resources about early childhood education can be located in one place.

The goal of this book is to formulate international research to include Latin America, South Africa, the United States, Turkey, Nigeria, Greece, Crete, and India. This book will serve as a resource for students, researchers, and practitioners in the area of early childhood education. The 18 chapters are in no particular order except that they are divided and organized into the major areas relevant to early childhood education: early childhood development, play, science, mathematics, technology, literacy, and exceptional learners. Each chapter contains an overview of background information pertinent to the chapter and a synopsis of research or a new research study. The information contained in this handbook provides a foundation for past and/or present research and suggests future research studies.

The first two chapters are included in the *Early Childhood Development* section because it discusses early childhood development on a broad scale.

Chapter 1, "Compulsory Preschool in Latin America: Comparative Evolution and Future Challenges," discusses a comparative study focused on dramatic efforts to increase preschool coverage, with a broad success that favors the level of attainment in primary education throughout Latin America. While this is recognized throughout the countries as a significant progress for the improvement of access for many young children, it has been acknowledged that the extent of this expansion has been very unequal. The comparative study helps to reveal the different developments, as well as the diverse situations and political agendas when Latin American countries adopt international agendas to their particular realities and education contexts.

Chapter 2, "Opportunities in the Odds: Exploring Adult-Child Interactions and Their Effects on Children's Cognitive and Learning Progress," is action research and raises awareness on the influence that small changes in adult-child interactions can have on children's cognitive and learning progress. The authors address learning opportunities found through the odds of conventional teaching in an early childhood setting. In an effort to promote good thinking that develops language and cognition in young bilingual children, the authors found the use of documentation, and asking good questions were important aspects to engage disengaged children and teachers.

The next section is identified as *Play* because it is an essential part of human development in early childhood. Play is crucial for children's imagination and their emotional, social, and academic well-being. It has often been said that play is a child's work or job. That said, it is their job to explore the world around them and take risks. Play is the human right of all children, no matter where they live. The idea that children need to play has stood the test of time. In this book, we explore movement, emergent literacy, and pedagogy.

Chapter 3, "Jack Be Nimble and Jack Be Quick: Increasing Movement Competence in Early Childhood Settings," focuses on the importance for early childhood researchers, caregivers, educators, and policy makers to understand the relationship of movement competence in early childhood to later movement and academic success.

Chapter 4, "Play as a Mechanism of Promoting Emergent Literacy among Young Children: The Indian Context," summarizes the status of emergent literacy in India, discussing the significance of play in early years. It is crucial to emphasize the role of traditional games, stories, and lullabies as a mechanism to enhance children's holistic development and learning. There is also a need for incorporating traditional play in the regular curriculum and classroom practices in early childhood programs and this has reflected the significance of inculcating cultural values and beliefs among children through traditional games, plays, and stories.

Chapter 5, "To Teach or Not to Teach in the Early Years: What Does this Mean in Early Childhood Education," examines this undertheorized notion by revisiting constructivist theory, reexamining the differences between constructivism and critical social constructionism, and in the process explores many underpinning beliefs about knowledge in early years pedagogy. Examples of critical social constructionist pedagogy, drawn from some of the "big ideas" in the social sciences, are provided in an attempt to blur the boundaries between the binaries that have dogged educational reform in the early years for decades.

The next section is *Science* in early childhood classrooms, specifically the Reggio Emilia approach in preschools in Turkey and the importance of addressing stereotypes in early childhood education.

Chapter 6, "Science Education in Reggio Emilia-Inspired Altın Çağ Preschools," focuses on integrated teaching and learning philosophy and the 3H principle of early childhood education, namely hands-on, heads-on (minds-on), and hearts-on education, because in Reggio Emilia classrooms, children are seen as a whole with their hands, minds, and hearts, and education needs to satisfy all. Moreover, this chapter presents some examples and photos of science experiences happening within the project named "80" in Reggio Emilia-inspired Altın Çağ preschools in Turkey so that the teachers can easily comprehend how to get children to work on science projects from the first stage of development of a project to the last stage.

Chapter 7, "Developing Young Scientists: The Importance of Addressing Stereotypes in Early Childhood Education," explores stereotypes young children hold of scientists and how to recognize, address, and combat these stereotypes in the early childhood classrooms. The history of drawings of scientists will be used to begin the discussion and pedagogical methodologies will be discussed.

The next section examines *Mathematics,* namely spatial reasoning, early numeracy, and mathematical concepts in games. Early childhood mathematical skills, whether in formal or informal settings, are designed to lay the foundation for one's life; therefore, they are of utmost importance.

Chapter 8, "The Importance of Spatial Reasoning in Early Childhood Mathematics," describes a study that uses a primary-level screener and diagnostic to assess students' spatial reasoning and then provides curricular resources to improve students' understanding of mathematics. The study shows students' mathematical spatial reasoning improved significantly.

Chapter 9, "Predictors of Early Numeracy: Applied Measures in Two Childcare Contexts," assesses differences in early numeracy, phonological awareness, receptive language, executive functioning, and working memory for children in two childcare settings (family and center) to determine whether applied measures of phonological awareness and executive functioning could serve as predictors of numeracy performance. These results suggest a connection between children's numeracy skills and a developmental change from receptive language skills to phonological working memory skills.

Chapter 10, "Black Students' Rich Mathematical Experiences: Mathematics Concepts and Xhosa Cultural Games for Reception Class," explores cultural games played by students during playtime and in their communities with the aim of eliciting mathematics embedded and attained while engaging in the game. The chapter recommends culturally relevant pedagogy that integrates mathematics learning with students' cultural artifacts for ownership of knowledge and recognition of pluralism for economic and development initiatives globally.

The next section is about *Technology* because it relates to early childhood education and includes television, (auto)photography, and coding. Each is a new literacy for the twenty-first century and, as a literacy, enables new ways of thinking and new ways of communicating and expressing ideas, as well as new ways of civic participation.

Chapter 11, "Tourist or Traveler? Unpacking Informal Conversations between Teachers and Young Children across Diversity," describes a study that uses autophotography to examine the ways teachers engage in informal conversations with young children who come from different racial, ethnic, and socioeconomic backgrounds, around their photos of home. Specifically, conversations are interrogated to identify what impacts teacher-student interactions across differences. Using Gee's discourse analysis, this study explores how the teachers built or lessened what the children viewed as significant, how they distributed their social goods—influence, power, or status—and how they created or positioned identities within the conversations.

Chapter 12, "Evaluating a Course for Teaching Advanced Programming Concepts with Scratch to Preservice Kindergarten Teachers: A Case Study in Greece," discusses a game-based approach to coding education for preservice kindergarten teachers using Scratch. The aim of using Scratch was to excite students' interest and familiarize them with the basics of programming in an open-ended, project-based, and personally meaningful environment for a semester course in the Department of Preschool Education in the University of Crete. For the projects, they were required to design their own interactive stories to teach certain concepts about mathematics or physical science to preschool-age students. The results we obtained were more satisfactory than expected and, to a certain extent, encouraging if one considers the fact that the research participants had no prior experiences with computational thinking.

Two chapters included in the *Literacy* section are relevant to two very important topics in reading: the screening of young children and emergent reading and brain development. Reading and reading difficulties are some of the most researched topics in the literature in regard to education. Emergent reading emphasizes the developmental continuum aspect of learning to read and advocates the importance of reading-related behaviors occurring before school. The brain-imaging evidence elucidates our understanding of the importance of emergent reading from a neurobiological point of view.

Chapter 13, "Screening Young Children at Risk for Reading Failure," focuses on the screening measures and their characteristics toward significance and effectiveness. More specifically, discrimination accuracy, sensitivity, and specificity as well as validity and reliability are taken into consideration. Some well-known studies are examined revealing a range of methodological issues, which affected the effectiveness of using measures in the extant research.

Chapter 14, "Emergent Reading and Brain Development," discusses brain imaging's evidence of high plasticity of young children's brains and emergent reading experience that can shape brain development to support fluent reading. Future studies are needed to understand how emergent reading experience can become a protective factor for children at risk for reading impairments. Future studies need to design early interventions to improve emergent reading experience, which is a crucial part.

The four chapters in the *Exceptional Learners* section are pertinent to the fact that there has been an increase in students with cognitive, social, and emotional disorders included in general education classrooms today. Significant debate continues to surround the issue of students with emotional and behavioral disorders and other disabilities for placement in general education settings. The practice of inclusive education within general education classrooms is becoming more prevalent within early childhood settings and there has been an absence of empirically sound research to guide policy and practice. To successfully deliver classroom curriculums, promote learner growth, and meet the goals of all students served within inclusive settings, teachers must have a basic understanding of the unique learning needs of all students, including those with visual impairments and the Individuals with Disabilities Education Act (IDEA).

Chapter 15, "Obstacles to Inclusion: One Early Childhood Inclusive Teacher's Perspective," explores the experience of one such environment in which several students with emotional disturbances are included in a first-grade classroom. The frustrated teacher expressed a perceived lack of knowledge in handling behaviors and persistent feelings of helplessness. She struggled with how to handle the behaviors of the students with emotional disturbances and questioned if their inclusion in the general education classroom was best for all.

Chapter 16, "Relationships and Resources: Supporting Exceptional Learners from Birth through Primary School," outlines common milestones of young children, challenges experienced by parents and caregivers of young children with exceptionalities, and strategies and resources designed to support families on their journeys. The information is designed to be presented in a way to help set families and their little ones up for success. The content provided in this chapter is built on the premise that knowledge is power, that all children can learn, and that parent-professional partnerships are central to the growth of all learners.

Chapter 17, "Promoting the Social Competence of Each and Every Child in Inclusive Early Childhood Classrooms," examines social competence in early childhood while considering existing research, developmental theory, and best practices and policies, many of which (on their own) address limited facets of a complex set of interactive competencies and outcomes. The potential and pitfalls of inclusive early childhood classroom structures relative to supporting interaction and social skill development are explored.

Chapter 18, "Including Children with Visual Impairments in the Early Childhood Classroom," is designed as a basic starting point for early childhood educators who have limited to no background in working with students who have visual impairments. The goal of this chapter is to give early childhood educators a basic understanding of visual impairments, to know what questions to ask when serving children with vision loss, and to show how accessibility can be approached in a way that is meaningful to students with visual impairments.

I would personally like to thank each and every author for their contribution to this book. Together, we have assembled something unique in the field of early childhood education, an international resource in the fields of literacy, science, technology, mathematics, science, and special education. We only advance the field when we learn about each other's work and embrace early childhood education as a whole field. The children we teach today are our future!

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Section 1

Early Childhood Development

Chapter 1

Compulsory Preschool in Latin America: Comparative Evolution and Future Challenges

Ana Ancheta Arrabal

Abstract

The establishment of Early Childhood Education (ECE) as a key to the success of different aims on the global agendas—Education for All Framework (EFA), Sustainable Development Goals (SDGs), among others—has contributed to the extension of ECE programs and preschool around the world. Latin American countries have also advocated for the development agendas, with the essential role played by education for sustainable human development. Over the last decades, these countries have made dramatic efforts to increase preschool coverage, with a broad success that favors the level of attainment in primary education. Even when this expansion has been broadly recognized as a significant progress for the improvement of ECE access for many young children in the region, it has been acknowledged that the extent of this expansion has been very unequal. The comparative study helps to reveal the different developments, as well as the diverse situations and political agendas for ECE, when Latin American countries adopt international agendas to their particular realities and education contexts. In this view, this study aims to identify the broad trends trying to include the affluent frames and evolutions of compulsory preschool in Latin America in order to open a space for debate around the particular pathways that this ECE policy has implicated in this region.

Keywords: preschool education, Latin America, comparative research, compulsory education, evolution

1. Introduction

Over the last decades, the establishment of the Early Childhood Education (ECE) as a key to the success of different aims on the international agendas for education, which is based on the recognition that ECE services can contribute to these goals, has been one of the main issues of the global agenda. As a matter of fact, early childhood education has become one of the areas identified for improvement within this framework, as the UNESCO-sponsored World Conference on Early Childhood Care and Education: Building the Wealth of Nations in Moscow, September 2010 outlined in its purpose. Hence, the Moscow Framework for Action and Cooperation, adopted by the Conference [1], moved ECE higher up on political agendas by planning a strategic position for ECE in the now current development and education agendas.

Nowadays, the SDGs hold the quality of early childhood care and education systems as a key element of the goal number 4 on education, and it is understood to play a major role in achieving the desirable outcomes [2]. In this respect, education SDG 4 covers learning from early childhood through adulthood, while stressing the universality of the goals and targets for countries at every level of development, as well as the key themes of education quality, learning, inclusion, and equity. Equity is emphasized here as means of focusing on quality without addressing the many aspects related to those on the margins and those who have been left behind. Actually, the beneficial role of quality ECE to, among other contributions, guarantee the success of the attainment and completion of primary education has been fully demonstrated by diverse international surveys, such as Program for International Student Assessment (PISA). This named survey across OECD countries shows that there is a better performance for students at the age of 15 years who attended preprimary school than for those who did not attended, even after accounting for students' socioeconomic status [3].

Latin American countries have also advocated for the development agendas, with the essential role played by education for sustainable human development. Moreover, when referring to education challenges in achieving the education goals in the region, the expansion of early childhood care and education services remained a priority [4]. Along this same line, the Economic Commission for Latin America and the Caribbean (ECLAC) aims at the universalization of preschool education [5], from an approach that is matched by the OECD [6], with respect to the central role of education policies in the fight against the transmission of inequality from one generation to the next. This is an especially relevant goal if those policies have been concerned with early childhood and the advancement of compulsory education. Yet, the inequitable socioeconomic structure of Latin America indeed interacts with the inequality in educational participation also at the ECE level, resulting in a dynamic where preschool education can hardly develop as the desirable equalizer to potentially tackle these social inequalities.

There is a widespread consensus in considering that overcoming the serious inequalities is the greatest structural challenge for the entire region of Latin America [5], especially because these disparities spread in the context of low socioeconomic mobility, which stems from existing political and family mechanisms that perpetuate the problem [7]. As a result of this imbalance, the disadvantaged groups continue to suffer lower opportunities of education, and unequal education continues to be as one of the challenges from the Latin American educational reality. The UNESCO Regional Bureau for Latin America and the Caribbean (OREALC) noticed that important levels of inequality related to elements such as social class, ethnic origin, and geographic location can be found in all countries of the region, which constitute the factors blocking the expansion of the provision of quality education [8]. Furthermore, the educational mobility in Latin America is very limited in comparison with other regions of the planet; thus, when the educational attainment from one generation with respect to their parents is assessed, the correlation between the level of the parents and their children is significantly higher in this region than in the rest of them [9].

Bering in mind these conditional factors, the aim of this work is to examine and compare the impact of the implementation of compulsory preschool education in the different Latin American countries and their diverse societies. Specifically, the focus is on the extent to which preschool education can mitigate the social inequalities in children's learning outcomes generated within the family context. Therefore, comparable data are analyzed and confronted in order to disentangle if compulsory preschool education can reduce social inequalities in educational attainment within this region.

2. Methodology

In World Declaration on Education for All (EFA) 1990, ECE was committed as the first fundamental goal for the Latin American countries that submitted this agenda, and, since then, expanding ECE access has been recognized as a priority. Nevertheless, UNESCO pointed out that the compulsory attendance policy could become a crash course for children prior to enter formal schooling without being complemented by measures to ensure the child's attendance in the early phases of ECE [10]. To this concern, the Educational Goals for 2021, which were adopted by the Ibero-American Conference on Education and reaffirmed in 2010, include ambitious goals relating to ECE. Particularly, the third general goal and its target reflect the political importance that the expansion of ECE from the early ages has taken on in the region. Moreover, the targets to include the children from vulnerable groups in this expansion can be founded in the second target from this agenda in order to promote equity and an equitable access to ECE. Quality ECE for low socioeconomic status children has been found to benefit from ECE to a greater extent than high socioeconomic status children [11]. Hence, it has been necessary to monitor the expansion of access to ECE as a first step to assess the equity but, along with it, the equity of the distribution and the quality of the provision needs to be examined.

The implementation and evaluation of the above-mentioned agendas have provided for strategies and action plans, as well as they have open new prospects to identify the trends and development of their consecution over time. As positive consequence, nowadays, it is possible to measure and compare the levels of achievement that the Latin American countries have reached in the expansion of ECE over the last decades. This comparative exercise allows the establishment of particular paths and dynamics that have taken place in the different countries and moments, in order to relate them with the present challenges and opportunities that education is facing within this diverse reality.

For the purpose of this work, the selection of indicators responds to the availability of comparable data of ECE in Latin American countries, focusing on the mandatory attendance policies and the real benefit of them. Therefore, in the next section, compared information shows a short description of the main types of provision of the national system in early childhood education together with the main selected elements on compulsory preschool education. These elements are the mandatory access and the age range for a guaranteed place, as well as the evolution of school life expectancy in ECE and of the scope of children with preschool experiences after the transition to primary school. Furthermore, in this first subsection, there are also compiled data on the equity of access in order to study the development and achievement of ECE expansion by comparing the enrolment ratios over time, as well as the school life expectancy.

The second subsection of the comparative study will focus on the last three rounds of PISA results and its evolutions from a selection of countries in order to relate their developments with the progresses on the implementation and the expansion of the compulsory attendance policies in ECE. This cross-national study of the comparable data over time can reveal to what extent the compulsory attendance policy has benefitted the Latin American countries, from a general perspective. In the same line, this exercise can help to show the disparities between these countries and the different social groups within these countries.

Bearing in mind that there are multiple pathways and different influences to understand the diverse ways in which ECE policy can be made efficient [12, 13], the comparative conclusions of this study will be presented in the final section of the work. There, some future perspectives and challenges around the compulsory preschool are also discussed, in order to complement the extracted conclusions.

3. Cross-national study of the compulsory preschool in the Latin American countries

3.1 Compulsory preschool education in Latin America

Historically, there has been a common trend among the Latin American countries toward the so-called divided model in the provision of ECE. For most of the cases, this division was established in terms of age, as it was also the designation and definition of the great variety of arrangements. However, since the 1990s, the universalization of at least the last year of preschool spreads as a goal throughout Latin America [14] and the implementation of its mandatory character has been determinant to set the current structure of ECE in the region.

Nowadays, in all the Latin American countries, preschool attendance is mandatory at the age of 5 years old, even though in some of the nations, this situation can start earlier for young children. As can be observed in **Table 1**, the laws on compulsory preschool education have been instituted in this region over the past two decades, although some of these countries did earlier (see the **Table 1** additional notes on the cases of Panama and Venezuela in 1946 and 1980, respectively). Nevertheless, the effectiveness of these initiatives has been only noted in recent times along the steady increase of the public investment on this level of each national education system. Thereby, **Table 1** shows significant and positive advances in the level of government expenditure on preprimary education per pupil, expressed as a percentage of the GDP per capita, in the majority of the countries over the decades when compulsory attendance policies were being implemented. As a result, all the Latin American countries have expanded the provision and opportunities of ECE for the age groups immediately preceding entry into the primary education cycle, according to the information drawn from the selected indicators in **Table 1**. This is the case for the number of years of free ECE that is now offered in every Latin American country and which is covered for 3 years in more than the half of these countries, with the only case of Chile where this value is below 2 years of free ECE. Another successful achievement has been the evolution of school life expectancy in preprimary education between 2002 and 2015, as the region on average has achieved a substantial improvement of 0.5 years, and in 13 countries, this indicator has reached the value of 1.5 years or even more (see **Table 1**). This is a fact that, along the rise of ECE enrolment ratios, has been mainly spurred by the widespread strategy in Latin America of mandatory attendance policy over the last decades.

Accordingly, it is visible in **Table 1** that during the period between 2002 and 2015, the Adjusted Net Enrolment Ratio (ANER [15]) 1 year before the official primary school entry age (%) has incremented all over the Latin American region. Furthermore, the nations that present the highest scores over 90% of new entrants with such experience by 2015 (Argentina, Brazil, Chile, Costa Rica, Ecuador, Mexico, Peru, Uruguay, and Venezuela) are mainly corresponding with those with the highest preschool life expectancy (see **Table 1**).

To sum up, from the comparative analysis of the **Table 1**, it can be concluded that all the Latin American countries have expanded the provision and opportunities of learning for young children prior to the primary entry since 2002. Notwithstanding the differences on the expansion of preschool coverage and progress between these countries exhibit a high level of variability, just as the increases in the enrolment ratios between 2000 and 2015 did not have the same intensity along the countries of the region. For instance, countries like Bolivia or Ecuador have experimented the highest increments (over 20 percentage points) in the ANER between 2002 and 2015 to achieve the highest standards (above 90%) compared

Countries	Current regulation on compulsory preschool education and age group	Free ECE (years)	Government expenditure on preprimary education per pupil as % of GDP per capita		School life expectancy in preprimary education (years)		ANER 1 year before the official primary school entry age (%), school year ending in	
		2015	2002	2015	2002	2015	2002	2015
Argentina	(Ley Nacional de Educación, 2006)4–5 years old	3	9.4	11.5	1.8	2.2	99.2	98.8[a]
Bolivia	(Ley de Educación, 2010)4–5 years old	2	7.6	12.1	1	1.4	67.1	92.5[a]
Brazil	(Lei de Diretrizes e Bases da Educação, 1996)4–5 years old	3	15.2[iii]	26.4	1.6[iii]	1.8	81.3	93[Z]
Chile	(Ley General de Educación, 2009)5 years old	1	13.1	18.6	1.6	2.5		97.5[a]
Colombia	(Ley General de Educación, 1994)5 years old	3	3.5	6.6	1.3	2.5[Z]	82.1	84.2[a]
Costa Rica	(Código de Educación Ley N., 2000)3–5 years old	3	14.8	18.3	1.2	1.6	85.1	93.4
Ecuador	(Ley Orgánica de Educación Intercultural, 2011)3–5 years old	3	34.6*	24.8	0.7	2.1	74.7	97.5
El Salvador	(Ley General de Educación, 1996)4–6 years old	3	6.1	6.8	1.6	2.0	75.4	85.5
Guatemala	(Ley Nacional de Educación 1991)4–6 years old	2	4.8	15.5	1.1	1.4	65.0	80.7
Honduras	(Ley fundamental de educación, 2011)5 years old	3	..	14.1	1[i]	1.2	..	81.3[a]
Mexico	(Ley General de Educación, 1993)3–5 years old	3	13.9	13.1***	1.4	2.1	83.4	98.7
Nicaragua	(Ley General de Educación, 2006)5 years old	..	0.6[ii]	4.2**	1.3	1.8**	73.3	87.3***
Panama	(Ley Orgánica de Educación, 1995)4–5 years old	2	3.9	3.9***	1.1	1.5	72.2	79.3
Paraguay	(Ley General de Educación, 1998)5 years old	3	12.1	12.8	1	1.1***	..	77.9***
Peru	(Ley General de Educación, 2003)3–5 years old	3	6.4	13.2	1.8	2.7	85.4	98.8
Uruguay	(Ley General de Educación, 2008)4–5 years old	2	8.0	..	2	2.7	100[ii]	96.7

Countries	Current regulation on compulsory preschool education and age group	Free ECE (years)	Government expenditure on preprimary education per pupil as % of GDP per capita		School life expectancy in preprimary education (years)		ANER 1 year before the official primary school entry age (%), school year ending in	
		2015	2002	2015	2002	2015	2002	2015
Venezuela	(Ley Orgánica de Educación, 2009)3–5 years old	3	7.22[iii]	17.12*	1.5	2.3	76.1	92.3

Explanatory notes: ANER 1 year before the official primary school entry age is the percentage of children at the intended age a year before entry into primary education who are enrolled in either preprimary or primary education.

*a: 2016 by UNESCO.UIS; [i]2003; *2008;*

*z: National estimate; [ii]2005; **2010;*

*.. No registered; [iii]2006; ***2012.*

Source: Table by author. Data extracted from UNESCO.UIS (2018), SIPI (2017), and ECLAC (2016).

Table 1.
Mandatory Early Childhood Education in Latin America: provision, regulations, compulsory age, school life expectancy.

with the rising in Brazil, Costa Rica, Mexico, or Venezuela (between 8.6 and 16.2 percentage points) or another countries such as Argentina or Uruguay that just had to keep these standards during this time (see **Table 1**).

Whatsoever, the implementation of compulsory preschool by the introduction of national laws in the Latin American countries can be considered as a constructive measure in the understanding and recognition of education as a fundamental human right. The evidence from **Table 1** indicates that the application of a year of free compulsory ECE derived in a general trend to extend preschool for all the young children in Latin America, yet the effectiveness of these measures has been constrained by every idiosyncrasy. Thus, despite the great improvements of the region, in countries such as Panama or Paraguay, the age group of children immediately preceding entry into the primary education cycle is still not benefiting from this legislative initiative by a wide margin (over the 80% ANER 1 year before the official primary school entry age). Moreover, the group of countries that now has to keep the efforts to overcome the value of 90% of ANER 1 year before the official primary school entry age, toward the current target of the Educational Goals for 2021, represents almost a half of the region. This is visible on **Table 1**, where this group includes the two above-mentioned countries and five more (Colombia, El Salvador, Guatemala, Honduras, El Salvador, and Nicaragua), even the availability and reliability of data remain a challenge of this measurement [16].

In order to chart the achievements of such mandatory policy and its benefits for young children, comparable data need to be interpreted in detail and to be disaggregated. Equally, causational studies to analyze the effect of preschool attendance on children's academic skills in Latin America were provided with caution, as no direct reference to a causal effect can be made [17]. The existence of still sharp differences in ECE access continues to be linked to the socioeconomic status and area of residence in the region, at the same time that the role of quality ECE has been pointed out as an equalizer [3]. The main question to be formulated at this point is whether the benefits of these mandatory ECE measures can have significant impacts in a very despair reality such as the Latin American region rather than to question the extent of its universalization.

Therefore, in the next subsection, the focus will be on the comparable and complementary data available that help to address if preschool education can mitigate the social inequalities in the children's learning outcomes of this region.

3.2 Effects of compulsory preschool education in Latin America

The comparative study of the Latin American region involves great challenges when trying to approach the development and results of educational policies. There are some conditioning factors of this particular context such as the socioeconomic inequality or the diversity of the different social, cultural, and political frameworks that characterize the region [5]. Along to this fact, the idiosyncrasy of each Latin American country reveals the diverse traditions and situations of ECE in the region, which help to explain the different frames and evolutions that give the priority and adopt the challenges from the international and regional agendas of education. Hence, in the following pages, far from standardizing inferences, the aim is to draw the paths that some of the Latin American countries have follow in the run to implement such agendas and their goals concerning preschool education. Thereby, in the first place, the impact of the ECE mandatory attendance policy is studied in detail through the evolutions of ANER 1 year before the official primary age considering the date of its implementation. In the second place, some of these national evolutions through the years are confronted with the level of later academic performance for those same age groups.

As it was evidenced in the previous subsection, significant differences can be founded among the Latin American countries when the developments of the percentages of the net enrolment rate 1 year before the official primary entry age are compared during the last years. However, it is important to study these evolutions in detail to bring to light the value of the historical traditions and the levels of effectiveness once the mandatory attendance policy came into play in the different countries. To this respect, bearing in mind the information from **Table 1** and **Figure 1** concerning the national dates of implementation of this measure, it is worth to attend to the different evolutions from these countries that can be confirmed in **Table 2**. This is the case for countries such as Colombia, Costa Rica, El Salvador, Guatemala, Panama, or Peru, where the implementation of mandatory preschool attendance during 1990 and 2000 resulted into later significant rises in the ANER 1 year prior primary.

Argentina: The Ley de Educación Nacional (2006), N. 26.206, modified by the Ley N. 27.045 in 2014.
Brazil: The Lei de Diretrizes e Bases da Educação (1996), N. 9.394/96, modified in 2006 and 2009.
Colombia: The Ley General de Educación (1994) established compulsory preschool education for the age of 5 years old.
El Salvador: The Ley General de Educación Decreto N. 917 (1996), revised in 2000, 2003 and 2005.
Guatemala: The Ley de Educación Nacional N. 12-91 (1991), revised in 2006, established compulsory preschool education for the age of 5 years old.
Mexico: The Ley General de Educación (1993), revised in 2000, 2003, 2004, 2005, 2006, 2013 and 2014; established compulsory preschool education for the age of 5 years old in 2004.
Panama: The Ley Orgánica de Educación N. (1946), revised in 1995 by the Ley N. 34, established compulsory preschool education between 4-5 years old.
Paraguay: The Ley Nº 4088 (2010) established ECE free-of-charge, but since the Ley General de Educación (1998) established compulsory preschool education for the age of 5 years old.
Venezuela: The Ley Orgánica de Educación from 1980, revised in 1999, established compulsory preschool education for the age of 5 years old.

Figure 1.
Additional notes on countries' implementation of mandatory ECE. Source: By author. Data extracted from ECLAC (2016).

COUNTRIES	ADJUSTED NET ENROLMENT RATE ONE YEAR BEFORE THE OFFICIAL PRIMARY ENTRY AGE (%), 1999, 2002 and 2005								
	1999			2002			2005		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Argentina	97.3	96.1	98.5	99.3	98.6	100	99.3	98.6	100
Bolivia	62.3	62.4	62.3	67.1	66.5	67.7	72.7	72.7	72.7
Brazil	82.1	..	..	81.2	..	..	88.1	87.8	88.4
Chile	82.1*	..	..	79.3*	..	..	79.8*	..	..
Colombia	74.3	..	..	82.1	..	..	93.0	92.4	93.7
Costa Rica	46.7*	..		61.5*		..	71.5*	...	...
Ecuador	66.2	64.7	67.8	74.7	73.4	76.1	78.7	77.9	79.5
El Salvador	55.1	50.3	60.7	75.5	73.3	77.7	81.3	80.4	82.3
Guatemala	55.7	53.7	51.6	65.0	63.7	64.7	72.9	73.2	73.3
Honduras	16.3*	..	..	..	..	..	31.1*	..	..
Mexico	84.8	84.4	85.3	83.4	84.9	83.5	92.1	87.3	92.1
Nicaragua	29.7*	..	..	33.6*		..	73.3	71.4	75.4
Panama	57.1	57.0	57.2	76.9	77.2	77.2	78.5	78.3	78.8
Paraguay	29.6*	..	..	32.9*	..	..	35.1*	,,	..
Peru	76.5	75.4	77.2	84.6	82.8	85.4	88.9	88.2	89.6
Uruguay	59.5*	..	..	66.6*	..	..	99.6	99.2	100
Venezuela	69.4	68.6	70.3	75.5	74.9	77	77.1	76.6	77.6

*Explanatory notes: *Gross enrolment ratio.*
Source: Table by author. Data extracted from UNESCO.UIS (2018).

Table 2.
Latin America adjusted net enrolment rate 1 year before the official primary entry age preschool education (%) school year ending in 1999, 2002, and 2005.

Despite that the ECE compulsory attendance policy was often announced as a sign of the government's commitment to ECE [18], its necessity has been in question as it did not seem always to help increase global enrolments in preprimary education [10]. In fact, for some of these Latin American countries, where enrolments were much higher during this period of time, such policy was yet nonexistent (see **Tables 1** and **2**). From this comparative analysis, thus, it can be concluded that the institutionalization of compulsory preschool in the Latin American region had positive effects toward the democratization of ECE and learning opportunities for the age group of children immediately preceding entry into the primary education cycle over the last decades. Yet, the effect of universalization is not a reality in half of the countries of this region (see **Table 1**).

In an attempt to relate these developments on the progresses through the implementation and the expansion of the compulsory attendance policies in ECE with the later educational attainment, PISA results are being compared among several representative countries from Latin America who had undertaken this test over the last three periods. For this purpose, the selected periods of time from **Table 2** (1999, 2002, and 2005) were the years that the same students who participated in the rounds of an international examination attended preschool by the age of 5 years. The PISA examination consists of tests in mathematics, reading, and science that have been taken every 3 years by 15-year-old students who are in grade seven or above and allow for cross-country comparisons and rankings. The PISA Reading, Mathematics, and Science scale range from 0 to 1000, and they can be presented by disaggregating the preschool variables of "Attend ISCED 0" and "Age when started ISCED 0". Supply information about the personal and family situations of the students is also compiled when the test is filled out by students. These data have been used to construct the preschool variable, which signals whether the student: (i) never attended preschool; (ii) attended preschool for 1 year or less; or (iii) attended preschool for more than 1 year.

The comparable character of the PISA results helps to reveal the existing disparities among the Latin American countries that have been assessed under this program. Equally, the comparative study can help to find evidence of the impact that the preschool attendance had in such results or its evolutions within this region, in order to discuss if the mandatory attendance policies have played a decisive function in them or not. Only eight Latin American countries have been undertaking this international examination over the last rounds of evaluation in 2009, 2012, and 2015. Hence, no generalizations can be extended from their results to the entire region. Nevertheless, the fact that those countries of the Latin American region hold the highest rates in preprimary school life expectancy, as well as in the ANER 1 year before the official primary age (see **Table 1**), makes them a good representation of the cases where the mandatory preschool policy has not failed. A previous comparison of the PISA test scores in Latin America from 2009 and 2012 using the Preschool variable with no controls revealed a positive correlation between early education—and its duration—and academic performance at the secondary education level in all the countries [17]. In PISA 2015, a subsample of students who took the core PISA assessment for mathematics, science, and reading literacy were administered the financial literacy and the collaborative problem solving components. This was different than PISA 2012, where the sample of students who took the financial literacy assessment was separate from the sample who took the core assessment. Hence, mathematics and reading scores obtained from the PISA 2012 financial literacy database were calibrated and standardized separately and thus may not match mathematics and reading scores obtained from the combined mathematics, reading, and science database. Supply data to construct the preschool variable is also different in PISA 2015, which signals whether the student: (i) never attended preschool; (ii) attended preschool for 1 year or less; (iii) attended preschool for more than 1 year, disaggregating the last two categories by the age when the student started to attend ISCED 0. Still mathematics, reading, and science scores obtained from the PISA 2015 financial literacy or collaborative problem solving database are comparable across databases. Therefore, in order to make comparable the scores by the preschool variable over the last rounds of PISA, estimations were made to obtain the values "attended preschool for one year or less" and "attended preschool for more than one year" (see explanatory notes from **Tables 3**, **4** and **5**).

Generally speaking, when the score in mathematics of students who had access to more than 1 year of preschool is compared with those who did not have access to preschool education, there is a significant advantage for the former group in all these countries for the last three rounds of PISA (2009, 2012, and 2015). Even no causal effect can be estimated due to the lack of randomly assignation of treatment and control groups to ensure bias-free estimations [17], in all the countries of the Latin American region participating in PISA 2012 and 2009, students have performed better in mathematics if they had more than 1 year of preschool education. This is a trend that most of these countries presented in PISA 2009 (data for Costa Rica are not available) and that can also be confirmed for the participant Latin American countries in PISA 2015 (see **Table 3**). Yet these considerable score differentials in **Table 3** tend to become less remarkable over time, with the exemptions of Chile (between 2009 and 2012 PISA scores) and Costa Rica (between 2012 and 2015 scores). In the case of students that had 1 year or less of preschool, the score differentials in mathematics compared with the students that did not attend preschool are less significant, and the progresses through time show that the advantage of this group of students over the students that did not attend preschool can be even questioned in countries like Brazil, Colombia, and Uruguay (see **Table 3**). However, no causal effect with the implementation of mandatory preschool policy can be established from this analysis, and only observations like the case of Peru where the overall scores in mathematics have improved through these periods of time.

	PISA 2009 Total	PISA 2009 ≤ 1 year	PISA 2009 > 1 year	PISA 2009 Did not attend	PISA 2012 Total	PISA 2012 ≤ 1 year	PISA 2012 > 1 year	PISA 2012 Did not attend	PISA 2015 Total	PISA 2015 ≤ 1 year	PISA 2015 > 1 year	PISA 2015 Did not attend
ARG	388	370	403	335	388	366	403	337	409	395	415	368
BRA	386	386	408	358	389	383	405	366	377	363	391	368
CHL	421	420	441	393	423	423	436	381	423	409	405	393
COL	381	386	397	349	376	380	385	351	390	372	400	383
CRI	-	-	-	-	407	408	416	384	400	393	425	392
MEX	419	416	426	375	413	411	419	378	408	392	416	383
PER	365	364	384	336	368	360	384	328	387	350	399	354
URY	427	411	443	373	409	390	426	370	418	367	437	422

Explanatory notes:
— Not available.
Total: Averages for PISA mathematics scale: overall mathematics, age 15 years by Age when started [ISCED 0].
≤ 1 year: refers to the attendance to ECE for one year or less. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "5 years" and "6 years or more" with the exemption of Argentina (see Appendix 1).
> 1 year: referes to the attendance to ECE for more than one year. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "1 year or younger", "2 years", "3 years" and "4 years" with the exemption of Argentina (see Appendix 1).

Source: Table by author. Data extracted from Organization for Economic Cooperation and Development (OECD), PISA, 2009, 2012, and 2015 Reading, Mathematics and Science Assessments

Table 3.
Average PISA test scores in Mathematics, total and by category of preschool variable, 2009, 2012, and 2015.

In the case of the average scores in reading in **Table 4**, when the pattern of students who had access to more than 1 year of preschool is compared with those who did not have access to preschool education, there is, again, a significant

	PISA 2009 Total	PISA 2009 ≤ 1 year	PISA 2009 > 1 year	PISA 2009 Did not attend	PISA 2012 Total	PISA 2012 ≤ 1 year	PISA 2012 > 1 year	PISA 2012 Did not attend	PISA 2015 Total	PISA 2015 ≤ 1 year	PISA 2015 > 1 year	PISA 2015 Did not attend
ARG	398	379	416	331	396	373	412	337	425	405	435	370
BRA	412	414	439	379	407	401	426	379	407	392	422	397
CHL	449	452	465	419	441	443	453	401	459	449	432	421
COL	413	419	429	380	403	407	414	374	425	406	434	419
CRI	-	-	-	-	441	420	449	422	427	419	458	421
MEX	425	424	434	378	424	422	430	383	423	406	430	389
PER	370	368	392	337	384	374	402	342	398	356	414	349
URY	426	405	445	368	411	396	436	368	437	380	458	404

Explanatory notes:
— Not available.
Total: Averages for PISA reading scale: overall reading, age 15 years by Age when started [ISCED 0].
≤ 1 year: refers to the attendance to ECE for one year or less. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "5 years" and "6 years or more" with the exemption of Argentina (see Appendix 2).
> 1 year: referes to the attendance to ECE for more than one year. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "1 year or younger", "2 years", "3 years" and "4 years" with the exemption of Argentina (see Appendix 2).

Source: Table by author. Data extracted from Organization for Economic Cooperation and Development (OECD), PISA, 2000, 2003, 2006, 2009, 2012, and 2015 Reading, Mathematics and Science Assessments.

Table 4.
Average PISA test scores in Reading, total and by category of preschool variable, 2009, 2012, and 2015.

	PISA 2009 Total	PISA 2009 ≤ 1 year	PISA 2009 > 1 year	PISA 2009 Did not attend	PISA 2012 Total	PISA 2012 ≤ 1 year	PISA 2012 > 1 year	PISA 2012 Did not attend	PISA 2015 Total	PISA 2015 ≤ 1 year	PISA 2015 > 1 year	PISA 2015 Did not attend
ARG	398	384	416	345	396	384	420	354	432	417	439	390
BRA	405	409	428	377	402	398	418	377	401	386	414	400
CHL	447	448	463	422	445	446	455	409	447	437	427	411
COL	402	407	414	374	399	402	406	372	416	399	425	408
CRI	-	-	-	-	429	429	438	412	420	412	447	415
MEX	416	415	424	376	415	414	420	380	416	399	424	401
PER	369	371	387	340	373	367	386	341	397	369	409	361
URY	427	413	442	380	416	398	432	379	435	385	454	421

Explanatory notes:

— Not available.

Total: Averages for PISA science scale: overall science, age 15 years by Age when started [ISCED 0].

≤ 1 year: refers to the attendance to ECE for one year or less. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "5 years" and "6 years or more" with the exemption of Argentina (See Appendix 3).

> 1 year: referes to the attendance to ECE for more than one year. Values for the 2015 results have been estimated from the average results of the values decomposed by ages "1 year or younger", "2 years", "3 years" and "4 years" with the exemption of Argentina (see Appendix 3).

Source: Table by author. Data extracted from Organization for Economic Cooperation and Development (OECD), PISA, 2009, 2012, and 2015 Reading, Mathematics and Science Assessments.

Table 5.
Average PISA test scores in Science, total and by category of preschool variable, 2009, 2012, and 2015.

performance, as in the rest of the Latin American countries, this correlation is negative (see 2015 values, **Table 5**). The average scores in science of students who had access to more than 1 year of preschool, compared with those who did not have access, shows also a considerable advantage for the former group in the majority of the Latin American countries for the last three rounds of PISA (2009, 2012, and 2015); with the greatest margins in Argentina, Uruguay, and Peru as it happened in the mathematics and reading tests (see **Tables 3–5**). The PISA 2015 survey focused on science, with reading, mathematics, and collaborative problem solving as minor areas of assessment. PISA 2015 also included an assessment of young people's financial literacy, which was optional for countries and economies. Still mathematics, reading, and science scores obtained from the PISA 2015 financial literacy or collaborative problem solving database are comparable across databases. PISA cannot identify cause-and-effect relationships between policies/practices and student outcomes, but the trends that where identified through this comparative analysis help to open up the debates around the effects of mandatory preschool and its duration in the later academic performance. Even more, for the first time, PISA 2015 shows that the changes in science scores per year attending preprimary school are not revealing a positive correlation in all the Latin American countries that have undergone this international examination, especially after accounting for schools' and students' socioeconomic profile [19].

From the comparative study of the developments on the ANER 1 year before the official primary age in the Latin American countries that have been undertaking the PISA examinations during the last three rounds, there are some facts that can be related. Therefore, three aspects are considered now to draw these connections: the progresses on the ANER 1 year before the official primary entry age for the established periods when the students of the last three rounds of PISA attended to preschool (1999, 2002, and 2005, respectively); the PISA scores for the group of students that attended to preschool for 1 year or less in the eight Latin American countries during the established periods (2009, 2012 and 2015); plus the level of universalization of preschool, which means an ANER around the value 100% and never under the 90%. In the last place, some considerations from the last 2015 PISA results will be interpreted with respect to the science performance by the number of years at preprimary school, and they will be taken in account in order to open the discussion around the focus of this work. Hence, the country developments can be summarized in the following highlights:

- Argentina sets off from high levels of ANER over the 90%, reaching almost the universalization of preschool since 2002 (above the 99%), despite no mandatory attendance policy was established until 2006, and it shows positive progresses in all the PISA scores of the last rounds (see **Tables 3**–**5**).

- Brazil, Colombia, Costa Rica, Peru, and Mexico developed significant rises toward the preschool universalization between 1999 and 2005, as a result of the implementation of the compulsory attendance measures prior and during these years. Nevertheless, these policies did neither make preschool universalization effective over these periods of time nor in the later years, though Mexico and Peru have almost reached it (see **Tables 1** and **2**). Along this fact, the PISA results in these five countries have tended toward worsening over time in all the different tests, as well as the score differentials between the students who did not attend to preschool and those who attended to preschool for 1 year or less (see **Tables 3**–**5**). Moreover, in PISA 2015, the current values in the changes in science scores per year attending preprimary school are revealing a negative correlation in these five cases after accounting for schools' and students' socioeconomic profile [19].

- Chile is the country that has implemented later a compulsory preschool attendance policy (see **Table 1**). This is also the only Latin American country where data on the ANER 1 year before the official primary entry age have not been available until the recent years; thus, no link can be established for the selected periods of time in this study. However, Chile shows a different trend in the evolution of PISA scores over the last three round of tests, as the score differentials between the students who did not attend to preschool and those who attended to preschool for 1 year or less became greater between 2009 and 2012 but they have diminished significantly between 2012 and 2015 (see **Tables 3**–**5**). A remarkable feature from this country is that in the last PISA 2015, the differentials in preschool attendance between the top and bottom quarter by the school socioeconomic profile are among the lowest in the Latin American region [20].

- Uruguay shows the greatest advances toward the universalization of preschool, as the rise on the levels of ANER between 1999 and 2005 was over 40 percentage points, reaching the universalization of preschool (above the 99%, see **Table 2**). In parallel, the effects of preschool attendance on the later academic performance have remained over time, as the change in science scores per year attending preprimary school in this country is revealing a very positive correlation, even after accounting for schools' and students' socioeconomic profile [19]. As a matter of fact, the case of Uruguay is quite reveling concerning PISA 2015, as it is the country where the change in science score per year attending preprimary school is the greatest from this region and among the highest of OECD [19].

In sum, from a general perspective, it can be stated that in the Latin American countries where the universalization of preschool has been achieved, PISA results have improved over the years, and the gross gaps have remained wider when the period of preschool attendance is longer than 1 year. This can be explained due both to the direct effect of having been in preschool for a longer period and to the impact of the socioeconomic factors that influence both the duration of attendance in early education and performance on the PISA tests [21]. Furthermore, in the last PISA 2015, the differentials in preschool attendance between the top and bottom quarter by the school socioeconomic profile in the Latin American region [20] show the highest values for the Latin American countries, where free ECE is guaranteed for a longer period (see **Table 1**). In the countries where preschool universalization is still not effective, PISA 2015 is revealing a negative correlation in the current changes in science scores per year attending preprimary [19].

4. Conclusions

ECE policies, such as the institution of compulsory attendance, need to be carefully evaluated with respect to their likely costs and benefits in practice, based on the best available data prior to their adoption [22]. However, this comparative study allows to examine and to compare the impact of the implementation of compulsory preschool education in Latin America to value the different conclusions that can be extracted from its results.

In the first place, the institution of the mandatory attendance policy in preschool education in the Latin American countries over the last years has been supported by a rise of the government expenditure in the ECE. These advances have been translated into significant benefits to expand the preschool provision and to extend the learning opportunities of young children in the region. Hence, it can be concluded from this study how the effects of such measures have been positive in terms of increasing the preschool life expectancy as well as expanding the adjusted net enrolment ratios 1 year before the official primary school entry age in all the Latin American countries over the last 15 years. Yet, almost half of these countries have to keep the efforts toward the current target of the Educational Goals for 2021, thus to overcome the value of 90% of ANER 1 year before the official primary school entry age. Thereby, the implementation of compulsory preschool in Latin American had positive effects toward the democratization of ECE and learning opportunities for the age group of children immediately preceding entry into the primary education cycle over the last decades, but the universalization of preschool is not a reality in half of the countries of this region.

Second, despite all the Latin American countries included in this study have expanded the provision and opportunities of ECE for the age groups immediately preceding entry into the primary education cycle, the effects of preschool attendance on the later academic performance have become more diluted over time, even for the countries that have improved their scores in the last rounds of the PISA tests (e.g., Argentina). Specifically, the extent to which compulsory attendance in preschool education can mitigate the social inequalities in children's learning outcomes generated within the family context can be in question by the results of this study, as the positive correlation between the duration of early education and the later academic performance is no longer existent in some of these countries when the preschool attendance is for 1 year or less. This is due to the confronted trend of preserving positive effects on the later attainment only in the case of students that have attended more than a year of preschool among the Latin

American countries that participated in PISA. This fact, as it was warned before [10], could be an indication that preschool education, with the compulsory attendance policy, has become an early primary education in Latin America. Hence, as the effect of having been in preschool for a longer period and the impact of the socioeconomic factors influence both the duration of attendance in early education and performance on the PISA tests [21], compulsory preschool education can only reduce social inequalities in educational achievement when it is mandatory for more than 1 year prior to enter formal schooling or when the universalization of preschool is guaranteed in the earlier years. This situation has been observed in the case of Uruguay where the differential score in science per year attending preprimary school is the greatest from this region and among the highest of OECD [19]. Today, Latin American children have a higher probability of being born in poor households than 20 years ago, even though recent results in poverty reduction are quite positive [23]. Therefore, beyond compulsory attendance policies, universal good quality services are needed to reach both the lower income groups and the middle classes so as to guarantee access to those most in need [24].

A. Appendix 1

Averages for PISA mathematics scale: overall mathematics, age 15 years by Age when started [ISCED 0], year and jurisdiction: 2015.

	1 year or younger		2 years		3 years		4 years		5 years		6 years or older		I did not attend [ISCED 0]		I do not remember	
Jurisdiction	Average	S.E.	Average	S.E.	Average	S.E.	Average	S. E.	Average	S.E.	Average	S.E.	Average	S.E.	Average	S.E.
Chile	368	(11.3)	388	(12.8)	426	(5.4)	439	(3.4)	426	(3.2)	392	(8.0)	393	(9.7)	404	(5.3)
Mexico	419	(12.2)	420	(8.0)	411	(3.1)	413	(2.9)	399	(4.1)	384	(6.7)	383	(12.5)	417	(6.3)
Argentina (2015)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)
Brazil	381	(5.9)	406	(7.7)	394	(5.0)	382	(4.4)	375	(3.5)	351	(3.8)	368	(7.7)	380	(4.1)
Colombia	377	(7.7)	402	(6.9)	413	(5.5)	408	(4.0)	386	(2.8)	358	(3.9)	383	(8.0)	385	(5.7)
Costa Rica	399	(13.8)	455	(10.3)	431	(7.7)	413	(3.9)	400	(2.9)	385	(2.9)	392	(6.0)	401	(4.2)
Peru	393	(9.7)	418	(5.7)	396	(3.1)	390	(4.0)	369	(3.6)	330	(6.4)	354	(6.7)	381	(6.1)
Uruguay	444	(6.6)	462	(4.9)	434	(3.8)	407	(2.9)	391	(4.5)	343	(6.4)	422	(14.1)	393	(6.2)

Explanatory notes:
— Not available.
†Not applicable.
S. E. Standard Error.

Argentina: Coverage is too small to ensure comparability (see PISA 2015 Results [Volume I]: Excellence and Equity in Education [OECD, 2016], Annex A4). The Reading, Mathematics and Science scale ranges from 0 to 1000. Some apparent differences between estimates may not be statistically significant.

Source: By author Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015 Mathematics Assessments.

A.1 Appendix 2

Averages for PISA reading scale: overall reading, age 15 years by Age when started [ISCED 0], year and jurisdiction: 2015.

		1 year or younger		2 years		3 years		4 years		5 years		6 years or older		I did not attend [ISCED 0]		I do not remember	
Year	Jurisdiction	Average	S.E.	Average	S. E.	Average	S.E.	Average	S.E.	Average	S. E.	Average	S.E.	Average	S. E.	Average	S. E.
2015	Chile	396	(10.3)	395	(17.0)	461	(5.9)	476	(3.1)	464	(3.4)	433	(8.3)	421	(9.3)	438	(5.5)
	Mexico	433	(13.5)	436	(8.9)	426	(3.4)	425	(3.5)	419	(4.0)	393	(6.8)	389	(9.3)	434	(7.3)
	Argentina (2015)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)
	Brazil	411	(5.8)	437	(6.1)	426	(4.9)	414	(4.1)	408	(4.2)	376	(4.4)	397	(7.0)	413	(4.0)
	Colombia	394	(9.3)	440	(8.3)	454	(5.8)	449	(4.6)	419	(3.6)	393	(4.2)	419	(9.4)	419	(5.9)
	Costa Rica	439	(17.7)	479	(10.1)	471	(7.9)	443	(4.7)	427	(3.0)	410	(3.4)	421	(4.6)	425	(4.6)
	Peru	408	(10.7)	435	(6.0)	410	(3.5)	401	(3.9)	377	(4.3)	334	(7.5)	349	(6.6)	392	(6.8)
	Uruguay	462	(7.2)	488	(5.5)	458	(3.7)	423	(2.9)	409	(5.0)	351	(6.9)	404	(15.3)	411	(6.4)

Explanatory notes:
— Not available.

†Not applicable.

S. E. Standard Error.

Argentina: Coverage is too small to ensure comparability (see PISA 2015 Results [Volume I]: Excellence and Equity in Education [OECD, 2016], Annex A4). The Reading, Mathematics, and Science scale ranges from 0 to 1000. Some apparent differences between estimates may not be statistically significant.

Source: By author Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015 Reading Assessments.

A.2 Appendix 3

Averages for PISA science scale: overall science, age 15 years by Age when started [ISCED 0], year and jurisdiction: 2015

		1 year or younger		2 years		3 years		4 years		5 years		6 years or older		I did not attend [ISCED 0]		I do not remember	
Year	Jurisdiction	Average	S.E.	Average	S.E.	Average	S.E.	Average	S. E.	Average	S.E.	Average	S.E.	Average	S.E.	Average	S.E.
2015	Chile	392	(10.6)	405	(13.0)	451	(5.3)	461	(3.1)	452	(2.8)	422	(6.4)	411	(8.3)	433	(4.2)
	Mexico	428	(12.3)	433	(6.7)	419	(2.9)	416	(2.4)	409	(3.5)	389	(6.1)	401	(9.1)	432	(5.9)
	Argentina (2015)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)	—	(†)
	Brazil	406	(5.8)	430	(5.8)	415	(3.9)	405	(3.3)	399	(3.0)	373	(3.0)	400	(6.4)	405	(2.9)
	Colombia	396	(7.9)	430	(6.6)	441	(4.8)	434	(3.8)	409	(2.8)	388	(3.3)	408	(7.0)	416	(4.8)
	Costa Rica	424	(15.0)	469	(8.7)	460	(7.6)	435	(3.9)	417	(2.3)	407	(2.5)	415	(4.6)	416	(3.7)
	Peru	405	(9.2)	426	(4.9)	405	(2.7)	399	(3.1)	381	(3.3)	357	(6.2)	361	(5.7)	395	(5.6)
	Uruguay	460	(6.5)	478	(4.0)	453	(3.1)	424	(2.6)	404	(3.7)	365	(5.6)	421	(12.6)	421	(5.8)

Explanatory notes:

— Not available.

†Not applicable.

S. E. Standard Error.

Argentina: Coverage is too small to ensure comparability (see PISA 2015 Results [Volume I]: Excellence and Equity in Education [OECD, 2016], Annex A4). The Reading, Mathematics, and Science scale ranges from 0 to 1000. Some apparent differences between estimates may not be statistically significant.

Source: By author Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015 Science Assessments.

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Chapter 2

Opportunities in the Odds; Exploring Adult-Child Interactions and Their Effects on Children's Cognitive and Learning Progress

Angela K. Salmon, Stephanie C. Campo and Maria X. Barrera

Abstract

This chapter aims to raise awareness on the influence that small changes in adult-child interactions can have on children's cognitive and learning progress. The authors address learning opportunities found through the odds of conventional teaching in an early childhood setting. In an effort to promote good thinking that develops language and cognition in young bilingual children, the authors participated in an action research experience that taught them the benefits of empowering teachers when making curriculum and pedagogical decisions. Teacher preparation and high-quality coaching that emphasized the idea of teaching for understanding Blythe et al. while making thinking and learning visible are vital components for an ever-changing environment. The use of documentation, and asking good questions were important aspects to engage disengaged children and teachers.

Keywords: questioning, visible thinking, documentation, disposition, cultural forces, flexible planning and coaching

1. Introduction

Childhood and teaching have been radically changing in the past few decades. Despite the efforts to implement developmentally appropriate practices and promote good thinking in the classroom, there are increasing gaps between theory, research, and practice. From a pragmatic perspective, the role of the early childhood educators still seems to be debated. Testing pressure (even at young ages), low teacher salaries, and knowledge-based school readiness occupies a high level of attention from administrators, teachers, and even parents. Consequently, quality of education is then compromised [1].

This chapter aims to contribute lessons learned in an action research experience conducted in a preschool that involved teachers who previously participated in professional development courses through a college and their center. It shows evidence that even small changes in adult-child interactions make a difference.

2. Theoretical framework

Upon collecting data from initiatives that implemented innovative ideas in the classroom, Perkins and Reese [2] used the metaphor, "When Change has Legs", to explain what makes innovative ideas happen. In their research they identify four legs that are necessary to achieve targeted changes; frameworks, leaders, community and institutionalization.

- Frameworks: teaching and learning frameworks.

- Leaders: the literature in both education and the corporate world emphasizes the importance of leaders inspiring and guiding initiatives. There is a practical visionary (usually a teacher or team of teachers) and a political visionary (typical the principal).

- Community: community of teachers, school leaders, and beyond who create a collegial culture.

- Institutionalization: once an innovation has proven effective over 2 or 3 years, it is easy to assume that the innovation is there to stay.

For this study we used the Making Thinking Visible framework. We highlighted the cultural forces developed by Ritchhart et al. [3] including the quality of questioning, documentation, and the teaching for understanding framework. The research team acted as the practical visionary. In an effort to observe the efficacy of the professional development in teacher's practice and coach teachers to implement what they learned, we found circumstances that delayed teachers to continue growing in the profession and consequently affected the quality of service provided to the children. Despite the efforts to engage the administration in the study, we were unable to have a political visionary.

There was limited room for developing community and institutionalization in the setting. However, the authors' contribution to this chapter is to share that despite the odds, it is possible to make changes and invite leaders and community to reflect on their role in transforming society. We want to emphasize the importance of good coaching to improve teacher practice. No one can change a teacher's paradigms; it is their responsibility to make the changes. Salmon [4] claims that good coaching cannot either ignore the teacher's theories about teaching, learning, and experiences, but can walk with them from their starting point and give them the time to construct new knowledge, just like the children.

In the up forth mentioned courses, there was an emphasis on teaching students to think and become metacognitive, being aware of their thinking. Good thinking is essential to develop language and cognition in first and second language. However, children often lack the metacognitive skills they need to succeed because cognition and metacognition are barely taught in the classroom.

2.1 Making Thinking Visible

The Visible Thinking Approach is a flexible and systematic research-based conceptual framework that aims to integrate the development of students' thinking with content learning across subject matters [5]. The framework values student thinking, promotes it, and makes it visible. Vygotsky [6] claims that children grow in the intellectual life of those around them. Adults play an important role in scaffolding children's thinking and learning. To help adults understand their roles in valuing, and teaching good thinking, Ritchhart [7] proposed cultural forces that could shape a classroom's culture. He stated that we must understand how group culture is created, sustained, and enhanced. This is not only about good thinking but fostering dispositions of thinking [8]. It is not realistic for teachers to offer a class about teaching creativity, but teachers can certainly enculturate good thinking in the different classroom experiences. Therefore, Ritchhart developed eight cultural forces:

- Expectations: adult expectations about the students' potential is critical. High expectations demand more from the students, while low expectations hinder students' right to learn.

- Opportunities: when teachers have high expectations, they will provide students with opportunities to think and learn. High quality performances involve good thinking.

- Routines and structures: adults who value thinking find the use of strategies that promote thinking useful. Thinking routines leverage students' thinking to the next level and promote high quality adult-child-interactions.

- Thinking routines are two or three step process that cue up cognitive behaviors related to good thinking. For example, close observation using *Zoom in*. This is a strategy that invites students to pay close attention to details and make inferences while using one section of an image at a time. Thinking routines should be used repeatedly in order to develop patterns of thinking.

- Language and conversations: it is important for children to use language of thinking in conversations. Children become metacognitive by using language of thinking. As children hear cognitive processes that accompany these labels, they will internalize the words and use them as part of their own vocabulary. Teachers should give specific instruction in those cognitive functions so that students possess experiential meaning along with the terminology.

- Modeling: children learn from what they see. Teachers' actions give children messages; we want them to see how thinking facilitates learning. Modeling is who we are as thinkers and learners.

- Interactions and relationships: all children can think; thus, teachers should create an environment of trust, respect, and perspective taking. This is related with listening and questioning.

- Physical environment: educators in Reggio consider the environment a third teacher. This innovative educational philosophy originated in Reggio Emilia, a small city in Italy, values the power of the environment to determine the culture and identity of the classroom. When teachers capture children's thinking processes in artifacts, photographs, videos, and so forth, they are sending the children the message that their thoughts are valued and respected. Children, teachers, and parents can revisit and learn from these forms of documentation.

- Time: children need time to think and reflect about their learning. Deep learning takes time and teachers should give students time to focus on conceptual understandings by finding evidence and applying these conceptual understandings.

2.2 Typology of questions

Questioning is an important component to promote good thinking. The quality of adult-child discourse is shaped by the type of questions that teachers ask. Through the questions that teachers ask, they communicate with their students their expectations for thinking. Inviting children to ask good questions sparks their curiosity and helps them become more metacognitive. When a child understands their thinking process, they gain the ability to learn how to learn. Ritchhart [9] considers questions as culture builders, for him, questioning is the chief way in which teachers and students interact around content. Ritchhart [9] proposes the following typology of questioning in the classroom:

- Review: recalling and reviewing of knowledge and information. This involves questions that produce terminology, procedures, content, events, and context.

- Procedural: directing the work of the class by going over directions and assignments, clarifying, checking for attention and agreement, task completion, and organizational and management related questions.

- Generative: exploring the topic. There are authentic questions or wonders that teacher do not know the answer to and essential questions that initiate exploration of a topic.

- Constructive: building new understanding. These questions extend & interpret, connect and link as well as orient and focus big ideas, central concepts, or purposes.

- Facilitative: promotes the learner's own thinking and understanding. These questions request elaboration, reasons, evidence, and justifications. They generate discussions among the class to hear different perspectives while clarifying and uncovering new ideas.

2.3 Teaching for understanding framework

Teaching for understanding (TfU) is a framework for thinking. Starting from differentiating knowledge from understanding, it is a guide that can help students learn concepts in depth and then transfer those concepts to another context. TfU is a collaborative approach for effective teaching that was developed, tested, and refined by Project Zero researchers at Harvard Graduate School of Education along with many experienced teachers and researchers [4]. The framework can help keep the focus of educational practice on understanding, while allowing teachers flexibility to design units that fit their priorities and teaching style.

TfU and Making Thinking Visible are two frameworks that complement each other. Both focus on thinking towards understanding. The TfU framework helps educators design curriculum while Making Thinking Visible and cultural forces provide strategies and conditions to promote thoughtful performances of understanding. TfU engages students in deep understanding as a result of good thinking.

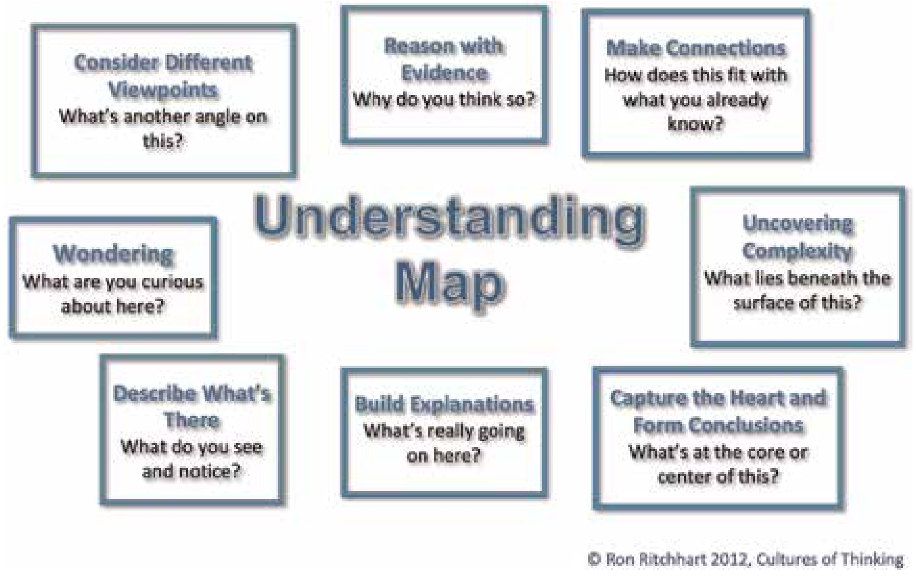

Figure 1.
Understanding map.

By answering questions from an understanding map (**Figure 1**), children can deepen their learning and go beyond knowledge.

2.4 Learning community of practice

A learning community of practice is created by people who engage in a process of collective learning in a shared interest. Teachers are often products of experiences and tend to teach using the ways they were taught [10] unless they are challenged to bring new ideas and theories to their classrooms as a result of their education. The art of teaching is a permanent invitation for teachers to reflect on their practice in connection with theory and their beliefs [11]. According to Ferrance [12], learning communities of practice benefit from action research that can be: individual teacher research, collaborative action research, schoolwide, or district research.

American phycologist and educational researcher Seymour Sarason [14] claims that when you ask teachers to justify the existence of schools, the answer will be that it is for students; it is not for the learning and development of teachers.... Yet, if contexts for productive learning do not exist for teachers, teachers cannot create and sustain those contexts for students." Learning communities of practice leverage teacher knowledge and empower them to lead their own learning. This is critical for teachers so they can make their own decisions and understand the implications of their teaching in children's learning and growth.

3. Methodology

This chapter refers to an individual teacher research focusing on the quality of adult-child interactions of three teachers from a 3-year old and 4-year old classroom. The research team and teachers focused on creating awareness of cultural forces, the quality of questions, and reflective sessions to improve adult-child interactions.

The research team contributed to this study with a leadership role as well as participant observers. This role involved working with the teachers and making efforts to encourage administrative participation as a means of creating long lasting change.

Their goal was to empower teachers to make curriculum and pedagogical decisions, reflect on the type of adult-child interactions they have, and reflect on the quality of questions that lead to thoughtful conversations. The research team worked with the teachers to create a sense of community by engaging teachers and administrators in reflective sessions to analyze their interactions with their students.

During class sessions, the research team documented class activities with field notes and videos. Teachers were then invited to reflect on their practice during reflective sessions in which the field notes and videos were reviewed and reflected upon using a ladder of feedback structure. The meeting times were limited; however, this was a risk-free environment open for teachers to share anxieties and accomplishments while receiving support for their efforts to implement new ideas.

During the gatherings, the research team attempted to model what they wanted the teachers to do. The research team recognizes the value of team work and how constant work must be done to evolve and improve on these practices. Resources utilized for reflective sessions included Cultures of Thinking, Making Thinking Visible, and the typology of questions to promote good thinking in the classroom.

3.1 Setting

This study took place in a learning center located in a shopping mall in a middle-class neighborhood serving young children from 3 months old to 10 years old. The center was randomly selected based on the participation of at least one teacher in sponsored professional development courses at a higher education institution offered by the Children's Trust, an initiative dedicated to improving the quality of child services. This learning center follows the High Scope Educational Curriculum, a program intended to create learning opportunities for children by actively involving them with their environment. This includes allowing children to make decisions and plan how they would like to interact with people, ideas, materials, and events as a means of pursuing their own interest. Spaces in the school are organized in a manner that facilitate this process. These spaces focus on subjects such as literature, science, creative art, dramatic play, as well as cognitive and motor development. The school is accredited by the National Association for the Education of Young Children (NAEYC) and Apple. The schedule implemented in this learning certain was one of continuous changes from one activity to the next (**Figure 2**).

3.2 Participants

Three teachers were observed. To protect the identity of these educators they were given pseudo names: Iris, Ana, and Marta. Marta participated in professional development courses provided through a higher education center in which one of the research team members was the instructor. This teacher led the 3-year-old classroom alongside Ana. Most students in this room were 3 years-old with the exception of a few younger students about to turn three and others that had just turned 4. Iris led the 4 year-old classroom that had students from age 4 to 6. The study was initially made up of 40 students. A few new students were brought into the rooms, either permanently or temporarily during the observations. The children

Garden Room Pre-K 3
Daily Schedule

6:30-8:00	Arrival Time/Free Play/Restrooms
8:00-8:30	Breakfast
8:30-8:45	Wash-up/Restrooms
8:45-9:00	Circle Time/Language/Music/Movement/Restroom
9:00-9:30	Outdoor Activities: Gross Motor/Free Play/Language
9:30-9:45	Restrooms
9:45-10:00	Small Group Activity
10:00-10:15	Planning Time
10:15-11:00	Learning Centers
11:00-11:15	Recall Time
11:15-11:30	Wash-up/Restrooms
11:30-12:00	Lunch
12:00-12:15	Wash-up/Restrooms
12:15-2:00	Naptime/Music/Quiet Activity
2:00-2:15	Wake-up/Restrooms
2:15-2:45	Snack
2:45-3:00	Wash-up/Restrooms
3:00-3:30	Outdoor Activities: Gross Motor/Free Choice/Language
3:30-3:45	Restrooms
3:45-4:30	Free Play
4:30-4:45	Clean-up/Restrooms
4:45-5:15	Story Time/Music/Movement
5:15-6:30	Quiet Activity/Dismissal

Figure 2.
Schedule.

came from diverse backgrounds: American, African American, Latinamerican, and Indian. Most students were bilingual, with the expectation of two that spoke only English.

3.3 Data collection

For 6 weeks the research team visited the classrooms twice a week for almost 3 hours during circle time, planning, morning movement ritual, outdoor time, relaxation time, and time in learning centers. Data were collected through videos that captured circle times, field notes that included the teachers' closing remarks, final observation notes, reflective session notes, and photos that illustrated visible thinking documentation found in the classrooms as well as images of certain interactions between the students and teachers. Video recordings were edited for analysis to highlight meaningful interactions. The analyzed recordings ranged from 9 to 16 minutes in duration.

3.4 Data analysis

The research team processed collected data using ATLAS.ti 8.2.3. Data were categorized using Ritchhart's cultural forces, the typology of questions, and the types of thinking that are part of an Understanding Map [2]. Codes were created and used to analyze collected data for the presence of cultural forces. Codes consisted of: environment, changes in concepts, expectations, interactions, language, modeling, opportunities. This analysis was conducted with the intent to provide a glimpse into the possibilities held when exploring opportunities in the odds of adult-child interactions and the outcomes they can have on children's cognitive and learning progress with the implementation of high-quality coaching that empowers educators when making curriculum and pedagogical decisions.

4. Findings

The research team witnessed the development of various cultural forces as a result of coaching teachers to leverage thinking in the classroom and encouraging them to reflect on their practice. Due to various changes that occurred during the collection of data, the research team determined that providing hard numbers for the outcomes seen could be misleading, therefore a decision was made to provide a fully qualitative description of the most common advancements that occurred. In a short time, the teachers became aware of the importance and impact of cultural forces in children's learning such as those of expectations, interactions, questioning, listening, opportunities, thinking routines, environment, and time. The teachers uncovered how these cultural forces become intertwined among each other. All these cultural forces came to light as can be seen by the stories that will follow, but certain combinations of some of these forces were more prominent.

4.1 Finding from the cultural forces lenses

4.1.1 Expectations

The research team emphasized a child-centered approach that values thinking and promotes it. Upon reflecting on the teacher's role in fostering thinking in children, a shift was seen in one of the teachers. One of the challenges when planning curriculum is time. You need to take time to be more thoughtful in the process of curriculum development to get more information from students and promote their thinking. Upon coming to such a realization Marta noted how it was no longer about having students do things such as drawing, for example, a little house. She said, "now we ask how did you come up with a house? How did you make it? and so forth". The challenge is to create better questions, to step back and let the children take control.

The expectations were not only about the children, but also the teachers themselves. Iris became more reflective and intentional about her teaching. In one occasion, during circle time, when she was asking the children questions, she noticed that her questions were not engaging, and the children were losing focus. This prompted her to involve the children by telling them, "Listen please, I need your heads". The research team interpreted this action as the teacher's efforts to empower children by inviting them to participate.

4.1.2 Opportunities

Implementation of rich thinking opportunities in which teachers ensured that students were actively engaged in metacognitive processes throughout planned experiences, rather than simple completion of activities were observed. During one instance Iris invited her students to draw their thinking while discussing their seed planting process. Salmon's [13] study states that a "drawing and telling" technique helps children deepen their thoughts. Iris asked the children: "how do you think your plant is growing? We will draw it." As a result, this aided students by providing them with a visual of what they were experiencing metacognitively. Daisy, one of Iris' students held up her drawing that depicted a small plant submerged in dirt and stated, "I think it's growing, but it's just inside the dirt". The researcher asked, what makes you say that? To which Daisy responded, "because I was observing my plant and can't see it, I imagine it was growing" (**Figure 3**). This example highlights

Figure 3.
Daisy explaining her hypothesis.

the importance of creating opportunities for children to develop and practice metacognitive abilities as well as language of thinking.

4.1.3 Routines and structures

The process of using thinking routines allowed teachers to dedicate a specific amount of time for students to think, make observations, use the language of thinking, and listen to one another. During one observation, the research team witnessed the implementation of a "Zoom In" routine.

Marta began the process by sharing with her students that she had something to share with them, but it was hidden behind a plain piece of paper and that she did not know what it was. She then proceeded to guide the students by telling them to observe a small portion of the item after exposing part of it. "What do you observe?", she asked.

Many of the students responded, "with our eyes!" Marta acknowledged their statement by nodding and responding with, "let's think, what could it be?". She lowered her voice and once again asked, what the object could be while allowing time for the students to look at the small area that was visible. After some time one student spoke up and said, "I see a mouth". Marta responded, "you see a mouth?" as she moved the hidden item closer for the students to have a better view of it. The children silently observed what Marta held in her hands. She then asked, "where do you see a mouth? Is this a mouth? Do you think this is a mouth? Angel, do you think it is a mouth? What do you see?" Another student, Daniela responded, "a house". Marta then stated, "Daniela thinks it is a house. Why do you think it is a house?". Daniela responded, "because I like houses". Marta pressed further, "what do you observe?". Daniela responded, "because there are windows". The teacher went on to explain to the other students that Daniela thought the item was a house because she could see windows and windows would not be found somewhere else, like the floor. After doing so she went on to individually invite other students that had been sitting quietly by asking them what they observed. When the full image was finally revealed, it was actually an image of horses. This dialog of sharing what the other students saw and why they thought what they saw was valid continued. Some students noted a specific color that could be seen while others noted more concrete images such as a window or a door. As time went on and thinking routines became more readily practiced the teacher noted its effect on the daily experiences faced in the classroom. Marta shared with us how using these routines helped planned experiences. She said, "it flows better, in how they (the students) participated more, they waited for their turn to share, they were engaged. The most important thing I have learned by using these thinking routines has been how I can see what my students are thinking, how they think, and I have come to the realization that they can say incredible things". Ana noted how the routines extended her students' abilities to think beyond the obvious. "I learned how to help the children express their thinking, expand their thinking and their vocabulary and make connections by using these routines".

4.1.4 Language and conversations

While analyzing language and conversations the research team noted an increase in the use of verbiage that supported thinking. Teachers began making efforts to use this language and encouraged students to expand their responses by using them. Using questions such as "what did you see in this little plant, what did you observe?" and phrases such as, "you are connecting!" when responding to one student's comment about the safety symbols being studied indicated the teachers attempts to name the students' thinking. The previously mentioned instance occurred as Iris held up a phone symbol. The student connected back to the poisonous symbol Iris held up earlier during circle time and said, "If that person gets that potion and they die and they call the emergency". Iris followed this statement with, "you are connecting, you are right!" Connecting is a thinking word.

4.1.5 Modeling

Actions such as the teachers showing their students that they are also learning with them was also witnessed by the research team. During one circle time the group shared flowers with one another. As the flowers were being passed around one student, Chris exclaimed, "This paints! This little thing paints!". Marta the teacher responded with, "why does it paint?" and Daniel stated, "Because look, it got me dirty". At that moment Marta exclaimed, "Ah! You touched it and it painted you! I didn't know flowers could paint!".

4.1.6 Interactions and relationships

Adult-child interactions that emphasized respecting one another's thoughts and that indicated that students are their own leaders and elaborate on their ideas were witnessed. Instances in which the teachers emphasized listening to one another and interactions that show genuine interest in what students want to share support these notions as could be seen in the following transcription that occurred one morning while discussing the weather:

> *Marta: Winter!*
> *Students: Winter!*
> *Marta: Where there is a little bit of cold. Here in Miami there is a little.*
> *Child 1: Teacher, when its cold snow comes out, snow!*
> *Marta: Yes! In other states where snow falls. Here in Miami snow does not fall. We need to go to other states where there is snow.*
> *Child 1: Yes.*
> *Marta: To see snow men.*
> *Child 2: I like it!*
> *Marta: Lets listen to what Fia is saying.*
> *Child 3: I was throwing snow at my dad. On his body.*
> *Marta: Fia did go! Where did you go with daddy?*
> *Child 3: With my grandma and Santa and I was playing with the snow.*

Teacher: Wow! And how is the snow, Fia? I have never seen snow, how is the snow?
Child 3: Its flat like this.
Marta: Its flat? White?
Child 3: Nods.

4.1.7 Physical environment

The physical environment played a large role when it came to creating opportunities for making the children's' thinking visible through documentation. When this occurred, students became engulfed in the experience at hand. During one of the research team's observation sessions Marta invited one of her students to document what his fellow classmates was writing. She handed him a piece of paper and pencil and guided him by saying, "Luke, write down what Shay said that it is very important". After scratching his head Luke proceeded to jot down what was being said. As the students took turns sharing during another Zoom In thinking routine being implemented, Luke continued jotting down what he heard his classmates said (**Figure 4**). At the end of the session Marta said, "Okay let's look at what Luke wrote, what did you write?". Luke then proceeded to read everything his friends had shared during the routine. Prominence in this practice of displaying the student's thinking appeared more as the study continued.

4.1.8 Time

The students and teachers work under the pressure of a tight schedule that eventually affects the quality of interactions. While analyzing documented adult-child interactions we discussed the benefits of giving children time to think. The teachers determined that it was powerful to provide students with the time to think and respond. In an exciting interview Annie stated how she has learned to wait and listen to her students' responses. This new practice taught her how to remain calm as they work through the process of thinking before responding and has helped her develop her patience. She went on to later share how she would advise other educators to practice thinking routines with their students, to listen to them and

Figure 4.
Luke documenting.

give them the opportunity to express what they feel and give them the time to think. By doing so, the teachers talk less, students likewise follow suite and implement the same practice as a means of encouraging their fellow classmates to also quiet down and focus.

4.2 Finding focusing on questioning

The art of questioning takes time; a close look of the teacher's questioning was critical to help the teachers improve the type of questions they ask their students. Throughout this process, we witness small instances of progress. Initially, most questioning that occurred at the start of this investigation was for revision and procedures. Eventually an occurrence of more open-ended questions commenced. At times this type of questioning was stomped as it was followed by a close ended question. During the first session the following pattern of questions was noticed: open ended questions were initiated by the teacher, the children responded, and then the teacher would follow up with another question, which instead of helping continue the conversation brought it to an end. In other words, the children would respond, and the conversation was over. The research team first noted this occurrence during circle time. The teacher proceeded by stating that she brought a laminated image of fish. She then invited students to observe the image and asked, "what do you see here?" Many of the children responded, "a fish". Other stated, "a fish in water". The teacher then asked, "who remembers what letter fish starts with?" She continued, "with the letter, F, very good."

The following part of the conversation illustrated another pattern: the teacher asks a question, the children respond, and the teacher evaluates. In one instance the teacher stated, "fish have scales and their skin is not like ours, it is hard. To eat them we need to remove the scales, right? Your mom has to remove them at home. Let's see another fish, that lives where?" One student responded, "in the water", while another responded, "there" while indicating with their hands. The teacher then followed with, "they live in the water? Why do you say they live in water?" The student responded with, "because they swim" and the teacher said, "and if they swim, it has to be in the water. On land do fish swim? You cannot swim on land, on land we walk". This occurred during the early sessions that were observed, before the teacher started using thinking routines. These types of responses seem to have the intention of being generative, but it becomes irrelevant.

Upon analyzing the type of questions, the teachers gained more awareness about the intentionality of their questions. However, as previously stated, the art of questioning takes time and good questions are developed through practice and reflection. Despite this obstacle, generative questions that were not stomped by close ended ones began becoming more of a norm. Questions such as, "what we can do when there is sun?", "what do you observe here?", "what makes you say fish live in water?", and "why do you think it's not real?" were the types of questions that began emerging.

5. Conclusions

Although there are several factors influencing teacher performance, it is important that teachers lead their own learning. The opportunity to reflect on their expectations about children as thinkers and the opportunities they provide for children to be cognitively engaged are two of those factors. If we want to consolidate experiences, the group being coached must remain intact, to create a sense of support and community among the group. This allows for progress to occur in a manner that will carry on beyond reflective sessions.

Despite the odds being faced in educational settings, opportunities can be created to nurture learning experiences that promote thinking. Experiences like this raise awareness on the influence of small changes in adult-child interactions. Through reflective sessions that focus on areas of growth for educators facing certain pressures from the centers in which they are employed, including a lack of administrative involvement in which the vision of the practical visionary leaders were unclear and support methods were blurred, improvements still occur.

The study had strong research-based frameworks that were attractive to the teachers and a research team that took action and acted as the practical visionary leaders. The political visionary leaders were not involved in the process. It was uncertain if we were supporting or enriching their educational program and goals, values.

The use of documentation and a strong framework to support authentic teaching and learning [4] helped the research team in its many roles such as that of participant observers. The research team provided coaching to support teachers in the implementation of the frameworks that they learned about during reflective sessions. The documentation was not only useful for the teachers, but for children who took ownership of their experiences and began participating in the documentation process (**Figures 3** and **4**).

With the results witnessed during a short time frame and despite accommodating to the ideals of the center, we believe that expanding on such work by providing more time for coaching opportunities could led to the promotion of superior thinking and learning in the classroom. Even when working with a strong framework, the practical visionary cannot make large advancements without the support and involvement of the political visionary.

Schedules are important to set up routines that help children predict what comes next and lower anxiety for the unknown. However, the schedule can also become a cause of stress if the teacher and children lose control of the learning process to serve a schedule. It should be the opposite. Allowing time for thinking creates the opportunities that children need to think. As Bennett [15] points out, schools often become places in which teachers are meant to comply with policy rather than contribute to its development.

When teachers can analyze their interactions with children, they can provoke thinking through the use of good questions. Ritchhart [9] argues that teachers can use questions in different contexts to achieve specific goals around thinking. Thinking routines are research-based strategies that help teachers ask good questions. This is an on-going and non-linear process that is supported through the implementation of such routines.

Acknowledgements

We would like to thank the Children's Trust for giving us the opportunity to provide professional development to teachers serving young children through the Quality Counts program. We are thankful for the school, teachers, children, and parents for opening their doors to us and allowing us to conduct this study. They provided us with information that helped change the way we think about improving the quality of education that young children receive. We would also like to thank Florida International University for helping make the publication of this chapter possible through their financial support.

Conflict of interest

There are no conflicts of interest.

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Section 2

Play

Chapter 3

Jack Be Nimble and Jack Be Quick: Increasing Movement Competence in Early Childhood Settings

Michelle Hamilton and Jennifer Ahrens

Abstract

Increasingly, child caregivers have been tasked with assuring that young children are academically prepared for school. As a result, many childcare settings are focusing exclusively on academic content. The narrow curricular focus has resulted in the exclusion of offering physical activity and structured motor skill lessons. Consequently, many children do not receive adequate physical activity to maintain a healthy weight and lack movement competence to actively engage in physical activity with peers or thrive in academic settings. Providing young children with structured movement opportunities, including body management concepts and movement, fundamental motor skill instruction, and directed opportunities to learn fine motor skills, is critical to movement competence. Finally, it is important for early childhood researchers, caregivers, educators, and policy makers to understand the relationship of movement competence in early childhood to later movement and academic success.

Keywords: early childhood movement competence, physical activity, obesity, fundamental motor skills, body management concepts, fine motor skills

1. Introduction

Jack be nimble,

Jack be quick.

Jack jumped over, The candlestick.

The lyrics to a popular early childhood rhyme that originated in the eighteenth century began with the chant, "Jack be nimble, Jack be quick." However, many educators working with young children will quickly tell you that all too often Jack is overweight, Jack is slow, and Jack lacks the necessary skills to jump over anything, much less a candlestick! Moreover, many early educators and child caregivers might also be quick to add physical activity and motor skills are not part of the early childhood curriculum, and there is not enough time to address anything not related to school readiness in the curriculum.

Over the past three decades, K-12 educational reform efforts in the United States have undoubtedly influenced early education curriculum. Early reform efforts introduced in 1989 by the Federal government, such as National Goals 2000, identified the goal of all children being ready upon entering school by 2000. These goals highlighted specifically the need for children to be academically prepared upon entering school or "school ready" [1]. Consequently, the emphasis on academic preparedness has resulted in "pushing down curriculum." Essentially, this has resulted in the academic curriculum once taught in primary grades now taught in early childhood preschool programs and childcare settings. Why does this really matter? After all, our early education programs are supposed to focus on preparing children to be academically ready or kindergarten. Correct?

Unfortunately, by focusing on a narrowly defined academic curriculum, policy makers, educators, and childcare providers are compromising critical areas of child functioning and development. From a developmental perspective, focusing exclusively on academic performance at a young age is akin to building the walls of a house before the foundation has been poured. Arguably, critical needs of children are being ignored for a cookie-cutter school readiness checklist.

For young children, it is important to have a strong foundation to promote positive health, physical activity, and the motor skills eventually leading to school success. Many caretakers and teachers erroneously assume children will naturally develop motor skills and are physically active through play. Unfortunately, positive outcomes will not occur without careful planning. By taking a close look at the early education programming, curriculum, and physical environment, more deliberative decisions can be made. By systemically addressing these needs through thoughtful planning, curriculum, and policy changes, it is possible to create a clear pathway for outcomes for children.

2. Reversing the trajectory of adverse childhood outcomes

Currently, millions of young children attend early childcare settings on a regular basis. These childcare settings include Head Start, public preschools, and private day care settings. It is not estimated that approximately 58% of children in the United States from 0 to 5 years attend a childcare setting outside the home [2]. This places public preschools and daycare providers in a unique position to address children's health and developmental needs.

Early childhood obesity has become more prevalent in the United States. In 2014, the Centers for Disease Control (CDC) reported that obesity rates of children between 2 and 5 years of age are 13.9% [3]. Obesity and overweight status is defined as children at 95 and 85th percentile of body mass index, respectively, taking into account age and height. However, the rates of obesity in early childhood appear at higher rates among Latino, African-American, and low SES populations of children [3, 4].

Childhood obesity is related to a myriad of health problems with long-term and short-term health consequences. Consequences for health can include increased risk for asthma [5, 6], diabetes [7, 8], mental health issues [9–11], and muscular, skeletal, and growth-related problems. In addition, children who enter kindergarten overweight are four times more likely to remain overweight or obese as an adolescent and into adulthood [12]. Without intervention, health-related obesity is one of the factors related to poor health consequences in adulthood.

Moreover, childhood obesity is likely to have long-term adverse impact on social development. For instance, obese children were more likely to experience depression, be more socially isolated, and have difficulties making friends with other children. Additionally, overweight children of all ages are much more likely to be targets for unwanted bullying by peers and other children.

Furthermore, childhood obesity affects important areas of children's development. Specifically, children's motor development is likely to be impacted. Young children with increased body mass index (BMI) are more likely to have difficulties in performing fundamental motor skills (FMS) that are important in early childhood activities [13, 14]. As a result, children who lack FMS are more likely to refrain from activities that require these skills.

Likewise, obesity can lead to poor academic performance for young children and adolescents. In younger grades, obese children are much more likely to perform poorly on standardized tests. A large-scale longitudinal study involving 11,192 kindergarten and first-grade children analyzed the standardized math and reading scores of children who were overweight and normal weight. In this study, overweight children performed more poorly on both math and reading scores [15]. Additionally, obese children and adolescents are more likely to dislike school and to consider negative long-term solutions such as dropping out of school [16].

2.1 Promoting physical activity in childcare settings

Participation in regular physical activity is one of the leading strategies recognized by public health officials to address early childhood obesity and is considered an essential part of the early childhood curriculum. The benefits of regular participation in physical activity for young children include maintenance of a healthy weight, increased academic skills, increased social-emotional development, and increased motor development. These benefits are important to the overall development of young children.

Physical activity and sedentary behaviors are among two of the contributing factors for early childhood obesity. The Society for Health and Physical Educators (SHAPE) and the American Academy of Pediatrics (AAP) have indicated children need to have a minimum of 60 accumulated minutes each of structured and unstructured physical activity [17, 18]. Structured physical activity can include movement instruction to increase knowledge and skills related to fundamental movement concepts and knowledge related to spatial awareness and movement skills. Often, structured activity is taught by a movement specialist who is knowledgeable in physical education and movement skills for early childhood. Unstructured physical activity is unplanned movement time in which children are allowed to make their own movement choices.

Unfortunately, many young children do not accumulate the necessary and recommended number of minutes of unstructured or structured physical activity each day to maintain a healthy weight [19, 20]. Schools and day care settings can play an important role in increasing the physical activity levels for young children by adapting curriculum, adopting policies, and supporting changes in the daily routines and practices to increase physical activity. The Health and Medicine Division (HMD) of the National Academies, formerly referred to as Institutes of Medicine (IOM), has provided specific and concrete recommendations for increasing physical activity and decreasing sedentary time for preschool and daycare settings [20]. Among the recommendations of the HMD are the provision of structured and unstructured physical activity, daily outdoor physical activity, and 15 minutes per hour of light to moderate and vigorous physical activity.

To increase structured activity, it is necessary to have a knowledgeable instructor or movement teacher who understands movement skills and concepts to provide young children with the foundation for an active lifestyle. For young children, a qualified instructor would include someone who is well-versed in providing developmentally appropriate physical education for young children. The availability of a movement instructor helps to ensure children are learning skills that allow them to learn to move efficiently to actively participate in childhood activities.

Obviously, one barrier for increasing the opportunities for structured physical activity in childcare settings is the lack of availability of qualified instructors. Often, teacher training and background may be a barrier to increase structured physical activity. In addition, certified physical education teachers may lack appropriate early childhood field experiences [21]. When consider hiring a movement teacher or physical education teacher, it is important to consider their background in working with young children. A background and understanding of developmentally appropriate movement for young children are essential for early childhood movement instruction.

Most often, the responsibility of teaching physical education or structured lessons falls upon childcare providers and teachers. Unfortunately, many childcare providers have little to no training in their teacher preparation or background to teach movement lessons to young children. This lack of training limits the ability to plan lesson content, including developmentally appropriate content that covers knowledge and skills to encourage movement competence in early childhood. However, it is possible to learn curriculum and concepts necessary to teach young children movement competency through purposeful professional development and workshops.

Likewise, many children also do not receive the recommended 60 minutes of unstructured physical activity time in childcare settings. The amount of unstructured physical activity time children receive is dependent upon factors such as environmental and facility factors, staff-related factors, and policies that encourage daily physical activity and movement [22–24]. A closer look at the physical outdoor and indoor space can provide valuable information on the opportunities children have to engage in physical activity in a school or day care setting. For instance, the availability of indoor and outdoor spaces in the school or day care is essential for physical activity for children to move. Likewise, a space for indoor movement such as multipurpose room or gymnasium is also important to encourage movement.

Additionally, an obstacle to providing unstructured physical activity is the involvement and participation of childcare providers in physical activity. Teachers and staff members can unknowingly undermine children's participation in physical activity. To be able to promote unstructured physical activity, it is important for teachers to encourage movement by modeling involvement in physical activity [23–25]. Teachers and staff members influence the amount, types, and levels of involvement of children in physical activity.

Unquestionably, the most significant barrier for physical activity in many childcare settings is the available time in the curriculum to devote to regular physical activity. Many childcare providers will claim there is not enough time in the curriculum for children to participate in regular physical activity. However, this is an example of a narrow lens in which physical activity is being viewed. Specifically, there is an ample body of research that demonstrates physical activity can enhance academic performance and behaviors including increased cognitive skills, academic performance, and attentiveness [26–28].

To successfully increase physical activity in the young children's daily activity, it may be important to address time constraints in the curriculum. Childcare providers may accomplish this by using an integrated curricular approach. An integrated curricular approach uses a more active approach to teaching content. By integrating physical activity with academic content, it is possible to increase the amount of physical activity time. In fact, there are a small number of studies demonstrating positive outcomes of integrating academic core concepts with physical activity on both academic performance and physical activity [29–31]. Recently, researchers demonstrated increases in literacy skills in an intervention study involving physical activity with preschool children. In this study, the experimental group of children who received an integrated curriculum demonstrated greater phonological awareness, letter recognition, and print awareness than the control group [29].

In addition, preschool children receiving the intervention were able accumulate 60 minutes per day of physical activity.

Additionally, a proven strategy to accumulate physical activity in the curriculum for children is to provide "movement breaks," throughout the daily routine or schedule for young children. These planned breaks can be 5–10 minutes in length and scheduled throughout the day in the classroom for young children. Researchers have indicated that movement breaks can be an effective way to introduce daily physical activity into young children's schedule [32, 33]. In addition, movement breaks may also help in increasing young children's attentiveness and time on task.

Finally, one strategy to improve children's physical activity levels is to use children's free time to provide instructions of motor skills. Children who are skillful are more likely to become involved in physical activity, demonstrate health-related physical fitness, and participate in physical activity opportunities that are available to them [34–36]. Conversely, young children who lack skills and movement proficiency are more likely to shy away from these activities and not accrue health-related benefits.

3. Increasing movement competence in early childhood

Over the past two decades, motor competence has been viewed as an important goal in reducing childhood obesity and increasing physical activity for children, adolescents, and adults. Children and adolescents who demonstrate motor competence are more likely to be physically active, have lower BMI, and demonstrate higher levels of physical fitness. The recognition of motor competence to the aforementioned outcomes has highlighted the importance of motor development in early childhood.

However, there is a lack of a consistent definition of the components of motor competence in the literature. A definition proposed nearly three decades ago declared motor competency is the ability to perform gross and fine motor skills with proficiency [37]. More recently, a definition presented motor competence as a theoretical construct divided into three areas including locomotor skills (e.g., running, galloping, skipping), manipulative movement, and stability or balance movements [38]. Other researchers have equated motor competence exclusively by children's ability to perform fundamental motor skills [39–41]. From a developmental perspective, it is unclear as to whether either of these definitions provides a comprehensive view of movement competence in early childhood.

Likewise, physical educators have deliberated on what it means to be proficient in movement. Physical literacy is a term that has been gaining momentum in the United States over the last several years. However, various institutions, international organizations, and individuals have applied vastly different perspectives and meanings to the term, "physical literacy" [42–45]. It is clear that various meanings, explanations, and interpretations have been assigned to the term, "physical literacy."

Consequently, National Standards in the United States were introduced in 2013 by the Society for Health and Physical Educators (SHAPE) to better define what it means to be a physically literate person [46]. The SHAPE definition implies to be a physically literate individual, a person who has the requisite knowledge, movement competence, values, and attitudes to move and participate in physical activity in a variety of contexts.

Specifically, the standards state the following:

> *(1) A physically literate individual demonstrates competency in a variety of movement skills and patterns. (2) A physically literate individual applies knowledge of concepts, principles, strategies, and tactics related to movement and performance. (3) A physically literate individual demonstrates the knowledge and skills to*

achieve and maintain a health-enhancing level of physical activity and fitness. (4) A physically literate person who respects self and others exhibits responsible personal and social behaviors. (5) The physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression, and social interaction. [46]

Although the standards provide a comprehensive view of the ultimate goal for "physical literacy," it is not entirely clear how the standards can be applied for early childhood movement competencies. From a developmental perspective, it is imperative that children acquire a large repertoire of movement competencies including knowledge of and application of movement concepts, fundamental motor skills, and fine motor skills. Movement competence in early childhood is important for participation in physical activity and future academic success.

3.1 Movement competence curriculum for early childhood care providers

Arguably, an early childhood framework for movement competence in early childhood is necessary to provide a conceptual understanding of movement competencies required during the early childhood years. A conceptual framework may provide childcare providers with an important tool to evaluate and plan developmentally appropriate movement curriculum and instruction to address children's movement needs. In **Figure 1**, movement competence in early childhood and key components for movement competence are depicted. These competencies include children learning body management concepts, fundamental motor skills including object control skills and locomotor skills, and fine motor skills that are necessary for participation in physical activity and future academic success.

3.1.1 Body management concepts and movements and movement principles

To learn to move with proficiency, it is first essential to have an understanding of basic movements and concepts. For child caregivers, it is helpful to understand terminology that is common to all movement. Rudolf Laban, born in 1879, is most

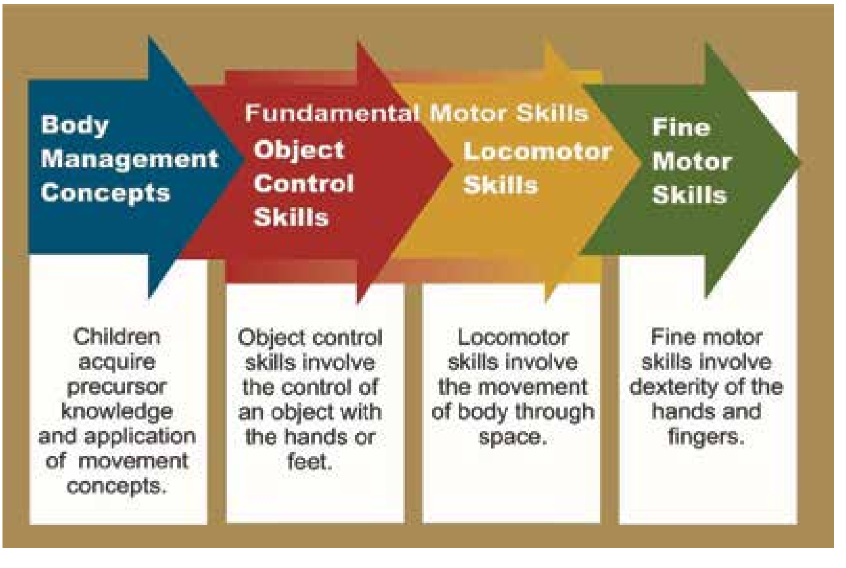

Figure 1.
Movement competence in early childhood. Key components of movement competence for young children.

often credited for his work in the notation of dance. More significantly, Laban's work has had a lasting impression on movement scientists for several decades. In the 1960s, Laban created a notational system to better understand movement, which is now known as the Laban movement analysis (LMA). However, what Laban is best known for is helping movement scientists to understand the most basic elements of movement including body, space, shape, and effort [46–48].

Much of Laban's work was popular in the latter half of the twentieth century. In fact, many Physical Education Teacher Education (PETE) programs have adapted Laban's work as part of a movement education curriculum. Laban's work has been the basis for many physical education textbooks for teacher preparation programs for the past three decades, although many movement educators and physical educators dismiss the importance of the work, citing that it is "out-of-date." However, the impact of Laban's work should not be underestimated in developing early childhood curriculum and instruction for movement competence in young children.

One of Laban's essential components of movement included an understanding of the body [47]. For young children, an understanding of the body includes an awareness of their bodies and how their bodies move. Body awareness provides the foundation for learning new movement skills. Child caregivers can start by asking children to point to body parts such as shoulders, hips, knees, wrists, elbows, back, and ankles and assisting children in more complex movements. Many teachers employ popular songs and activities to help young children learn their body parts.

Furthermore, an understanding of the body includes the application and exploration of non-locomotor movements. Specifically non-locomotor movements are movements that are performed while stationary. Learning how to shake, twist, bend, wave, sway, and swing are all examples of non-locomotor movements. Children can learn how to shake an arm or shake their entire body. Lessons exploring non-locomotor movements can be designed for children in the classroom or other space.

Moreover, shape is the form that the body occupies in space. Many of the movements children learn in movement require an understanding of the various shapes and forms the body can produce. When children are first introduced to a movement, one of the first movement qualities that they are introduced to is the body form or shape. To understand shape, it is essential to understand the various planes of movement including the horizontal plane, the vertical plane, and the sagittal planes of movement [47–50]. Within a horizontal plane, children can explore movements including expansion, contraction, wide, and thin. In the vertical plane, children can experiment with movements that include tall, short, high, or low. Also, in the sagittal plane, children can explore movements with their body including curved movements such as concave and convex shapes.

Additionally, an understanding of spatial concepts is necessary for young children in both the classroom and physical activity settings. Two of the spatial concepts which children struggle with in the classroom include personal and general space. It is not uncommon to observe children standing or sitting too close to one other or running into one another as they move about the classroom. Child caregivers can work with young children to understand spatial movements such as personal space to allow children to understand the boundaries of their own personal space through guided learning experiences. In addition, children can learn to move around the classroom and physical activity settings through planned movement instruction.

Moreover, one of the more challenging spatial concepts includes the use of locatives in both the classroom and physical activity settings. Locatives include relationships to objects and persons. Young children struggle with classroom directions when terms such as "in front, behind, toward, away, around, on top, and below," are provided. Often, even more difficulties arise when directions such as left and right are included. Providing planned movement experiences to allow children to practice these concepts can prove to be valuable to children in both classroom and physical activity settings.

Finally, the last of the important body management concepts includes an understanding of effort. Within Laban's movement analysis framework, concepts include direct or indirect movement, weight, and time [47, 50]. An example of direct movement would include running from point A to point B. Indirect movement would include moving in a zig-zagged or curvilinear pathway. Within the movement quality of weight, children can learn to explore the use of force. For instance, movements using force or energy including soft vs. hard or light vs. heavy may be implemented in the classrooms or physical activity settings. Likewise, movement activities focusing on the quality of time of movement can also be implemented. Structured lessons including quick vs. slow movements can be explored.

3.1.2 Fundamental motor skills

Fundamental motor skills (FMS) constitute an important component of movement competence in early childhood. FMS play a vital role in promoting children's health, physical activity, cognitive, and social development during the early childhood years [39, 51, 52]. In addition, a lack of FMS is related to higher BMI and lower rates of physical activity for children and adolescents. Ideally, it is important young children begin learning these skills so they have the requisite skills for a healthy lifestyle.

FMS generally involve the large muscles of the body and fall into one of two categories. The first category of these skills includes the manipulation, reception, or projection of objects. These skills are known as object control skills. The second category of skills involves the transport of the body through spaces. These skills are known as locomotor skills (i.e., hopping, jumping, running, skipping, galloping, leaping). Both object control and locomotor skills play an important role in achieving movement competence during the early childhood years.

Often, many child caregivers have misconceptions on the ways in which young children learn motor skills. One common perception is that children learn motor skills as part of the maturation process and that children will learn them when they are ready. A second myth is that children who learn motor skills at an early age are athletically gifted. In reality, the only way for young children to become skillful and proficient in motor skills is by receiving instruction, opportunity to practice, and feedback during the learning process. Without purposeful instruction, it is unlikely that children will learn to execute object or locomotor skills.

The absence of FMS can limit a child's movement participation experiences throughout their childhood years. Lack of FMS can lead children to withdrawal from social opportunities or to avoid participation in physical activities in which these skills are required. Ideally, it is important young children begin learning these skills so they have the requisite skills for a healthy lifestyle.

The absence of fundamental skills can limit a child's movement participation experiences throughout their childhood years. Lack of fundamental motor skills can lead children to withdrawal from social opportunities or avoid participation in physical activities in which these skills are required. In addition, young children who have difficulty with FMS generally find themselves socially isolated from their peers in physical activities.

Moreover, providing young children with modest amounts of instruction can provide positive gains in motor skill proficiency. Several researchers have demonstrated the efficacy of teaching children fundamental motor skills in a relatively short period of time. One researcher demonstrated that parents could effectively teach object control skills to preschool children who were at risk for academic delay in an 8 week motor skill intervention [52]. Similarly, in a separate intervention, comparable gains were demonstrated by child caregivers in a 9 week motor skill intervention teaching object control skills to young children [53]. Also, one researcher demonstrated that paraprofessionals could effectively provide direct instruction for both object control and locomotor skills to children in a 12 week motor skill intervention for preschool-aged children who were considered at risk for academic delay [54].

3.1.3 Fine motor skills

One of the most overlooked areas of movement competence in early childhood is the development of fine motor skills. Specifically, fine motor skills are used in many classroom activities in early childhood and primary grades. Consequently, children

Skill/Concept		Essential towards	Activities include
Body Management Concepts	Body	Understands and identifies body parts and relationship of parts. Can apply non-locomotor movements in various movement combinations.	Early childhood songs and dances. Simon Says, Head, Shoulders, Knees and Toes. Shaking, twisting, stretching, flexing, swinging, swaying, turning.
	Space	Understands space and application of spatial concepts such as general and personal space. Understands how to move in relationship to persons or objects using locatives.	Standing in line, sitting in a classroom circle, running games and activities. Moves to directions in classroom or physical activities that include in front, behind, around, next to, on top of, over and under.
	Shape	Understands how to shape the body in space by creatively selecting body movements or combinations.	Can shape body in curved, angular, symmetrical or non-symmetrical arrangements. Can apply knowledge of shape to form numbers or letters with body in classroom and physical activity games.
	Effort	Understands how to use concept of weight, space, time, and flow to produce movement.	Can produce movements that include light or strong; direct, or indirect, quick vs. slow, and bound vs. flowing.
Object control skills		Knowledge of basic biomechanics to control objects.	Throwing, catching, kicking, rolling, striking, bouncing a ball.
Locomotor skills		Learning to travel through space in different ways.	Galloping, skipping, running, hopping, jumping, leaping, sliding.
Fine motor movements		Learning to use the hands to support school readiness activities.	Dynamic tripod for writing and coloring, pincer grasp for picking up small objects, visual motor integration for copying letters/numbers.

Table 1.
Essential movement components and activities for early childhood.

who successfully develop fine motor skills are more likely to have success in classroom activities involving coloring, writing, and cutting with scissors.

More significantly, the development of fine motor skills is also related to later academic achievement in young children. Results from a large-scale study using data from two longitudinal databases demonstrate the importance of fine motor skills in academic performance [55]. Specifically, data from the National Longitudinal Youth Study (NLYS) and the British Birth Cohort Study (BCS) examined the relationship on early fine motor skill tasks and later performance in math and reading. The authors from this study concluded children's fine motor performance was positively correlated with future performance on both math and reading.

To explain the relationship between academic performance and fine motor skills, it may be first of all important to identify specific fine motor skills that support academic achievement (**Table 1**). For instance, visual motor integration is the ability to coordinate motor actions in response to visual stimuli. When children copy letters, numbers, or print from a chalkboard, they are using visual motor integration. If a child has poor visual motor integration, they will have a difficult time with this skill. Since the learning of math and many other subjects are still highly dependent upon these skills, it is somewhat easy to understand the significance of these skills [56].

Also, the dynamic tripod is a fine motor skill position required for handwriting in children. This is often a difficult skill for children to learn as it takes practice and instruction. In some cases, this is a skill that many public schools in the United States are no longer teaching to young children. If a child struggles with this foundational skill, the ability to perform homework or other writing tasks in class will become more difficult. Fortunately, these skills can be learned with structured lessons that provide children with an understanding of the necessary techniques to excel in handwriting.

4. Conclusion

In summary, it is important for early childhood educators and caretakers to address current practices and views on how best to prepare young children for school success. Academic preparation, while important, should not drive all curriculum and programmatic decisions. The lack of focus on fundamental children's needs including physical activity and development of motor skills is detrimental to the health and future success of young children.

Early childhood educators and caretakers hold the key to changing the course of potentially lifelong negative health consequences which have their origins in early childhood. From a public health perspective, early childhood is a critical time in which habits for physical activity and motor skills are developed. Examining barriers to physical activity such as space, professional preparation, and available time are important first steps for caretakers and providers. In addition, childcare administrators can assist in ensuring opportunities for unstructured and structured physical activity with guided instruction to learn movement concepts, gross motor skills, and fine motor skills. Finally, looking at opportunities to increase movement through curricular integration can increase movement competence and academic success in early childhood.

Recommendations for policy makers include increasing policies to support physical activity in schools and private day care settings. In addition, policy makers could shape public opinion on the importance of movement to young children by highlighting the issues in their respective communities. Providing clear guidelines through policy for physical activity time in accordance with the suggested amounts of physical activity times provided by the Society of Health and Physical Educators (SHAPE) can increase opportunities for children.

Future researchers can also explore the impact of physical activity and movement interventions on the school readiness of young children. Although preliminary evidence suggests that more active children have better academic outcomes, more evidence-based research is needed. Additionally, further research needs to explore the effects of integrated physical activity and preschool curriculum on both the physical activity levels and the academic outcomes of children. Finally, curriculum development research needs to be conducted to develop, refine, and implement movement lessons for teachers and caretakers without a movement background.

By introducing physical activity and movement competence into the early childhood curriculum, the narrative for the future of many children can be rewritten. The narrative may include a brighter future where children have attained a healthy weight status, have developed the motor skills to participate freely in physical activities, and have acquired the necessary fine motor skills to support academic success. However, this future cannot happen without changes to many of our childcare settings as well as revisions to the curriculum and programs.

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Chapter 4

Play as a Mechanism of Promoting Emergent Literacy among Young Children: The Indian Context

Neelima Chopra and Ikanshi Khanna

Abstract

The chapter has highlighted the status of emergent literacy in India, discussing the significance of play in early years. The sections have been summarized in a way to provide an overview of diverse play opportunities available to young children in the Indian setting. The authors have further correlated early learning experiences in the diverse cultural settings in India and how these practices contribute to enhance emergent literacy. Thus, it is crucial to emphasize the role of traditional games, stories and lullabies as a mechanism to enhance children's holistic development and learning. There is also a need for incorporating traditional play in the regular curriculum and classroom practices in early childhood programs. The chapter also reflects on the significance of inculcating cultural values and beliefs among children through traditional games, plays and stories.

Keywords: emergent literacy, early learning, learning through play, play in early years, play and early learning in Indian context

1. Introduction

Internationally early childhood years are defined as the period from birth to 8 years and are regarded as the most important years in a child's life. Research has indicated that period from birth to 8 years has a crucial impact on children's overall development and learning. There is a rapid growth in the brain during this period and any stimulation provided at this stage rapidly promotes the growth of the brain. By the time a child reaches 3 years of age, the brain has tripled in size [1]. The structural changes in the brain take place faster during the first 8 years than at any other stage of one's life. Synaptic connections are also made during the early years of a child's life. The strength of these synaptic connections is determined by the early life experiences as they respond strongly to outside stimulation. Since development and learning are directly related to the number of these synaptic connections, early childhood becomes the crucial period to help build a strong foundation and promote development and learning in young children.

Research evidence over decades also suggests that the experiences during the early years influence the overall health, behaviour and learning of an individual throughout his/her life. The Council for Early Child Development is a not-for-profit, charitable organization, founded in 2004 by Dr. Fraser Mustard and has worked on many research studies which advocate that the early childhood is the 'period of opportunity' and children's experiences influence neural pathways for later development [2]. It is also suggested that the experiences young children have while their brain is developing will have an impact on their development and will remain with them for their entire lives [3]. Children's experience during the early years set a critical foundation for their entire life-course [4]. Thus, early years are termed as the 'critical period' or 'sensitive period' which have an impact on the overall development of the child. The early childhood years are critical for the development of brain and its associated capacities like hearing, vision, numbers and language skills as well as social and emotional skills.

2. Emergent literacy in India

Development of language and early learning capacities of children are inextricably linked. Interestingly the relationship between language, culture and identity are closely intertwined. Thus it is crucial to understand and have a common definition of emergent literacy for young. This term serves as a holistic package of language and literacy development in young children. This is especially with respect to biological, cognitive, social and emotional development among young children.

'Emergent Literacy' is a process of making an individual literate – that is positive reading and writing experiences by an individual in socially significant and personally meaningful ways. In addition to this, "emergent literacy" approach is characterized by looking at children "in the process of becoming literate" [5, 6]. Thus, it is significant for children to read books to have pleasure, co-read to make meanings, understand that print/script has association and directionality, writing and drawing can be used for expression and communication among others.

To summarize, the ability to read and write in young children or 'emergent literacy' is understood to be interrelated and interconnected, developing mutually through everyday play and other activities conducted by children. It is through these activities, children understand that written words make sense and have a meaning. The concept of emergent literacy also appreciates that the understanding about reading and writing in young children develops much before they enter formal school. In fact, young children are already in the process of understanding and constructing their language skills through interactions with family members and friends. Research into young children's spontaneous engagements with written language before school-going age led to many new insights about the literacy acquisition process.

Research and related theories of child development and early learning suggest that early childhood from birth to 8 years is a critical period of development [7]. The foundation for future development and learning is laid down during this critical period from birth to 8 years, covering the pre-primary and early primary years.

The crucial early years are known to be critical for early learning and positive educational outcomes in later years, especially related with language and literacy skills [8]. This chapter focuses to highlight the status of emergent literacy in India, discussing the significance of play in early years. This will provide an overview of diverse play opportunities available to young children in the Indian setting and the impact on their holistic development.

3. Importance of programs in promoting positive emergency literacy among young children

Early childhood educational programs play a significant role in a child's life as they provide appropriate stimulation to young children at a 'critical' stage of their life and help them develop their full potential. Early learning in the first 5–8 years of childhood has decisive consequences for academic performance in school, as well as overall welfare and performance at work [9]. The importance of the early childhood educational programs has been further advocated by the results and findings of various research studies. Recent research on cognitive development provides reinforcing evidence that early education is crucial in getting children off to a good start in life [10]. It is also reiterated that early childhood services, including preschools can have a major beneficial impact on young people's lives and give meaning to the long espoused social aim of children attaining their full potential in life [11].

The positive impact of early childhood education is observed on different outcomes in children, including increase in academic skills of the children. A longitudinal study reported that children enrolled in child care and preschool environments scored higher in reading, mathematics and fine motor assessment than children with no regular attendance in preschool or participation in early childhood programs [12]. Similarly, it is also reported that preschool has a positive net effect on English and Math scores [13].

In addition to academic benefits, early childhood programs also have a positive impact on other early outcomes, as children who attend preschool or other early education programs have been reported to have enhanced cognitive, verbal, and social development, and these benefits are maintained into the first few years of school. Moreover, children who attend an early childhood educational program exhibited enhanced pro-social behaviour like cooperation, sharing among peers and displayed less antisocial traits like delinquency. Findings from various research studies also report a positive impact of early childhood educational programs on cognitive, non-cognitive skills, school achievement, job performance and social behaviors and leads to lower juvenile delinquency and arrests [8].

Many economists have also reported that investing in early childhood programs has economic benefits in addition to the benefits to the individual. Investing in programs that provide education for young children also produces large economic returns. Every $1 invested in services to help families with young children, between $4 and $7 was saved on child protection, health, education and justice system [14]. It is further elaborated that interventions at an early age have positive long-term benefits for the child and are also more cost-effective than interventions at a later age [15].

However, the quality of early childhood education is an important factor and influences the impact of an early educational program on children's learning and development. Various research findings have supported this statement. Two longitudinal studies, the Perry Preschool Project and the Abecedarian project have yielded sound empirical evidence and reported that high-quality early childhood programs have significant positive benefits for both the children and society in general. Similarly, the publication of The Effective Provision of Preschool Education (EPPE) research findings have provided robust evidence that the provision of high quality early childhood education make a significant difference to the learning outcomes of young children [13]. This report on EPPE Project also stated that there is no single factor that determines preschool attainment but good quality early learning provision is important. Similarly other researchers and studies also reported that programs that provide high quality to children are more likely to provide long lasting benefits to the young children attending these programs. High quality programs are especially beneficial for children at risk and belonging to disadvantaged sections of the society. Evidence for the influence of high-quality, comprehensive preschool experiences to mitigate the negative effects of risk on disadvantaged children's emerging academic, social and self-regulatory competencies are reported by many studies. Moreover, high quality programs have also been reported to have a positive impact on overall development of children.

4. Role of play in promoting overall development and learning among young children-unpacking play: concept of emergent literacy

Emergent literacy is a term used to describe early reading and writing development among young children. It refers to children acquiring some language, reading and writing skills before formally entering the primary school. It includes listening, speaking, reading, writing and thinking. Literacy development does not begin upon entering a formal primary school, but it begins early in life and is an ongoing process. Emergent literacy is influenced in the context of home, with family members and peers. It is also viewed as the reading and writing behaviour that precedes and eventually develops into conventional literacy. It is thus, important to understand the sequence of changes and development that occur in young children.

The sequence of changes that occur in children's physical, motor, language, cognitive and socio-emotional skills are referred to as growth and development among children. These changes occur from birth and continue till the children reach adolescence stage. Children's holistic growth and overall development is often observed through their enhanced skills in the five domains of development mentioned above. Cognitive abilities include abilities of children to learn and problem solving, while socio-emotional abilities involve skills of interacting with others and mastering self-control. Language abilities include understanding and use of language for communicating with others. Physical skills include fine motor skills and gross motor skills.

Play has a major influence in developing the abilities and skills of children. It is argued, however, that free-flow play is at the centre of humanity across all parts of the world and within ancient civilizations [16].

According to popular beliefs, play is a concrete, manipulative, fun, hands-on, and creative activity. Play provides open-ended, self-discovery and theme-based teaching for children's learning and development. Varied play activities and opportunities lead to better physical, language, cognitive and socio-emotional skills among young children. As children engage in play activities, they tend to use language skills to communicate among each other, develop strategies to play and win, learn social skills to cooperate and share among friends. Thus, group play activities are especially relevant for enhancing overall development of children. Individual play activities are also equally important for overall development of young children.

All aspects of development and learning are thus influenced by play. Children are intrinsically motivated to engage in play activities even when they are very young. A 3-month old child loves to look at familiar face and smiles on recognizing the mother and enjoys participating in vocal exchange with the mother. An 8 month old child eagerly looks forward to playful exchanges with an older sibling and takes interests in games like peak-a-boo or hiding of objects. As children grow, their play grows in complexity and becomes more cognitively and socially demanding. Through play children learn to explore and discover, use their understanding to play imaginatively, express their emotions and inner feelings.

Play also helps young children in development of abstract thought by understanding the use of symbols as forms of representation. Play is also a beautiful medium for young children to understand and develop a sense of who they are, learn social skills of sharing, turn-taking and negotiation and deal with conflict with friends and family and learn to negotiate and solve problems. Play also helps children to cope with emotional loss and come to terms with any traumatic experiences.

A few important features of play that describe in more detail how children behave, and learn while playing have also been outlined. Children use the first-hand experiences from life in their play [17]. They make up the rules as they play and make play props. Children choose to participate in play on their own; they cannot be made to play. Children also rehearse the future in their role-play and pretend play. Children play alone sometimes, or they may play with adults or other children.

Children playing get deeply involved while playing and it is often difficult to distract them from their deep learning. Children try out their earlier learning, skills and competencies when they play. Also children at play coordinate their ideas, feelings and make sense of their relationships with their family, friends and culture.

Based on the experiences as an early childhood educator and conducting observations in pre-primary and primary classrooms, the following play and learning activities were observed as helpful in developing and promoting emergent literacy among young children:

- Activities which encourage children to speak in the classrooms like show-n-tell, individual recitations, group recitations.

- Theme based, short-term, coordinated planning of play activities. The curriculum and activities to be conducted need to be planned keeping in mind theme-based planning and provide children with opportunities or experiences that integrate language and literacy activities.

- Efforts to integrate language and literacy activities during free play of children.

- Opportunities for listening to music or musical instruments in all classrooms. Planned musical classes for children should be included in the curriculum. Children need to be exposed to different musical instruments.

- Fun activities that help children experiment with reading and writing need to be planned and organized. These also help children to experiment with different writing materials.

- Reading a variety of story books also helps children to become aware of different writing styles.

- Writing has a communicative purpose; thus writing can be more meaningful when children write letters to their grandparents or friends make a list, make birthday invites and so on.

- Children need to be encouraged to participate in discussions and sharing their views.

- Teachers also need to provide opportunities to learn from peers. Creating learning corners, providing access to a variety of books and other literacy objects helps children in expressing themselves, thinking and sharing with their friends. Thus, more opportunities for collaborative learning can be provided by providing the appropriate classroom materials and planning such activities in the curriculum for the children.

In addition, traditional play activities in the Indian context are also useful in promoting emergent literacy among young children.

5. Diverse play opportunities available to young children in the Indian setting

Several researches and innovative early childhood care and education programs have recognized that children learn best through play and learning by doing. Children in the younger age group are naturally curious and exploratory in nature. They want to discover their immediate world using their senses and physical attributes. Many researchers in the field of child development have noticed children in constant interaction with their environment, and they want to touch, feel and experience everything they see. All that matters to children is to play and enjoy with everything they come across. Furthermore children learn by doing, by being the active participants in the learning process. Although play promotes growth and development among children, children do not engage in different play activities for these outcomes. Rather play among children is self-initiated and is often described as being natural, spontaneous, enjoyable and is a reward in itself.

5.1 Play and cultural diversity

One of the most common elements of childhood across cultures is play. Considering the diversity in India, it is utmost important to understand the diverse play opportunities available to young children in the Indian setting.

Moreover, exploring the relationship of play and cultural diversity is important for following reasons. First, a rapidly growing enrollment of young children from culturally diverse backgrounds is entering schools; this is significant in most urban cities where the migration is denser.

Second, play is a way for children to learn about the world around them. They not only learn about themselves but also about diversity in principles, ideologies etc. among other people. And finally, play can encourage positive bonding and relationships among children with diverse cultural settings and enhance a positive awareness of individual differences as well. Playing traditional games enhances friendships or health but it is deeply connected towards making children prepared for the journey called life.

5.2 Play and cultural values

Imparting cultural beliefs & values to young children is a way to orient young minds about their tradition in every society. There is also another thought that stresses upon the cultural influence on children and that it can come from many sources including the family, neighborhoods, child care and education centers, and the media. Play in early years also helps in developing a sense of pride and understanding of people in various cultures from the very beginning. Play is one of the mostly adapted techniques used with children to help them know and understand about their culture, practices, norms, customs, and values. It is also indicated that many traditional games with specific rules, provide a great means of communicating social norms of a society and form an integral part of that culture [18]. These games and their rules help in integration and solidarity among group members while providing aspects for segregation from other group members. Moreover, the types of play organized by children and play materials used are associated with their culture, for example, *kaudi* (small shells), pebbles and coconut shells are associated with communities living on beaches or near oceans and sea. Play during the early years also provides ample opportunities for young children to practice skills that will be useful to them as adults in that community. Play thus, serves an important role in enculturation.

This aspect is also enumerated in book on the history of toys [19]. The book describes that although some play materials such as toy animals or balls appear to be common among children everywhere, often toys and play materials mirror the culture in which children live. The author describes that at times children's play material might have religious significance, while at other times they may be related to skills of the adults in the community. The author also gives the example of Eskimos and how they made toys with ivory as ivory was easily available. Similarly people living near sea often made toy boats.

Similarly in India the play material available for children from different regions of the country depends on the locally available material to them. In Odisha, an east Indian state, children play with toys made of jute materials, while children living in the remotest village of Nandubar in Maharashtra, a west Indian state, have toys made out of wooden twigs, sticks etc.

Children can connect with their heritage through traditional games and this has a deep lifelong positive impact on their learning. Early childhood researchers and practitioners have been actively discussing the importance of play in the lives of young children and guiding ECE educators through different sources about the use of play and traditional games, stories & lullabies as a means of promoting cultural awareness.

6. Early learning experiences in the diverse cultural settings

Children have been observed to play in diverse settings. Regardless of city, suburban, or rural settings, throughout the world, children play. If they grow up in an agrarian economy and accompany their mothers into the fields, they find ways to play within that environment, and there are reports that mothers who work in such settings also find ways to make the time with their children pass in playful ways [20]. Children play whether they live in rural or urban settings; belong to rich or poor families. One of the most common essentials of childhood across cultures is play.

Children's play is influenced by cultural backgrounds and it is imperative to recognize the importance of cultural influences on children's play. It is also important for early childhood educators to recognize the importance of play in the lives of young children in order to make use of play as a means of promoting cultural awareness.

It is important to understand the relationship of play and cultural diversity as a large population of young children belonging to culturally diverse backgrounds are entering early educational setups. It is through play that children learn about the world around them and learn about their own and other cultural values. Play helps children understand and enhance a positive awareness of individual differences and cultural diversity of other children around them. Thus, play experiences provide an excellent way to teach children about differences among communities and negate any negative perceptions or stereotypes.

7. Role of traditional games, stories and lullabies as a mechanism to enhance children's holistic development and learning

Playing games has always been an exciting and the most loving part of growing up for us. Numerous times we fondly recollect the happiness experienced while playing childhood games. Most of us have definitely played traditional games when we were young, going to the terrace or outside on the streets or nearby park to play with our friends, was the most enjoyable part of our daily routine.

Indian traditional games like—*Kho kho, stapu, Langadi tang (one-leg hopping)*, skipping rope, *kancha, gilli danda, luddo*, and many more do not require exorbitant play materials or accessories like sports gear or specific shoes, all that is required is young enthusiastic & energetic children and space to play in.

Playing traditional games have always brought children together, encouraging teamwork and social interaction. Team games like *gilli danda, kho-kho,* encourages children to develop maneuvers to strategize and win the game. Unstructured play has a vital role in developing children's physical, behavioral and interpersonal skills, therefore the need to re-establish traditional play in children's lives.

Children also have an immense love for stories and lullabies. Stories help in creating an enchanting and delightful world for young children and help them in learning nuances of life. Storytelling provides an inimitable way to understand, respect and appreciate one's own as well as different cultures. This further helps in encouraging positive beliefs and attitudes towards diversity including people from different religion, communities, ethnicities and regions.

Folk-tales or folk-stories are constructed and told in captivating ways, and they carry huge entertainment prowess. Diversity exists in terms of stories considering the Indian setting and cultures they have. A common version of any story entails characters–human or animal–with the simple structure of a beginning, highlights, and conclusion. Often, these stories take shape of puzzles, with leading questions for children to express and solve it and further facilitates moral values among them. Almost all children are motivated by the suspense entailed in the stories, the characters and situations they are already familiar with. Children also learn to pay attention and to follow instructions, when the levels of stories extend from simple to complex. Moreover, many folk-tales, although essentially similar in situation, have been adapted in specific languages and therefore provide children with an opportunity to expand and learn their first language. Through the folk-tale activities, children use their short and long-term memory, exercise abstract thinking, and gain collective problem-solving skills [21]. Storytelling when narrated to children in various ways can Enhance intercultural understanding and communication among young children (**Figure 1**).

While listening to folktales and traditional lullabies, children participate actively, rather than listening passively. Children enjoy stories which are dramatic, vivid and involve situations that they have not heard about. Narrating stories and forming conversations around the characters and things in it, is the oldest form of imparting education about culture, family values and traditions. People around the world

Figure 1.
Story telling by 'Katha' teacher.

have always told tales as a way of passing down their cultural beliefs, traditions and history to future generations. We all have a story to tell and a drive to tell it.

In India, children generally go out and play with their friends or cousins on the streets or nearby parks. These street games have been played by previous generations as children. Parents or grandparents often narrate stories and share their experiences of playing these games as young children. Some of these traditional games played through generations are described below:

a. 'Kanchas' or playing with small stones or marbles was a caveman's game (**Figure 2**).

The origin of Kancha can be marked out to the early days of mankind. Kancha also known as Goti is an Indian traditional game which is mostly played by children and is cherished and fondly remembered by people of all ages. Kanchas are absolute fun to play with. The objective of this game is to hit a few marbles on the ground with your own marbles using a particular technique. Whoever is successful in hitting the targets takes the marbles of all other players and is the winner.

Figure 2.
Kancha or glass balls.

b. 'Gilli Danda' another traditional cricket-like game played on the Indian streets and villages (**Figure 3**).

It is believed to be more than a thousand years old – dating back to the Mauryan Dynasty [22]. Gilli danda is known by various other names as well: like Tipcat in English, Lappa-Duggi in Pashto, Kon ko in Cambodian, Pathel Lele in Indonesian, Celikçomak in Turkish, Ciang sat in Zomi language, Đánh Trỏng in Vietnam and Quimbumbia in Cuba so on so forth. Gilli danda is played using two small wooden

Figure 3.
Boys playing Gili Danda on the streets.

sticks which can either be prepared at home or with the help of the carpenter. While gilli is small, about 3 inches in length, the danda is 2 feet long with tapering ends, serving as a bat. The game is usually played in teams making a metre diameter circle on the ground and an oval shaped hole is dug in the centre of the circle and the Gilli is placed across the hole. The games allow the players to develop exceptionally good hand-eye coordination, ability to catch and strong wrists.

c. Kho kho is a traditional game that originated in Maharashtra one of the Indian western state (**Figure 4**).

This game is played widely on Indian streets and on special sports events like children's sports day in schools. The game hosts two teams, each containing 12 members, out of which 9 play at a time. The purpose of the game is to tag all the opponents in the team and the team with the shortest time to do so, wins. The game is one of the most popular sports in India and is enthusiastically played among children and adults alike. Besides the obvious health benefits, the game helps to propel sportsman spirit and camaraderie among the players. Since the game involves running, good for cardiovascular system. Hence, a kho kho game can help with a plethora of things.

Figure 4.
Children playing kho kho.

d. A popular playground game 'hopscotch' in which players toss a small object into numbered spaces of a pattern of rectangles outlined on the ground and then hop or jump through the spaces to retrieve the object (**Figure 5**).

This popular game is also played in other countries and is loved by all. In India it is called Stapu (Hindi), Nondi (Tamil), in Spain and some Latin American countries, it is rayuela, although it may also be known as golosa or charranca.

Figure 5.
A popular playground game of Hopscotch.

e. 'Ludo', one of the most played indoor board game of India (**Figure 6**).

This board game is an effective tool to develop child's numeracy skills and positional language. Ludo is a great platform to reinforce the pre-number concept (counting, colors, and shapes) among young children. And just like any other game, the benefits of playing Ludo go beyond learning math.

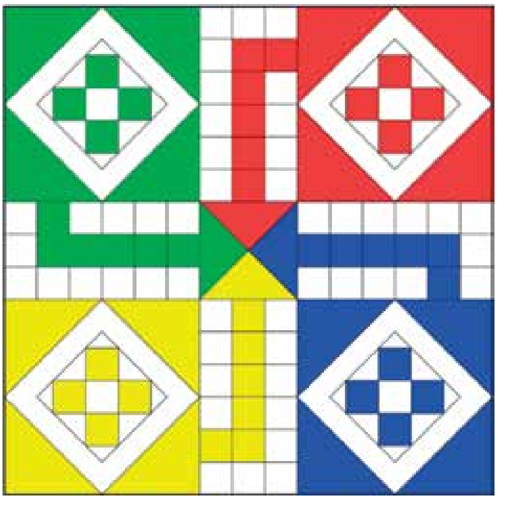

Figure 6.
A board game—'Ludo'.

The benefits of the game include sharpening the concentration and enhancing the presence of mind. They also ensure the improvement in the focus and dedication of the child, this allows children to work on their eye-hand coordination, judgment skills, calculation as well. These games improve the concentration power of the player and further enhance their focus.

Fascinatingly one can observe the expansion in child's interactions with friends and at the same time attaining gross motor and physical strength [23]. Children also obtain better understanding of numbers and number related concepts like counting, sequencing, addition and subtraction. By grouping, regrouping, adding and reducing pebbles, children learn to do skip count of two, three, and four and so on and thus eventually learn multiplication tables. Thus, for early childhood practitioners working with young children and promoting developmentally appropriate practices, play becomes an important vehicle for advancing children's social, emotional and cognitive development and also helps in promoting numeracy and emergent literacy skills [24].

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Chapter 5

To Teach or Not to Teach in the Early Years: What Does this Mean in Early Childhood Education

Susan Krieg

Abstract

Pedagogy in the early years has often been constructed as a choice between child-centered, play-based, or teacher directed learning. Child-centered learning is often characterized as "following the child's interests." This chapter examines this under-theorized notion by re-visiting constructivist theory, re-examining the differences between constructivism and critical social constructionism and in the process explores many underpinning beliefs about knowledge in early years pedagogy. Examples of critical social constructionist pedagogy, drawn from some of the "big ideas" in the Social Sciences are provided in an attempt to blur the boundaries between the binaries that have dogged educational reform in the early years for decades.

Keywords: early childhood, social justice, pedagogy, social constructionism, social science, play

1. Introduction

In many countries, the importance of the early years (birth-8) is now recognized and this has often led to greater investment in early childhood education and care (ECEC) [1]. Alongside this investment, policy makers have increased their accountability expectations of early childhood programs, often in terms of more measurable learning outcomes. This increased accountability has created particular tensions for educators working with very young children in the birth-5 years (often referred to as the pre-compulsory years, i.e., the years prior to the compulsory school age). These tensions are related to views about what constitutes learning in the early years and what it means to "know." This chapter explores how a deeper engagement with philosophical ideas about knowledge might inform practice in the early years and enable early childhood educators to articulate their practice more effectively.

Discussions and debates about how children learn and what it means to "know" are informed by ideas and beliefs about knowledge. For example, the early childhood years have often seen a shift of pedagogical focus from what a child *wants* to know in the pre-compulsory years to what a child *needs* to know in the early years of school. Educators in the pre-compulsory years (birth-5) have claimed to "follow the child's interests" as the basis for their curriculum planning and their pedagogy (ways of teaching and learning). However, in the compulsory years, a shift toward what the child "needs" to know in order to function in society becomes dominant and is often focused on literacy and numeracy competencies. Both these perspectives include "knowing" as an important feature of learning. Therefore, this chapter focuses the discussion on knowing and knowledge (epistemology) as important and often un-examined dimension of early childhood learning and teaching.

This chapter examines the possibility that early learners may be supported more effectively if early childhood educators better understand the epistemology that underpins their practice. Therefore, the first sections of the chapter revisit the differences between constructivism, social constructionism, and critical constructionist theories as a way of exploring what it means to "know." This deeper theoretical work may also contribute to a "shared pedagogical frame" for early childhood educators working across the birth-8 years. The second half of the chapter focuses on what this means for practice. Utilizing one of the "big ideas" from the Social Sciences, some examples of how understandings of social and critical constructionist theory can inform transformative teaching and learning in the early years.

2. The dimensions of a shared pedagogical frame

In its broadest sense, pedagogy relates to an interactive process where the educator enhances and sustains learning. The different dimensions that make up a pedagogical frame include beliefs about knowledge and the learning process that in turn construct the relationship between learners, teachers, and contexts. These aspects of pedagogy have been described as the processes through which children achieve the outcomes proposed and how educators should support them [2]. Researchers [3] have expanded understandings of pedagogy to include the dynamic of the pedagogue-child relation (care, empathy, acknowledgement, etc.); the pedagogue-content relation; the child's relation to other children and the pedagogue's relation to a group of children. Although each aspect of a pedagogical frame is interrelated and therefore difficult to separate, this chapter focuses on beliefs about knowledge (the pedagogue-content relation) for I contend that these underpin the relationship between learner, educator, and context.

Although not often acknowledged in many discussions of early childhood practice, beliefs about what constitutes knowledge and how it is produced underpin early childhood pedagogy. As Gergen ([4] p. 17) contends "Beliefs about knowledge inform, justify and sustain our practices of education." Many discussions of the differences between the child-centered, play-based pedagogy in the birth-5 years and a "teacher directed" and "subject driven" approach in the early years of school are underpinned by beliefs about knowledge. However, constructing pedagogy as a choice between a child-centered or a teacher centered, subject driven approach does not reflect the nuanced approaches to pedagogy that are evident across the birth-8 years. In their study of early childhood pedagogy Siraj-Blatchford et al. [5] conclude that we should be moving away from such a polarized description of teaching and learning. This "moving away" requires sustained intellectual work. This chapter explores the possibility that the ambiguity that characterizes debates about early childhood pedagogy is related to lack of understanding regarding the epistemological basis of our teaching and learning. This chapter addresses this ambiguity and explores how constructivist perspectives have been challenged by critical social constructionist ideas. The next section of the chapter therefore briefly revisits contemporary research into constructivism.

3. What does it mean to "know" and what counts as knowledge?

Early childhood education has traditionally been informed by a "constructivist" view of knowledge in which each individual (child) is engaged in a process of "building up" knowledge as they encounter the experiential world. From a constructivist perspective, learning involves a "personal construction of meaning" [6]. This constructivist view of knowledge contrasts with an objectivist epistemological perspective where knowledge is seen to be "discovered" (often by others) and then can therefore be transmitted "ready-made" to the learner ([6] p. 332). This contrast has been the basis of educational debate for decades and has often been described as an epistemological impasse that has created polarized positions regarding what constitutes teaching and learning.

Some theorists have attempted to find a way through this impasse. For example, Elder Vlass [7] argues that while "radical" social constructionists argue that *all* knowledge is socially "constructed," realists and moderate constructionist theorists would agree that there are some aspects of the world that are the way they are independently of how we think about them. Similarly, moderate realist theorists would agree that there are aspects of the world that are best knowable through social processes involving interpretation. We will now explore more deeply the basis of these ideas and their implications for teaching and learning in early childhood.

Cognitive constructivism, the explanatory framework developed by Piaget [8] focused on how individual learners adapt and refine knowledge based on individual experience. Piaget's depiction of the developing child as a "lone, inventive young scientist, struggling to make independent sense of the surrounding world…" ([9] p. 9) has dominated early childhood pedagogy for many years. A cognitive constructivist approach to young children's learning focuses on the workings of individual mental processes. Most early childhood educators working with children aged between birth-5 would argue that they work from a constructivist paradigm with children actively involved in constructing their own knowledge. While many early childhood educators working in the early years of school would also argue that they are working from a constructivist perspective, these educators are often working in school systems which have an objectivist epistemology as their "default" position where knowledge is seen to be "transferred" from the minds of teachers to the minds of learners [10].

While many theorists continue to take a constructivist approach and maintain an interest in the internal working of the individual mind, social constructionist theories have emphasized the social processes involved in learning. Within a social constructionist frame, we move our gaze from individual characteristics as explanations for learning, to a focus on the social unit of activity and regard individual higher cognitive processing as derived from that [11]. Vygotsky [12] claimed that "…all higher (mental) functions originate as actual relations between human individuals." An emphasis on the social dimensions of learning has contributed new ideas about the relationship between educators, early learners and knowledge. For example, a cognitive constructivist frame views learning as primarily individual but in a social constructionist paradigm, the centrality of interpersonal relationships (often with a more competent "other") is fundamental when considering how early learners make meaning of their worlds.

3.1 From constructivist to social and critical constructionist perspectives

The difference between the constructivist and social constructionist paradigms relate to their differing emphasis on either the mental processes of the *individual* *mind* as constructing knowledge from within (constructivist) or an emphasis on the mind and knowledge as formed by *social practices* (social constructionist). Ernest ([13] p. 484) uses metaphors to make some distinctions between constructivist and social constructionist positions. He appropriates the idea of "persons in conversation" to describe constructivism. Here the emphasis is on the individual mind as personal, separate, and idiosyncratic, and the construction of reality occurs and then maybe is "adapted" in conversation with others. This can be compared with a social constructionist perspective where the construction of knowledge is likened to individuals as "actors in a drama." The child is not constructed as separate from the social milieu, but is part of it, an active social participant. Here, the social is prioritized over the individual and "to be knowledgeable is to occupy a given position at a given time within an ongoing relationship." Social constructionist perspectives have been challenged and extended by Critical Constructionists who argue that the process of constructing meaning is "inseparable from our culture and the *power relations* embedded in our culture" [14]. A critical perspective is concerned with examining the power relationships in the social world and exploring how the cultural scripts being enacted in any dramas position children: some with more power than others.

This chapter presents the possibility that a deeper understanding of these different perspectives regarding knowledge (how it originates and is communicated) enables early childhood educators to make more equitable, inclusive curriculum and pedagogic decisions. Working within a critical social constructionist paradigm means that the child's social circumstances are no longer seen as "background," but rather, as the basis of learning. The next sections of the chapter examine how a critical social constructionist perspective opens up the possibility of new "ways of being" for young children and the adult educators with whom they are interacting.

4. Opening up new ways of teaching and learning: Social Science in the early years?

In this section of the chapter we use some of the "big ideas" drawn from the Social Sciences to explore the question of whether a better understanding of our beliefs about knowledge can contribute to a pedagogy that honors what children "want" to know and also connects with what they will "need" to know in order to function in society. The subsequent discussion presents the possibility that the "big ideas" that drive investigation and inquiry in Social Science are at the heart of young children's learning and that a critical social constructionist perspective offers the potential to support children's interests in a collaborative process of making meaning of their social and physical worlds.

The Social Sciences are concerned with society and the many relationships among individuals within any given society. The concepts guiding inquiry in the Social Sciences connect with the commonly espoused principles of early childhood education for understanding and sustaining relationships is fundamental to pedagogy in the early years. Teaching and learning in the early childhood years has been described as "Social pedagogy" and is primarily concerned with "learning to live together" (Bennett [2] p.12). The focus of this chapter is how intentional teaching, informed by a critical social constructionist epistemology, might play a part in "learning to live together."

4.1 Exploring some of the big ideas involved in "learning to live together"

The subsequent sections of the chapter draw examples from one of the Social Science disciplines: the concepts of place and space (Geography) to explore teaching and learning in the early years from a critical social constructionist perspective. The proposition explored here is that pedagogy informed by a critical social constructionist stance and a better understanding of the concepts and methods of inquiry offered in the Social Sciences may support early childhood educators to sustain, enhance and extend young children's learning about "living together" that might contribute to a more socially just world. We propose that the big ideas of "place" and "space" might inform a more socially just pedagogy than a cognitive constructivist approach. This is because the concepts of "place and space" provide the stimulus for exploring the *diversity* of the life-worlds that children bring to a learning event in more equitable ways than those pedagogies of the past where notions of a "universal" childhood formed the basis of inquiry and learning. In summary, we argue that the diversity in children's experiences of place and space offers the opportunity to explore differences and similarities as ways of broadening children's understanding of their worlds.

Understanding "place" is something that the child "wants to know." This interest is evident (for example) in the sandpit or block corner where young children are intensely involved in negotiating boundaries and borders, establishing possession, sharing and claiming space. So, is it possible (and beneficial) to connect the child's "wanting" to know with broader educational purposes and outcomes? We argue that these "sandpit" situations offer the opportunity to extend and enhance young children's understanding of wider society. Understanding place and space has been identified as something children "need to know" in many curricula. For example, in the Australian curriculum (ACARA) [15] the "concepts of place and space" include the understanding that "the ways people organize and manage the spaces in the places we live...can be designed and redesigned to achieve particular purposes." It seems that knowing who "owns" spaces and which space is appropriate for a particular activity is important for participation in the social worlds of the home, classroom and beyond.

4.2 Intentional teaching in the early childhood years

In a general sense, the word "intentional" co-located with the word "teaching" implies that there is a sense of *purpose* behind the early childhood educator's pedagogical decisions. The synonyms for the word "intentional" add further clarity as to what might be involved in intentional teaching. These synonyms include: considered, designed, mediated, planned, premeditated and proposed. These verbs are familiar to early childhood educators. Quality early childhood programs have a clear sense of direction and purpose where educators are able to articulate the broad learning outcomes that guide their practice: they are purposeful. For example, many early childhood curricula provide evidence that children's understandings of the relationships between the times, places, people and events in their world are intended learning outcomes.

A considered approach to any intentional teaching and learning demands attending to *why* early childhood educators might engage with children's interest in "place": what is the purpose behind sustaining and extending children's thinking about this concept? If a primary educational aim or purpose of early childhood education is to "learn to live together" in ways that are inclusive and socially just, the first question early childhood educators must address is: What concepts might contribute to a more socially just world through children's exploration of "place"? What are some of the understandings of place that are important in contemporary times? These questions require careful consideration for the responses will guide the educator's conversations, interactions, choice of materials and intentional teaching.

Returning to the theoretical concepts introduced in earlier sections of the chapter helps clarify how a critical social constructionist perspective can offer some useful ways of seeing the learning that is occurring as children are playing out their understanding of place. Firstly, the child, from the moment of birth would be considered to be an *active participant* in the world: they are "actors in a drama." The child is not preparing to play a part but *is* playing a part and making meaning of the world. A social script informs each child's experience in so many ways with cultural tools (such as language), symbols, customs, food and common uses of space. From a critical social constructionist perspective, what is important here is that the adults interacting with the child see their role (and the roles of other children) as co-constructing this meaning together.

4.3 Exploring the social and physical world in contemporary times

The concepts of place and space are some of the most common stimuli for young children's play. Children bring to their play their own unique understandings and experience of "place" as they take up roles, re-construct situations and events in their play. For example, in one very disadvantaged setting, the educators took the decision to construct a Police Station play area. The result was that some children assumed a position of power and leadership in the play that had not previously been observed. These children enacted processes (such as being called by a number, prioritized, segregated, and questioned) that demonstrated their experience of this particular "place." This example illustrates how an early childhood educator's understanding of the importance of "place" informs the provision of diverse "places" within early childhood classrooms that contribute to, and support, children's cultural identities and learning. Another example is where the provision of a "publishing" corner in the early years classroom provides opportunity for children to assume the identity of illustrator, writer and author that might not otherwise be possible.

In order to better understand how children utilize their life-world experiences in play, contemporary early childhood research has moved away from a developmental perspective with its emphasis on the child as individual to the child as a social participant. This participation is crucial to children's construction of knowledge. The child's knowledge and understanding can be understood from a "Funds of Knowledge" (FoK) [16] perspective, foregrounding the social origins of knowledge as a result of participation in particular cultural and social circumstances. It is beyond the scope of this chapter to discuss a FoK approach to teaching and learning in depth, but it is relevant to acknowledge that in recent times, a FoK approach recognizes children's learning in terms of both the "sources" and "areas" of knowledge as not only household and community experiences but also popular culture, media and classroom participation.

Alongside a recognition of the knowledge children have developed within their social worlds, the concept of "working theories" [17] to describe children's "evolving ideas and understandings" is also useful and consistent with a critical social constructionist epistemology. Utilizing working theories as a way of explaining children's knowledge construction contributes to a more inclusive pedagogy for it highlights not only the cultural "situatedness" of the child's understandings but also "how different access to funds of knowledge may offer insights into matters of inclusion, exclusion and status within children's play" ([18] p. 297). As illustrated in the Police Station example above, the type of knowledge and experience of "place" that children bring to their play may contribute to their status and power but also can lead to exclusion and powerlessness [19]. Take a moment to consider what a

First Nations child, the child experiencing homelessness or the child of a refugee family might contribute a discussion about "place."

One of the principles underpinning a socially just education is that if curriculum and pedagogy enables the most disadvantaged children in the group to participate equally, this benefits the whole group. If the experiences, conversations and resources used in the inquiry about "place" include the experience of the homeless and refugee children, this not only values those children's experiences, it broadens and extends the whole group understanding of place. Intentional teaching techniques such as shared book reading, situates children's own experience of place alongside those of other children: those found in stories, media and popular culture. In this process, the group's knowledge about place is broadened and extended. However, the educator's skill in facilitating and mediating the exchange and sharing of these life-world experiences becomes crucial.

4.4 Intentional teaching as "inviting children into a conversation"

As previously noted, intentional teaching in the early years often means continuing the ideas and interests that children are exploring through play. However, there are many unexplored issues associated with the assumption that, in a group of young children, it is possible to follow *all* of the children's ideas and interests, *all* of the time. Educators continually make considered decisions about *which* of children's multiple, sometimes very transitory, ideas and interests will be pursued further, and whether to involve a larger group of children into this pursuit. I had the privilege of discussing these questions in a personal conversation with Carla Rinaldi in 2012. Carla suggested that the process involves considering whether one child's interest is relevant to the larger group and if so, engaging children in an extended inquiry can be seen as "inviting children into a conversation." This idea of "inviting" children into a shared inquiry or conversation resonated with my research into early childhood pedagogy within a critical social constructionist paradigm.

An epistemological perspective that views knowledge as constructed rather than as "truth" enables the teacher to work alongside the child (or children) in the process of co-constructing knowledge. Viewing teaching and learning as a co-construction of meaning reduces the divide between "teacher led" or "child centered" perceptions of teaching and learning in the early years. No longer is the adult positioned as only ever "responding" to the needs or interests of the early learner: the adult is now in a reciprocal relationship, also contributing ideas and ways of knowing and supporting other children to participate in the conversation. Co-construction is described as a process where two (I would argue and sometimes more) people interact and "each participant listens to the other's ideas, contributes from their own, and together they develop their unique shared meaning" ([20] p. 37). The child's voice is heard and valued and all participants make links between experiences, across time and distance. Thus, co-construction re-positions both the early learner and the teacher. The educator is learning alongside the child/children. Returning to our example of "place," in Australia, as the indigenous child contributes ideas about connection to the land, perhaps supported by a visiting indigenous elder, the educator, along with the children in the group is deepening their knowledge of "place."

Viewing learning as "co-construction" is premised on the belief that both the child and the educator (or another child/children) with whom they are interacting see a "context, a situation, or a phenomenon, which is 'objectively' the same in qualitatively different ways ...and if we become aware of others' ways of seeing, then we have a certain degree of collective consciousness" ([21] p. 190). Here, we see a shift from a cognitive constructivist perspective focused on the individual child's construction of meaning to a critical social constructionist paradigm concerned with the pair or group's understanding of a phenomena, experience or concept.

By interacting with others (both adults and children), children will be exposed to a much wider range of "ways of seeing" (in this case, place) than is available when working or playing alone. The child finding their own way into a "landscape of ideas," concepts, terms and facts shared by others, is learning [21]. However, in this solitary process, their own perspectives limit individuals. By learning how others see and experience place, a child will be broadening their ideas of the multiple ways that "place" can be seen and "meaning is enriched in the process."

In this process of co-constructing meaning, adults actively participate as "intentional mediators" [22] and this concept of "teaching as mediation" opens up new possibilities for thinking about teachers' work with early learners across the birth-8 years. This approach does not assume the dominance of one knowledge over another but different knowledges are not "valued as more or less true…but are put side by side and treated equally important as different ways of understanding" ([23] p. 285).

As becomes evident, within this framework the role of the pedagogue is significant, the teacher has important work to do working alongside the learner/s, mediating between the known and the unknown. The teacher, is not only a "mediator of knowledge" but a "critical mediator of knowledge" whose role involves making the "culture, worldview and social arrangements and everyday practices of their society more accessible" ([22] p. 349).

4.5 Teaching as mediating: extending pedagogic repertoires

Mediation involves many different pedagogical decisions. As previously discussed, the educator's consideration of whether a child's idea is pursued at an individual, small group, or whole group level is an intentional decision. Designing learning experiences for individual children, a small group or the whole group requires sophisticated and purposeful planning. One of the benefits of planning whole group experiences is that the "shared" experience ameliorates some of the inequities of individual children's opportunities. For example, as part of the group conversation about "place," a carefully planned excursion to a particular "place" (e.g., an Art gallery) offers all children to participate equally in a conversation about what makes this place special, what happens there, and the people who are involved, etc. The excursion forms the basis of a more equal conversation than sole reliance on children's previous opportunities. Again, the diversity of life-worlds can be brought into the conversation to extend children's understanding of place. For example an indigenous perspective regarding how, although many galleries now include indigenous artworks, in times past, indigenous artists displayed their art in culturally significant, natural places would be important.

The language used in the educators' questions, resources, responses and comments is critically important from a critical social constructionist perspective. Using accurate words such as "space, artists, artworks, light, hanging" in context invites children to think about particular space (in this case the Art gallery) in new ways. Literature, storytelling, and multi-media resources are useful to enhance "shared" understandings about place. Asking the children why they think people have created art galleries stimulates thinking about how "places and spaces" are designed by people for particular activities: one of the core principles of understanding the social and physical world.

A common mediating strategy utilized by early childhood educators is illustrated by the Police Station example described previously. Educators often "orchestrate" the environment by introducing props and organizing space related to particular social activities (shops, hospitals, homes, etc.). Working within a critical social constructionist paradigm includes considering the environment as mediating strategy. In a socially just pedagogy, the environments being provided must include aspects of diverse children's experience. For example, in an Australian context, in the sandpit, are the tools and toys from a solely western repertoire (Tonka trucks, cranes, plastic containers) or do the props include examples from indigenous ways of knowing such as bark, native plants, and perhaps some tools that could be used for re-constructing animal tracks.

Photographs and videos can be the stimulus for enhancing and extending children's learning about "place." For example, based on a Photostory [24] methodology, children could be asked to take a photo of their favorite place, both in the classroom and in their wider worlds. For very young children, families or carers could be asked to capture the places where their babies or toddlers are happiest and share these with the educators. These photos could be the basis of whole group discussions about whether there are common features of these places. What makes the space special: the people or activities there, plants, animals, materials, quietness? These ideas could be used to make changes in the way the center is organized. The photos could be sorted, re-arranged, published and shared in many ways, utilizing multiple technologies such as slide shows, e-books and photo-books with captions.

Video recording children at play in the sandpit, particularly if there is a dispute about territory, ownership and use of space could be the basis for beginning significant conversations about "place." Using the words "boundaries" and "borders" introduces important ideas regarding how "ownership" is established, who makes the decisions related to whether and how space is shared, not only in the sandpit, but also in the wider world.

Lastly, experiences in the Arts provide the opportunity for children to co-construct meaning as they explore, express and communicate aspects of their social and physical worlds in unique ways. For example, drawing, then sculpting the people who live in the "place" called home is a valuable opportunity for children to explore the concept of "place" over an extended time using different materials to represent and express their ideas and understandings of the places, people and events in their worlds.

5. Conclusion

This chapter has presented the possibility that revisiting our beliefs about knowledge from a critical social constructionist perspective offers early childhood educators the potential to make more socially just pedagogical decisions. Using examples drawn from the Social Sciences regarding the concept of "place and space" we have examined the potential of intentional teaching for sustaining, enhancing and extending young children's learning.

The chapter has explored how a metaphor of the child as participating in a "drama" as they find their way into a landscape of ideas, utilizing the cultural tools (such as language) that are made available in their life-worlds, offers the teacher a position as a critical mediator in the process of learning. The teacher is an important player in the drama: making connections, supporting children's working theories, initiating and sustaining "big" ideas over time.

A critical social constructionist epistemology opens up new ways of thinking about teaching and learning in the early years that moves beyond a choice between either a child-centered or teacher-directed approach. Pedagogy informed by an understanding of critical social constructionism pays attention to the knowledge that children bring and extends this knowledge in ways that contribute to a more socially just world.

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Section 3

Science

Chapter 6

Science Education in Reggio Emilia-Inspired Altın Çağ Preschools

Hatice Zeynep İnan

Abstract

This chapter focuses on three aspects of science education in early childhood, namely, (1) the way Reggio Emilia teachers accomplish the early childhood science content and science process skills that children need to acquire at early ages, (2) the philosophy of teaching and learning science in Reggio Emilia preschools—integrated teaching and learning and 3H principle—and (3) the 80 Project. This chapter discusses integrated teaching and learning philosophy and 3H principle of early childhood education, namely, hands-on, heads-on (minds-on), and hearts-on education, because in Reggio Emilia classrooms, children are seen as a whole with their hands, minds, and hearts and education needs to satisfy all. Moreover, this chapter presents some examples and photos of science experiences happened within the project named "80" in Reggio Emilia-inspired Altın Çağ preschools in Turkey so that the teachers can easily comprehend how to get children to work on science projects from the first stage of development of a project to the last one. "80" is a child-sized doll made with craft paper by the preschoolers. The 80 Project presents the journey of the preschoolers who looked for ways to recover 80.

Keywords: science, preschool, early childhood education, teaching and learning, science process skills, integrated curriculum, Reggio Emilia approach, 3H principle, Altın Çağ

1. Introduction

Reggio Emilia approach is very compatible with preschool science education standards in terms of both science content and science process skills. Distinguished Reggio Emilia teachers believe in active education and create exemplary science projects in which children's science knowledge and skills can be nourished successfully. Reggio Emilia classrooms provide science-rich contexts of inquiry-based and social-constructivist education where children cooperatively construct their knowledge of science by hand, by mind, and by heart. Children actively work on the projects through hands-on experiences, construct their knowledge of science with their peers and teachers by questioning and theorizing, and love the subject matter by following what they inquire for and what they are interested in. Since Reggio Emilia approach does not provide a predetermined program but instead a heuristic perspective to education of young children, children find a chance to be involved in culturally relevant projects that take into account the unique needs and interests of children and integrate various disciplinary subjects [1] (**Figure 1**).

Figure 1.
Altın Çağ Reggio Emilia-inspired preschool.

This chapter aims to show how teachers can help preschoolers happily construct their knowledge and meet standards successfully in their Reggio Emilia-inspired preschools. More specifically, it focuses on three aspects of science education in early childhood, namely, (1) the way Reggio Emilia teachers accomplish the early childhood science content and science process skills that children need to acquire at early ages, (2) the philosophy of teaching and learning science in Reggio Emilia preschools—integrated teaching and learning and 3H principle—and (3) the 80 Project. This chapter discusses integrated teaching and learning philosophy and 3H principle of early childhood education, namely, hands-on, heads-on (minds-on), and hearts-on education, because in Reggio Emilia classrooms, children are seen as a whole with their hands, minds, and hearts and education needs to satisfy all. Moreover, this chapter presents some examples and photos of science experiences happened within the project named "80" in Reggio Emilia-inspired Altın Çağ preschools in Turkey so that the teachers can easily comprehend how to get children to work on science projects from the first stage of development of a project to the last one. "80" is a child-sized doll made with craft paper by the preschoolers. The 80 Project presents the journey of the preschoolers who looked for ways to recover 80.

2. Content of science education in early childhood

Early learning and development standards for children posit a concept (e.g., associations, attributes, function as an example for Knowledge Big Ideas, http://education.ohio.gov) or a skill (e.g., classifying, comparing, and contrasting, symbolizing as an example for Process Big Ideas, http://education.ohio.gov) that preschool children should gain. Standards ideally consist of developmentally appropriate practices that promote children's cognitive, social, emotional, sensorimotor, and some other development areas, while they are required to be responsive to the cultural and social contexts in which children live. Developmentally appropriate practices emphasize the importance of supporting children's development and active learning and offering children to engage school experiences such as hands-on and minds-on learning, inquiry-based activity, in-depth research, and cooperative learning [2, 3].

Schools are usually required to incorporate standards (both content and skills) into their existing curriculum. Traditional teachers used to give children science content knowledge by using predetermined curriculum in which standards are incorporated. However, teachers, who believe in Reggio Emilia approach, reconceptualize standards in early childhood education settings and follow a reverse pathway of integrating aspects of standards into their early childhood settings. "We are not mandated but check standards periodically to look at the curriculum, make connection between the work that we are doing and those standards, and pull out some of the standards for professional/parent conferences or undergraduate lessons. We're not married to standards. We don't let the standards drive the curriculum, children's ideas drive the curriculum." This interview excerpt, from a teacher in an American preschool inspired by Reggio Emilia Approach at a research university in the USA, describes how teachers benefit from standards in Reggio Emilia preschools.

Malaguzzi [4], the founder of the Reggio Emilia schools, states that they follow children's tread of interest, build the science content and skills on that interest, and create a curriculum "from" children not "for" children. Accordingly, anything can be the topic of a Reggio Emilia project, and teachers take advantage of that project topic, in which children are interested, to help children experience the joy of exploring and learning science content and gaining skills, especially science process skills.

3. Science process skills in early childhood

Children in Reggio Emilia preschools usually conduct research on the topic of their interests and engage in science exploration and experiments. Science process skills (i.e., observing and predicting) and integrated scientific process skills (i.e., controlling variables, building hypothesis, interpreting data, experimenting, and formulating) are one of the essentials of conducting research [5, 6]. Young children usually make use of the basic skills, namely, science process skills, instead of integrated scientific process skills, which are more complicated. While children are conducting research on the topic of a project, they need to use science process skills to be able to actively build their content knowledge and satisfy their natural curiosity in the environment. In Reggio Emilia preschools, children act like a little scientist and use science process skills frequently. Basic science process skills that are used by young children in Reggio Emilia preschools can be defined as follows:

Observation: observing, noticing, and collecting information about the world.

Prediction: making a guess and answering the questions like "What happens if?" and "Guess what happened?"

Identification and measurement/calculation: labeling the information with a name or a feature that has a meaning shared with others.

Comparison: figuring out similarities and differences between/among objects and events.

Categorization/group: organizing and combining information into meaningful units based on comparisons.

Data collection/record: collecting things/information and recording them.

Interpretation/communication: making meaning out of the gathered information, sharing that information with others, and explaining information to others.

Utilization: generalizing information from one place to another and from one experience to another [7, 8].

As stated by Fleer, in order for teachers to achieve effective teaching, they should not only enrich their content/skills knowledge in science; they should also have a strong educational philosophy and pedagogical applications to be able to teach science [9]. Reggio Emilia approach provides a contemporary and an alternative perspective to early childhood science education.

4. Reggio Emilia philosophy of teaching and learning science

Reggio Emilia approach is examined and defined here from the perspectives of integrated teaching and learning and 3H principle.

4.1 Integrated teaching and learning

There are many models to integrate curriculum, namely, fragmented, connected, nested, sequenced, shared, webbed, traded, integrated, immersed, and networked model. Each model displays a different type of curriculum, being content oriented and/or single disciplined through process oriented and/or student focused. The integrated curriculum model aims competence in the mean of overall integrated learning competence in math, science, literacy, art/music, and all other discipline domains. Moreover, curriculum integration encourages teachers to take into account children's whole development including cognitive and social development, while integration happens in the program and experiences [10, 11].

In curriculum integration, planning begins with a central topic in Reggio Emilia classrooms and develops through new research experiences (explorations) and theories (children's ideas and hypothesis on how the world works). Children are encouraged to ask questions and addressed to search on their own interests. There is freedom for inquiry, questioning, diverse ideas, and differences. Unlike the separate-subject approach, in integrated curriculum model, there is collaborative planning and conceptual integrity. In the integrated curriculum model, child is in the center (child-centered and child is the one who is questioning), but in Reggio Emilia approach, the child, teacher, and parents are all in the center as being protagonists, and all are questioning [10–13].

Reggio Emilia approach resembles more immersed model because as stated by Fogarty, integration takes place within learners, and immersed learners constantly make connections to the topic of the research. Children control their own learning by choosing the topic which they inquire about and which they are interested in. Teachers constantly observe and collect data about interests of children and then decide what to do next in the planning of the curriculum, just like in Reggio Emilia preschools [3, 10–13].

Charbonneau states that competency is one of the factors that is needed to be "successful." All other factors are understanding the relevancy of what they are learning in the classroom to life in the "real world," applying what they learn to that real world, making their own decisions comfortably and trusting in their own ability to do so, questioning and inquiring thoughtfully and creatively, using problem solving skills, and having realistic and high expectations for their own performance [14]. According to those factors, Reggio Emilia children appear to be competent. Moreover, Charbonneau indicates that formal measurement and evaluation models do not provide enough information about how children think and process concepts and how they assess their own learning. However, Reggio Emilia teachers accomplish that successfully through pedagogical documentation of all protagonists of education including children and the program.

4.2 3H principle in education of young children

The term 3Hs used by Inan [5] is new to science literacy, but the idea behind 3Hs is not new to science educators. The acronym 3H principle stands for "hands-heads-hearts-on education." "Hands-on" science education stands for children's active engagement with science, "heads-on" science education stands for inquiry-based education, and "hearts-on" science education stands for interest-based science education. These three qualities of science education, namely, hands-on, heads-on, and hearts-on, refer to education and development of the whole child. Such whole-child perspective considers cognitive aspects of learning (e.g., inquiring, categorizing, reasoning, predicting, interpreting, and theorizing), social aspects of learning (e.g., discussing, being a part of the learning community, cooperating, sharing, communicating, playing, learning from each other), language aspects of learning (e.g., communicating ideas using hundred languages, using technical terms), physical aspects of learning (e.g., engaging with both small motor skills and large motor skills like writing, drawing, jumping, running), and affective skills (e.g., satisfying their own interests, inquiries, and needs, working on love of subject matter in a playful context, caring about others, and having fun) [5, 15].

Reggio Emilia approach proposes an ideal early childhood science education by making use of a wide variety of theories, such as constructivism, social constructivism, play, and inquiry-based education. All those theories emphasize various strategies for education of young children. Taking those theories into consideration, Reggio Emilia teachers create a context for hands-on, heads-on, and hearts-on science education and get all three to work together. Projects, when maintained by appropriate teacher support, enriched environment, and documentation, create a playful context in which children can be actively and happily engaged in their science-related inquiry [5, 15].

This chapter presents the extended example of a negotiated science project, the 80 Project. The 80 Project is a co-constructed project that emerged at Altın Çağ preschools which are Turkish preschools inspired by Reggio Emilia approach. The 80 Project emerged out of a group of children's interest in ambulances and the teacher's initial planning with emergency services and took its direction from children's interests and the teacher's support, enrichment, and deepening of this interest. I describe how this emergent, integrated, science-rich project started and developed with some photos so the teachers can easily comprehend how to get children work on science projects from the first stage of development of a project to the last and how elements of this particular preschool accomplish curriculum integration and 3H principle of early childhood education and satisfy children's hands, minds, and hearts.

5. The 80 project

It was a regular school day in Reggio Emilia-inspired Altın Çağ preschools, and a group of 5- to 6-year-old preschoolers was playing in the classroom. Nobody knew that a long, productive, and joyful science project was started. The 80 Project was started with examining body organs by making a child-sized doll with craft paper named by the preschoolers "80" at the beginning of the school year (September), and then the project was evolved into ambulance, hospital, and drug production through January, and the story of curing the doll at the hospital lasted until the end of the school year.

Child A: If the doctor does not give us a prescription, we cannot take a drug, and we cannot recover.

Child B: Why are all of the drugs being sold in the pharmacy?

Child C: Doctors examine the patient first, and then we go to the pharmacist, who stays somewhere different.

Child A: Doctor, how do you know what drug will cure me?

Three children looked so excited about a wounded patient pretending to be in the ambulance. They were trying to help the patient who hurt his leg. The children were using some cloths to carry him from the ambulance to the emergency room. However, the cloths were not really helpful to carry him. Some more children started going into that pretend play. Some of them were pretending to be doctors, some of them were nurses, one was the ambulance driver, and one was the wounded person.

The preschoolers were laying their cloths on the floor, and one was pretending to be a patient and putting himself down on the cloth as if it was a wheeled bed or a surgery table. The teacher of the classroom, Didem, decided to add a fitted bed sheet, because it was stronger and bigger than child cloths to carry someone. Then, the preschoolers started using it. Pretend doctors were covering the wounded knees and legs with napkins and wipes, and the patient was recovering suddenly.

Since the preschoolers were getting more excited during the process of this pretend play, the teacher decided to enrich the play and add some more materials, such as bonnet, bib, scissors, gloves, cotton, body/organs, stethoscope, bandage, blood pressure device/sphygmomanometer, and so on. Moreover, since Reggio Emilia approach aims to create an environment which displays and supports cultural integrity, the teacher allowed the preschoolers to bring their toys or materials from home. For example, in order to make herbal drugs, some preschoolers brought plants or beans from home (**Figure 2**).

The preschoolers continued to work in the classroom by using newly added materials and make visits to the playground and outside the school. They started investigating medical materials and making a special place for patients. They used tiny ropes to weave and cover a table. They said that nobody except patients and doctors can enter this place and then patients are not allowed to exit this place and even touch the ropes. The teacher said that it is like a quarantine room at hospitals, and patients, who might have an infectious disease, are not allowed to leave the

Figure 2.
Preschoolers are experiencing medical materials.

Figure 3.
Weaving the table with tiny ropes to create a quarantine room at the hospital.

room. With the help of enriched physical environment and materials, the preschoolers started working on more in-depth inquiry questions (**Figure 3**).

Child D: You might have cancer and I will write you Calpol and antibiotics.

Child A: Doctor, how do you know what drug will cure me?

Child B: I will give you a pink pill.

Child C: I will give you cream and antibiotics. My mom has a blackberry cream.

Child A: I think that antibiotics are sour.

Child C: No, I think that they are delicious.

The teacher was systematically asking herself questions (see **Table 1**), listening to the dialogs among children, observing and documenting what preschoolers were playing and discussing, and asking questions at circle or project time, because teachers inspired by Reggio Emilia at Altın Çağ preschools observe the interest and grab onto that if there is a lot of potential and then build on it by reinventing the classroom environment and asking provocative questions. The teacher said that the preschoolers were interested in ingredients of drugs and inquired about how to make drugs and cream. As stated by Strozzi and Vecchi, "In considering a significant experience such as that which is lived in a preschool, nothing should be neglected, not even the most apparently insignificant or marginal details" [16]. The teacher started asking the preschoolers provocative questions such as:

- How can drugs cure people?
- Why are colors of drugs all different from each other?
- Some drugs are cream; some are capsules. Are there drugs in various forms?
- Why does taste of drugs vary from each other?

• What do children know?—What do they inquire?
• What hypothesis do they have?—What do they want to know?

Table 1.
The teacher frequently asks herself those questions.

The teacher enriched the environment by putting different versions of drugs and encouraged them to draw and paint those. The preschoolers realized that drugs are in different forms, like pills, capsules, syrup, and tablets. Since Reggio Emilia teachers believe that classroom is a reflection of life, Didem was not only setting up materials and hands-on experiments depending on what the preschoolers were interested in but also taking them to field trips. She decided to take the preschoolers to an herbalist to explore how to make plant-based drugs. The teacher said, “We participate in professional development studies in the related content and child education, cooperatively work with atelieristas and pedagogistas, check resources and read books on various topics in which we feel insufficient and frequently take preschoolers to field trips to provoke their inquiries and enrich our knowledge.”

The preschoolers started making drugs by mixing stuff, asking deeper questions, making more statements, and producing deeper hypothesis on drugs after visiting an herbalist.

Child A: How can we make chemical and organic drugs?

Child B: Can we make drugs with milk of fig leaves?

Child C: Can we make colorful drugs by smashing scallions and tree leaves?

Child A: Plants also need drugs, because otherwise bugs eat leaves of plants.

Child B: Immunization has also drugs inside.

Child C: Cia beans become jello, how come? (When he mixed Cia beans with water, water became jello.)

Child D: What seeds come from what plants? (examining a cucumber to see the seeds inside).

Child A: They should take the drug dough to the factory so that they can make drugs. Otherwise, they cannot make drugs at school. She said that they need a truck to take the dough to the factory.

Child N: I agree with Arya.

The backbone of curriculum integration is to develop a theme according to interests and needs of children. The teacher said that especially the dialog on drug production between preschoolers just above made the teacher think that this might be a good start of a fruitful project, because the preschoolers were so eager to mix stuff to make drug dough since the previous week. The teacher was right on this foresight about making herbal drugs, but she did not include some of the other project ideas that emerged at school since some other ideas were given priority to investigate. On the other hand, sometimes the teacher wanted to include some ideas but had difficulty in finding out what preschoolers were really interested in. For example, two preschoolers were talking on animals and drugs as follows:

Child B: Animals also need drug.

Child E: Injection is done to muscles, but there is no muscle in animals.

Child B: Animals run fast; that’s why they get sick quickly.

The teacher wanted to enrich the classroom by putting a frog body toy, and two children tried to explore inside the frog and cure the frog, but their interest did not last long. The teacher realized that they were not really interested in animals.

Figure 4.
Examining, drawing, and experimenting with herbs.

She caught what the preschoolers were really interested in, namely, curing people by mixing stuff to make drugs, and set up the physical environment accordingly.

At first, the preschoolers used macaroni to make fake drugs and painted them with watercolor. The teacher was looking for opportunities for "teaching on the fly" and thought that it might be a good time to introduce informative sources, such as books, because choosing appropriate children books is one of the right teaching methods in science. After reading books, watching informative videos, and conducting research on the Internet about how to make real drugs, the preschoolers wanted to use real plants and herbs. They started making organic drugs by squashing leaves, garlic, daisy, flaxseed, linden, flowers, *Aloe vera* plants, and some other plants that they collected outside the school (**Figure 4** and **Table 2**).

Child H: How can we get liquid from roots of the plants that we grow in pots?

Child Z: What part of the root should we use?

The preschoolers wanted to get the liquid out of the plant to make organic drugs, and they were surprised that some of the plants have more liquid than others and some are oilier than others, such as hazelnuts. They also realized that liquid taken from different plants has varied colors and smells different. The teacher asked the preschoolers if they can create new colors by using that liquid and then color paper to make an exhibition of those papers.

The teacher created places where they could investigate the plants on the light table, create colored paper, and make drugs by using beans and roots of plants that they planted in pots before and plants that they collected outside the school. They drew pictures of daisy, flaxseed, and linden to compare them with each other and compared dried ones with nondried ones and whole ones with sliced ones.

Since the preschoolers were confused and inquired on *Aloe vera*, the teacher opened Expert TV for children to get information on what they wanted to know. She also asked them to draw aloe vera while watching Expert TV at the same time and checked if they could make association, for example, Expert TV says that aloe vera could make hands softer, and the preschoolers draw hands with aloe vera. Then a preschooler came up with the idea of squeezing liquid from aloe vera by using an injection syringe and said that the liquid is sticky. Then all other children became interested in and put the liquid on their hands to make them soft. However, since their hands became sticky, they cleaned their hands immediately with a tissue, and then they realized that their hands became softer.

Table 2.
Experiences with Aloe vera.

The preschoolers also drew germs on the computer, made X-ray films on the computer, drew pictures on the light table, created body of 80 with craft paper, and used treads to make blood circulation. All kinds of art activities in that Reggio Emilia-inspired preschool aim to create a platform where preschoolers' ideas and hypothesis related to the world can develop, be enriched, be actualized, and be visualized.

Child D: Recipes says that tea water should be hot, but I drink cold tea.

Child Y: No, we should not drink cold tea; it might make us sick.

One day, they had herbal tea for breakfast and started asking questions about the vitamins inside herbal tea, such as daisy, linden, and rose hip. They were interested in understanding ingredients of liquid, such as vitamins and minerals inside liquid. During group time, the teacher asked children what vitamins are good for health and what fruits/vegetables provide what vitamins. Discussions started, and the preschoolers said, for example, orange has vitamin C, and it is good for cold. However, they were more excited about the rose hip tea (rose hip means a nose of a bird in their native language, Turkish). They said that rose hip cannot be something to drink, because it is a nose of a bird and a running nose will not be something nice to drink.

The teacher brought some provocations, such as experiments, videos from Expert TV, and field trips to some of the trees on the school way. After watching videos about herbal tea, vitamins, colors, and sequences of how to make tea, the preschoolers made some experiments to make herbal tea. The teacher provoked them to use science process skills all the time. The preschoolers started measuring ingredients of tea and making guess on heat of the water (hot, warm, or cold). They used many recipes and used various scales to measure water and herbs to make herbal tea. By mixing cold and hot water, they experienced how to make warm tea. They also compared bagged daisy teas with whole daisies. They opened bagged daisy teas to observe how they are different from whole dried daisies **Table 3**.

The preschoolers watched a drug factory video and said that people are making dough by pouring something like flour into the liquid mixture. They also started making their own drugs by using the liquid they squeezed from plants and mixing it with flour. Then, they checked a real drug to see if their drug was hard enough. They had a problem with the liquid they squeezed from plants by smashing them,

Weight versus volume The teacher asked the children to use the recipe they got from Expert TV, but the preschoolers got confused about how to measure 1 l hot water and 250 g rose hip. They tried to measure a bottle with a ruler. Then, the teacher brought various sizes of bottles to the classroom, and a discussion started on how to measure 1 l hot water. They realized that two half liter bottles make 1 l, but when they put two bottles on top of each other, it becomes longer than 1 l bottle. After working on various kinds and sizes of bottles, they realized that liter works only for liquids, not hard ones. They stopped measuring it with a ruler and started making their own liter by using bottles. At first, they put numbers on the bottle randomly. The teacher provoked them by bringing measurement cups and bottles with numbers on it, and the children compared them with their own bottles. It is important to note that the teacher already showed them measurement cups before the project, but none of the preschoolers were interested in, and none of them questioned how those numbers work on it. However, when they needed to measure water, they were more interested in such provocations that the teacher created, such as various sizes of bottles and photos of bottles presented on the table by the teacher. As seen in this exemplary project, the projects help children use their intellectual acts, and their wonderful ideas come true eventually through many trials and errors, and teachers accomplish the goal of raising questions and leading reflection, research, and adaptation.

Table 3.
Tea making and measurement.

Figure 5.
Examining, drawing, and experimenting with plants.

because they could not color the drug dough as they wished. Then, they decided to add acrylic color to the drug dough (**Figure 5**).

Spontaneous events and teacher's purposeful planning deepened and extended children's interests. The teacher added more plants/herbs to the investigation table for children to observe, draw, examine, compare and contrast, and mix them with water, namely, mint, sweet basil, black tea, beans, pepper, lavender, linden, flaxseed, chia seed, garlic, and green/dried tea leaves. The preschoolers discovered that the dried tea leaves give more texture and leave more color into the water than the green ones. They painted and colored the paper by using the plants. After that, they created posters by adding statements of what to cure under the name of the plants. The children were practicing reading and writing during the project whenever it was needed. They hanged those posters to the walls so that everyone could see what plant can cure what illness (**Figure 6**).

When the 80 Project was going on in the class, some other long-term and short-term projects were happening at the same time, too, such as snails, city, map, plants, planets, clay masks, graduation ceremony and party organization, molds, robots and producing energy with windmill and potatoes, and light break in water. Sometimes different projects united, for example, the preschoolers made paint by soaking blue paper into water, and they used that blue-colored water as eye drops to cure eyes of their doll (**Figure 7**).

The preschoolers used different things like cabbage to make colored water and eventually to make drugs. They made three experiments (one with soap, one with bleach, and one with lemon juice) to make different tones of a color from light to dark, because drugs also have different tones of colors (**Figure 7**).

The preschoolers used bottles and pipes to fill the basins. They were experimenting with the pipe system and trying to figure out which basin will be

Figure 6.
Writing "daisy is good for stomachache and insomnia."

Figure 7.
Drug making with cabbage and colored water.

Figure 8.
Drug factory: pipe system and solving math problems.

filled first with the mixture they made from a cabbage. They were so excited to solve that problem (**Figure 8**).

The preschoolers made syrup by using red paper and water. They also used coffee, vinegar, water, and oil to make syrup and realized that density makes some stay up and some stay down. Moreover, they said, "the mixture with vinegar makes bubbles, but the mixture with coffee does not make bubbles when I put my finger into the mixture."

When the preschoolers used cloths and paper to make a surgery table, they were able to put their dolls onto that surgery table. However, they also wanted to lie down, and the surgery table they made was not hard enough to carry them. They decided to use their own school bed as a surgery table and asked the teacher to carry a real bed into the classroom and use it as a surgery table then.

The Body Project contributed to children's science knowledge and shaped the emergence and the course of the 80 Project. During the process of the 80 Project, the preschoolers examined the topic more deeply. They read books and magazines related to body parts and hospitals, science, and ambulances, made an X-ray machine, and examined photos, X-ray films, brain tomography, cardio, cardiac graphs, heart massage, first aid, rescue breathing, bandage, plant names, organs like gall bile, allergic reaction, eye drops, pediatric thermometer, various forms of drugs, and so on. The preschoolers experienced and gained a lot of new technical terms, but sometimes they would not be able to pronounce it correctly, for example, Child N calls stethoscope as "steloscope." They also wanted to visit an x-ray center in the city. However, the center did not accept to host children in the x-ray center since it is not good for children's health.

The preschoolers were still so interested in curing each other, covered each other's injured parts with bandage, put each other to the surgery table, invited the teacher into their play, and asked her if she could be a patient (they played such pretend play of going to hospital and taking the teacher to the hospital). The teacher entered a doll into the play, because the preschoolers were so eager to experiment some creams on someone's body. For their security, the teacher entered the doll as a patient, and then the project developed into production of drugs and curing the doll named "80." The preschoolers made a series of surgeries on 80, but 80 died at the end. And then they built a hospital and a pharmacy. Each doctor had his/her own room, and they put their names on doors at the hospital. During the process of the 80 Project, they learned "emergency room," "ambulance materials," "drug production," "hospital," "ambulance," "important phone numbers," "body parts," "organs' functions," "germs," "good and bad bacteria," "measurement: liter," "skeleton/X-ray films," "blood circulation," "first aid/heart massage and rescue breathing," and so on. The preschoolers also made drug boxes and cash and brought them to the pharmacy to sell the drugs in boxes. They used the drama language a lot. End of preschool was coming, those preschoolers were ready to go to the elementary school, and the project ended because they said that 80 died. However, the project did not really end, because the preschoolers excitedly said that they put 80 into the recycle bin and 80 will recover there. On the last days of the school, the preschoolers said that three babies were born out that recycle bin. It might be the beginning of new journeys and new Reggio Emilia-inspired projects!

6. Ohio's new learning standards: kindergarten through grade 3

Standards, which are aimed to provide a comprehensive approach for supporting children's development and learning, represent essential skills that support children's learning of an academic content. **Table 4** presents the three standard statements that are accomplished during the process of the 80 Project. There are some more standards that are accomplished by children during such project, but the ones on the table were chosen on purpose, because they refer to the topic "innovation and invention" in which children exceeded standards in most cases and accomplished even third-grade standards. This table shows how related national science standards were met and even exceeded quite naturally in the course of doing the 80 Project.

Pre-kindergarten (3–5 years)	End of grade 1	End of grade 3
Standard statements:	**Standard statements:**	**Standard statements:**
Use imagination and creativity to interact with objects and materials	Interact with a wide variety of objects and materials without concern of product or outcome	Interact with a wide variety of objects and materials with the end product as the focus
Use creative and flexible thinking to solve problems	Identify differences between problem types, and adapt strategies based on the type of problem	Work backward from a proposed solution in order to solve a problem
Engage in inventive social play	Engage in elaborate, inventive, and social play	Negotiate and integrate the ideas of others in the elaboration of inventive social play

Reference: Retrieved from http://education.ohio.gov [August 27, 2018].

Table 4.
Topic: innovation and invention.

Figure 9.
Learning community is negotiating and discussing the 80 Project.

Moreover, the 80 Project in Reggio Emilia-inspired Altın Çağ preschools included all of essential qualities of science education, got all three Hs to work together, and thus satisfied hands (active engagement with science in a hands-on way), minds (inquiry-based science education), and hearts (the interests and needs of preschoolers). Accordingly, since the ultimate goal of curriculum integration is the "whole child" and competence in the mean of overall developmental competence in social, cognitive, linguistic, emotional, and physical domains, all the development areas were accomplished during the process of the 80 Project, such as social development: They cooperated, negotiated, took turns, trusted each other, overcome fear of doctor, took social responsibility, shared stuff and experiences with each other, and so on. Since teachers accept democracy as a part of the classroom culture, they support children to take an active role in the process of democratization. The preschoolers were able to share their ideas in a democratic atmosphere, listen to each other, and participate in projects as they wanted, became aware of the roots of conflict, and had an opportunity of learning ways to manage them constructively. Furthermore, out of 19 children, all started writing, and 17 out of 19 started reading (writing prescription, shopping at pharmacy, and cash design). It is also essential to note that Child N started writing first and then started reading, which is different than the conventional reading and writing. The preschoolers achieved all the standards for their age and even achieved some of the standards of first and upper grades (**Figure 9**).

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Chapter 7

Developing Young Scientists: The Importance of Addressing Stereotypes in Early Childhood Education

Donna Farland-Smith

Abstract

Children are born natural scientists. Research has shown they draw less stereotypical images of scientists the younger they are and less school experience they have. This chapter explores stereotypes young children hold of scientists and engineers and how teachers might recognize, address, and combat these stereotypes in the early childhood classroom. From an early age, children receive messages directly and indirectly about scientists, from their parents, media, television, books, and school. The messages they receive help them shape their science identity and test ideas about who can be scientists and what stereotypes exist. Evidence has demonstrated that students are aware of stereotypes and they are able to recognize and discuss stereotypes in a way that broaden their perception of scientists and engineers. To begin the discussion of pedagogical methodologies, the history of drawings of scientists (and engineers) will be discussed. Likewise, these discussions of stereotypes and new awareness can increase career choices including these two fields: science and engineering. Explicit instruction about the stereotypes the stereotypes and implications that follow for early childhood science classrooms will be discussed.

Keywords: stereotypes, elementary science instruction, attitudes and perceptions toward scientists and engineers, nonfiction historical trade books

1. Introduction

How do young scientists develop? What draws some people into science or engineering long before they realize there is something called a "career?" Why are some people, regardless of gender, attracted to science careers and some not? What stereotypes, both explicit and implicit, exist that contribute to one's ideas and perceptions about scientists? These are some of the questions to be explored in this chapter.

It is important to note that the intention of this chapter is to recognize that all children in early childhood are natural scientists. Two well-accepted ideas about how young children embrace science and interact with the environment come from Reggio Emilia and Maria Montessori. Both approaches support the child as their own scientist, and exploration is key in each of these approaches. The Reggio Emilia approach is an educational philosophy focused on preschool and early education that is student centered and uses self-directed, in relationship-driven environments. The Montessori method views the child as one who is naturally eager for knowledge and capable of initiating learning in a supportive, thoughtfully prepared learning environment. Regardless which curricula focus, the environment is the third teacher and science is taught in that environment. Thus, children assume the role of scientists naturally.

In the book, *The Last Child in The Woods*, the author, Richard Louv, even cautions against the opposite experience, "If education and other forces intentionally and unintentionally, continue to push the young away from direct experience in nature, the cost to science itself will be high. Most scientists today began their careers as children, chasing bugs and snakes, collecting spiders, and feeling awe in the presence of nature. Since such untidy activities are fast disappearing, how, then, will our future scientists learn about nature?"

However, we know that it is not practical that all children develop into scientists, but rather it is to not turn children off to science careers precisely when they are the most open to it. It appears that the more children go through formalized science in schools, the less they like and enjoy science and think about themselves in science careers. Therefore, the formative early childhood years become even more precious when it comes to lifelong aspirations. For example, we know that girls especially self-select out of math and science careers by age 10, which means what happens in early childhood years is extremely important [1]. While it is generally accepted that adolescents need to begin to think and plan for career choices, this suggests that even long before children are able to express or verbalize which careers may be interesting to them, they are processing information about their possible future.

As young children gather lots of information from parents, media, books, and schools, they collect, reject, and store ideas about scientists conceptually. For these reasons, asking children to Draw-A-Scientist has become an accepted method to provide a glimpse into how children represent and identify with those in the science fields. This chapter looks broadly at the critical aspects involved in on the different phases of one's academic life in order to observe how early childhood students take a variety of experiences with scientists and internalize them into their own science identities. Some of the central experiences discussed are perceptions of scientists at crucial developmental times in relation to formal schooling. For example, the biographies of Thomas Edison and Benjamin Franklin suggested that the very foundations of modern industry and design grew first in the waters and woods and farmlands of childhood [2]. This chapter will now discuss how to recognize stereotypes in science, what stereotypes mean, and how to combat these stereotypes.

2. How to recognize stereotypes about scientists in young children

Stereotypes are what people think something is like with limited information. Unless one is presented with more information, they may never broaden or change an original idea or conception. They remain unfixed. Stereotypes can manifest in numerous different ways. Sometimes it is very obvious. In science, it can be as simple as hearing a parent say, "I was not good at science," or "science is for boys." At the early childhood age, it can be as simple as a child saying, "I want to dress as a mad scientist for Halloween." Other times, it is more subtle, like the desire not to be like "the smart kids."

Sometimes children act a particular way, to reinforce a stereotype or to get a particular reaction from a parent or not. Young children use a variety of experiences to test out their identities in science and "check" with the adults in their lives for some sort of response, both positively and negatively. The teachers who unknowingly call on boys versus girls when asking science questions can reinforce a science stereotype. Parents' expectations, society's expectations, the media, and a teacher's response are all the beginning of children testing out others' ideas about their own science identity in early childhood. They will ultimately use these experiences to contribute to their identity in science in and outside the classroom and eventually a career. This suggests that what early childhood educators do is extremely important because they build the foundation for one's entire career.

The kinds of books teachers introduce and their assumptions must be explicitly challenged in early childhood classrooms. The kinds of television shows parents introduce must accompany some conversation about the scientists portrayed. Young children need to question and think through their ideas in order to broaden their idea about scientists. Children's interests in science are formed by age 14, and therefore the early childhood years are extremely important [3–5].

Science capital, as described by [6], is the academic, social, and cultural aspects of a student's life and how they may relate to a child's science aspirations. The role of family should not be overlooked in terms of influence on the child; [6] found that parental attitudes to science play an important role in shaping children's science aspirations. The survey data suggest that while a family's social structure location is important, family attitudes to science and their encouragement and fostering or not to science in their everyday life seemed to have an important influence [7].

Therefore, scientists and engineers are "who we are" and "what we do" or who we are and what we do not do. These stereotypes may form early on in life, and they may seem so acceptable because they come from our family of origin and we cannot recognize them. Young children need to be challenged in the classroom on their ideas for just these very reasons.

3. Science identity

Science identity, as defined by [8], demonstrates competent performance in relevant scientific practices with deep meaningful knowledge and understanding of science and recognizes oneself and gets recognized as a science person by others. The construction of this identity requires the participation of others as it is constructed socially within communities of practice [9]. Students develop identities through engaging with the practices and tasks of the science class upon entering a community of practice such as the science classroom [10]. Learning science in this community then becomes "a process of becoming to be, of forging identities in activity" ([10], p. 3).

Regrettably, in early childhood many students form perceptions of scientists and science that are narrow, inappropriate, and inaccurate [11–16]. Older elementary students included more indicators of stereotypical images in their illustrations than did 5- to 7-year-olds, suggesting that by fourth and fifth grades, students already have formed their limited views of who a scientist is [12]. Inaccurate views of scientists are widely held by students from elementary through high school [12]. In 6 years of research, having children draw pictures of scientists that are stereotypical, male images of white men in the laboratory increased with age [17]. Therefore, the least stereotypes are drawn by the youngest children [18]. In the examination of gender differences, only girls draw female scientists, and the majority of the female scientists are drawn by Kindergarten to second grade students, meaning children are less aware of the gender stereotypes associated with scientists at the youngest of ages [18]. Parents and teachers should provide experiences for young children that lead them toward rich and rewarding experiences in science [19].

4. What stereotypes mean: review of literature on children's perceptions of scientists

Starting at about second grade, one of the ways researchers have documented is that students possess stereotypical images of scientists by using paper and pencil/crayons methods [12, 15, 16]. This stereotype has been consistently portrayed by students for well 50 years [11–16]. This suggests that, as teachers and parents, there is a very short window of time in which to address this stereotype as it is forming. While paper and pencil may not be developmentally appropriate, another way may be through informally interviewing or talking to children regarding their ideas about who can be scientists and engineers.

Understanding this limited view individuals have of scientists is important because these ideas relate to children's science-associated educational and career aspirations. In other words, if children did not identify with such depictions, then they tend to not "see themselves" in these kinds of careers. A meta-analysis spanning five decades of Draw-A-Scientist studies studied that US children's gender-science stereotypes are more closely matched with males versus females. This is interesting considering women's representation in science has risen substantially in the United States, and mass media increasingly depict female scientists. Therefore, despite many efforts to attract females to science and make science a more diverse career field, children still associate science with mostly males.

Engineering is becoming increasingly popular in early childhood classrooms worldwide. Allowing students the opportunities to think and act like scientists goes hand and hand with the opportunities to play and build like engineers. For example, the *Next Generation Science Standards* (*NGSS*) has incorporated engineering throughout its K-12 standards. For example, one of the way to best describe how these two disciplines work together is to discuss one of the practices in the *NGSS,* Constructing Explanations (science) and Designing Solutions (engineering) [20]. Science is the way we make sense of the world or construct explanations, and engineering is the way we design solutions and/or solve problems and make the world better.

Therefore, research conducted on students' perceptions of engineers [21–23] has used similar drawing methods, like the Draw-A-Scientist Test, of the past decades. The activity is called the Draw-An-Engineer Test (DAET) or Draw-An-Engineer-At-Work (DAEWT), and the purpose is to have students describe their knowledge about engineers and engineering through drawing and sometimes written responses. These illustrations are then analyzed for stereotypical features described in the previous studies much like the illustrations of scientists of Draw-A-Scientist Tests.

Much in the same way, students have commonly associated beakers, chemicals, and lab coats with the tools scientists need to perform their duties. Students associate engineering with fixing, building, and working on things, and when asked to draw engineers, students portrayed engineers as physical laborers or working on cars [24–25]. Students often associated engineers with blueprints, computers, and safety gear and believed that engineers needed these items in order to perform their work. For these reasons, the parallel between scientists and engineers is a closely linked one.

5. Visiting scientists

It is not an uncommon idea for teachers to find ways for students to see scientists and engineers as individuals in a variety of settings and roles. Therefore, the most natural suggestion for broadening students' ideas or perceptions about scientist might be to get them to meet a scientist or an engineer by bringing one into their classroom. While this sounds like a relatively easy task, there are several things to consider so that the teacher does not unknowingly reinforce the stereotype by recruiting a stereotypical scientist. The teacher should also be cautioned that there is tremendous value in meeting many scientists to appreciate the scope of many differences of scientists rather than limiting a scientist visit to one person.

Classroom teachers are limited by time. Not only do they struggle to meet day-to-day responsibilities of instruction, but also local, state, and national requirements, as well as other expectations, placed upon them. As a result, teachers need guidance in selecting appropriate scientists and engineers (visitors) for their students. However, it is not clear that matching mentors to students based on race or gender is necessary or more beneficial for early childhood classrooms. However, the number of studies that used visiting scientists with early childhood students has been small for a variety of reasons. These sorts of visits take time to set up, and the relationship between the scientist and even several scientists takes time to develop and establish. A well-educated scientist does not always make an appropriate person to discuss science topics in a developmentally appropriate way to early childhood students.

Visiting scientist programs are built on the assumption that a visiting scientist will benefit children's perceptions of who scientists are and the work they do. For students at this age, the best bet for the classroom teacher would be to ask for parent participation and engage parents in science and engineering careers in their classrooms. However, this can have drawbacks too, as the classroom changes year after year. Even if scientists and the engineer are carefully screened and properly trained for the classroom (and they would need to be for early childhood classrooms), there are simply not enough scientists to fill the need nationwide. Even when the resource pool is expanded to include such professionals as radio/TV meteorologists, county extension agents, and wildlife management professionals, the availability of scientists is still limited by their own work schedule and restrictions of geography. An oceanographer, for example, would be ready in one part of the country but not another. This would be something to consider.

Be sure to prepare your class with questions before the visiting scientists or engineer comes and after he/she leaves. This will get the students thinking about the kind of work the scientist does. Be sure to cue the students into things like how the scientist dresses, etc., to start addressing the stereotypes. Did he/she wear a lab coat? Did they work in a lab? Did they work from home? Once the visiting scientist/engineer leaves, be sure to process the visit with the students aloud and discuss their expectations versus what really happened, what surprised them, and how did they see this scientist/engineer as a "real" person?

Make no mistake; authentic experiences with successful scientists and engineers who can relate to early childhood students can be powerful. If there are opportunities to do so, teachers need to restructure their learning environment so that students' beliefs about science, scientists, and themselves lead to positive attitudes and to less-sex-role stereotypic views concerning the nature of science and the physical attributes of scientists. However, the time, opportunity, or desire is not available; the remainder of the chapter will discuss two other ways to combat stereotypes if no visiting scientists are available: trade books and televisions shows.

6. Combat the stereotypes: stereotypes in books

Because young children do not have the paper and pencil option available to them before second or third grade, a nonfiction historical trade book or television show may be used to prompt explicit discussion. In this section, how to use trade books with early childhood students will be discussed.

6.1 Implementing nonfiction historical trade books

Linking nonfiction historical trade books and science content uniquely enables the teacher to model scientific thinking to stories of scientists and engineers in science lessons. This idea is that biographies of scientists can allow the teacher to highlight the human dimension of scientists and engineers while you encourage science learning. These stories will help broaden students' perceptions of scientists and engineers as real people and will add explicit and implicit opportunities for your students to consider science and engineering careers.

A book series that guides teachers in addressing non-stereotypical scientists [26, 27] has lessons linking the biographies of scientists and science content. This is one example of using nonfiction historical trade books in science teaching as a way to invite scientists and engineers into the classroom without the hassle of finding and scheduling guest speakers. Each chapter of this book presents three lessons based on children's literature biography of a scientist. Each lesson is organized according to *NGSS* [20] alignment, the character trait or disposition of the scientist, recommended science teaching strategies, and the learning cycle. However, if you decide to select the biographies for yourself, the following selection has guidelines for selecting biography-themed trade books for a science classroom.

6.2 Guidelines for selecting biography-themed trade books

The *Science Trade Book Evaluation Rubric* [28] can help teachers evaluate science trade books for use in their classroom. This rubric assesses the science- and literature-related appropriateness for trade books. It includes two main sections: literacy and science content. With respect to literacy, the rubric looks at plot development, imagination, and continuity if the story is fictional or whether the book contains sufficient information that is clearly organized in appropriate text structures if the story is nonfiction. The rubric further looks at the writing style, the suitability of the book's illustrations and graphics for the text it relates to, and the presentation of positive ethical and cultural values, including gender and racial representation. With respect to science content criteria, the rubric's key elements address the following: whether the science content is substantial, accurate, and current, whether the content has a "human face" (is personalized), and whether the content is intellectually and developmentally appropriate for the target audience. However, one aspect of science trade books not clearly addressed in the *Science Trade Book Evaluation Rubric* is the representation of scientists, particularly within the context of "science as a human endeavor."

Some places to begin looking for quality books include the National Science Teachers Association (Yearly Trade Book Awardees) and the Caldecott, Newbery, and Orbis Pictus Award lists.

6.3 Suggestions for selecting science trade books

When selecting science trade books with a focus on science as a human endeavor for their classroom science instruction, teachers may want to consider the following ideas below (in no particular order). The trade book should focus mostly on one particular scientist. The gender and/or ethnicity of the person(s) included within its pages may or may not be related. Meaning, the book is selected because of the work of the scientist, not necessarily the ethnicity or gender; however, there is nothing wrong with selecting a book to explicitly teach that someone besides a white male can do science. Trade books, by their very nature, evoke a storytelling aspect of the book that undoubtedly reflects the human endeavor of science versus a presentation of sets of facts.

1. The trade book must contain accurate information. There are two things to consider: (1) the accuracy of the scientific information and (2) the attributes of the process(es) of science as delineated by the *NGSS* [20].

2. The trade book must include a nonstereotypical representation of a scientist. The trade book should include images of both men and women while remaining historically accurate.

3. The story presented in the trade book should illustrate the roles of people engaging in the scientific enterprise.

4. The illustrations in the trade book should be artwork that is esthetically pleasing in a way that encourages children to want to enjoy the book over and over again. Books with high-quality illustrations will help achieve this goal. These trade books stand out because they are so different from the typical information texts currently found in the science sections of the bookstore. Informational texts are read for information, and we encourage students to read trade books for enjoyment.

5. The trade book must be age appropriate, and the practice of science must include students' practice and learning. The content of the trade book must be both age and developmentally appropriate for its intended audience so that readers can cognitively connect with what is being presented.

Gather the science trade books, and then consider the following:

Assess their science content for accuracy and developmental appropriateness, so the books clearly suit your students' reading ability ranges, interests, and abilities. Students should be able to grasp the scientific concepts that are being presented.

1. Assess the books' literacy qualities, including the narrative, style of writing, and cultural appropriateness.

2. Determine how well the books show the personal side of science for the main characters (i.e., determine how well the books describe science as being a human endeavor).

3. Consider the quality of the illustrations that help tell the story. For the age and developmental levels of your students, consider the brightness of the colors and whether the photographs or other types of illustrations are understandable and appropriate.

7. Combat the stereotypes: stereotypes in TV

Young children do not have the paper and pencil option available to them before second or third grade, a nonfiction historical trade book or television show may be used to prompt explicit discussion. In this section, how to use a television show with early childhood students will be discussed.

1. Select a television show that has a scientist included. The stereotypical or non-stereotypical portrayal of the scientist is not as important as the discussion that will follow between you and the young scientist.

2. Discuss with your child or your class some explicit assumptions about the scientist* on the show. For example, does the scientist wear a lab coat? Do they always work in a basement? What activities are they doing that considered science?

3. Just start asking the child questions about scientists, and see where it leads. Try to listen to the child and know that you do not have to answer every question.

*This can also work for field trips or visits like the zoo or science centers that have places where scientists are working on site.

7.1 Sid the Science Kid

Sid the Science Kid was selected as an example in the section because this author has used this television show for a research study to understand what aspects of science preschoolers were exposed to during the 1 and 30 minute episode. The goals of this particular study were (1) to analyze process skills: observing, inferring, classifying, measuring, predicting, and communicating within each episode; (2) to evaluate the number of questions asked within an episode; and (3) to evaluate and analyze how and who used the word "scientist" during each episode. Overall study findings (about the use of process skills) suggested preschoolers are exposed to observation and predicting most often while watching the television show and are exposed to an average of fifteen questions per 30-min episode. The explicit and implicit use of the word scientist (an average of five times per episode) might actually help young children visualize themselves as scientists [29].

Another research study about Sid the Science Kid found that the show successfully engaged both preschool children and their adult caregivers. It also reported that during and after viewing Sid the Science Kid, children asked more questions related to the concepts from the programs [2cite]. This is not surprising since children's exposure to particular topics would naturally lead to the questioning of new information in which they were exposed. It was found that when comparing viewers and non-viewers when presented with similar materials to those they had watched on Sid the Science Kid, the children in the viewer's category replicated the activities and use terminology they heard on the show, while nonviewers did not [30]. In a study with adult viewers, adults reported increased confidence with science content and increased comfort and interest in engaging in science activities with their preschool-aged children (2cite). Another reason this show would be good to have a discussion about the role of the scientist was that it was specifically found in a research study to measure the impact of the show on caregivers' reports of low-income children's science talk at home and found that watching the show had a positive impact on children's science talk [31].

7.2 Who is Sid?

Sid is a "Science Kid" who wants to be a scientist when he grows up! The television show produced by the Public Broadcasting System first began in 2008; since then they have aired about 70 episodes about the 4-year-old Sid. The main character, Sid, is an inquisitive preschooler who is always asking questions about how things work and the world around him. As he goes to preschool each day, he tries to answer these questions using the nature of science and basic science principles along with the help of his classmates (May, Gerald, and Gabriela).

The idea for the show was created around Sid and his question for each episode, and every show has basically the same blueprint. There is a brief description of the show as Sid begins each day with a question on his mind. As he greets his family for breakfast, he includes them in his science experiment. Then, he is off to school, and he brings the same question he is wondering about to the school playground usually in the form of a survey. His teacher, then, investigates whatever the particular question he has on his mind for that day at school. After school his grandmother reinforces what he has learned that day on the ride home from school.

The conceptual content of Sid is based in the *National Science Standards* [32], Cognitive Learning Theory, and on the preschool science curriculum, Preschool Pathways to Science [33]. The topics discussed on the show include earth, life, and physical science. Preschool specific topics per episode include tools and measurement, changes and transformation, senses, health, simple machines, backyard science, weather, the body, force and motion, environmental systems, light and shadow, technology and engineering, and living things.

8. Conclusion

It is recommended that teachers restructure their learning environment so that student beliefs about science, scientists, and themselves will lead to positive attitudes and to less-sex-role stereotypic views concerning the nature of science and features of a typical scientist [34]. This chapter has suggested that teachers can successfully address stereotypes in existing early childhood science classroom without restructuring their entire classrooms. Simple addition and/or modifications of trade books and/or television episodes (or visits from scientists) will serve their students well, by creating opportunities for discussions to broadening early childhood students' ideas about who can be scientists and engineers.

This chapter examined the development of the young scientists. It is often accepted that approaches to teaching young children in general include science and seeing themselves as scientists. However, as children progress through the school years, something happens with traditional schooling, and children often lose their curiosity and their sense of being scientists. They tend to try in fit in traditional idea of what others believe they should be a scientists or not, and this contributes to their science identity beginning as in early childhood.

In early childhood settings, children must be supported in their own role as scientist, and exploration is key to seeing themselves as a scientists. The Reggio Emilia approach and the Montessori method both were mentioned earlier in this chapter as examples of learning environments where children can "see themselves as scientists". Thus, children assume the role of scientists naturally.

Young children are impressionable and are forming images of not only their own identity but also their science identity. This is an important realization for teachers and parents of young children to recognize so that they can have fruitful discussions to uncover any stereotypes or limited thinking on the part of the young child. As previously discussed in this chapter, this can be accomplished through several ways that include trade books, trips to the zoo, or television shows. The most important aspect is that it is intentional on the part of the adult to try and build a communication stream between the child and the adult to discuss the implicit and explicit assumptions that will inevitably come with age and culture.

Early investment and exposure to scientists and engineers can inspire many years of discovery, even if children do not enter science careers. Finding developmentally appropriate trade books and television shows to address stereotypes can be both meaningful and relevant to the everyday lives of young children and their teachers. In addition, science content is framed in relatable ways to its characters yet investigated through the nature of science, through posing questions and investigating objects and events that can be directly observed and explored for young scientists.

This chapter offered some practical tips for teachers because there is a real need for professional development for early childhood teachers on the issues of stereotypes in general.

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Section 4

Mathematics

Chapter 8

The Importance of Spatial Reasoning in Early Childhood Mathematics

Kelli Rich and Jonathan L. Brendefur

Abstract

It is important to recognize the critical role spatial reasoning, relational thinking, and mathematical modeling play in the overall development of students' central understanding of mathematics. Spatial reasoning predicts students' later success in higher levels of mathematics, such as proportional thinking and algebraic reasoning. The National Research Council report implores educators to recognize the importance of developing spatial reasoning skills with students across all areas of mathematics. This chapter describes a study that used the Primary Math Assessment—Screener and Diagnostic to assess students' spatial reasoning and relational thinking. The results highlighted curricular resources to improve students' understanding of mathematics. Students' mathematical spatial reasoning improved significantly.

Keywords: spatial reasoning, relational thinking, early childhood, mathematics, achievement, DMTI

1. Introduction

It is important for educators to recognize the critical role spatial reasoning along with mathematical modeling plays in the overall development of mathematical skills and understanding. It is a fundamental bridge to algebraic thinking and conceptual understanding. The National Research Council report [1] urges educators to recognize the importance of developing these skills with students across all areas of mathematics.

Bruner's [2] modes of representation describe the process of enriching students' understanding by working through enactive, iconic, and symbolic (EIS) models. The enactive (physical) and iconic (visual) models are critical to help students develop connections to a task and allows for better recall of mathematical ideas. It is critical for teachers to expose students to different methods of modeling relationships with multiple representations. Students will have a better opportunity to generalize and build on existing foundational knowledge of equivalence throughout their mathematical careers.

Many students have difficulty in understanding concepts without being able to first observe a pictorial image of an idea in their mind [3]. Mathematics curricula loaded with symbolic representation require students to memorize procedures, denying the student an opportunity to utilize their visual thinking modality in the

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process of building conceptual understanding. On the other hand, curricula that embed more iconic models may allow for students to deepen their understanding of the mathematics and improve their skill levels [4]. Thus, we wanted to investigate whether there was a significant difference in first grade students' performance in spatial reasoning after being introduced to mathematics that included a plethora of iconic modeling.

2. Spatial reasoning

Spatial reasoning is strongly correlated with achievement in mathematics [5–7]. Students who perform better on spatial tasks also perform better on tests of mathematical ability [8–10]. Spatial reasoning involves (a) composing and decomposing shapes and figures, (b) visualization, or the ability to mentally manipulate, rotate, twist, or invert pictures or objects, (c) spatial orientation, or the ability to recognize an object even when the object's orientation changes, and (d) spatial relations, or the ability to recognize spatial patterns, to understand spatial hierarchies, and to imagine maps from verbal descriptions [10, 11]. Recent evidence indicates that spatial reasoning training can have transfer effects on mathematics achievement, particularly on missing term problems (e.g., $7 + \_\_ = 15$), which are important in developing algebraic understanding [8].

In addition, spatial reasoning skills and mathematical competency are directly related to each other [12–15]. Learning with specific spatial reasoning tasks improves students' abilities in the Science, Technology, Engineering, and Mathematics (STEM) fields [16, 17]. And there is a strong link between spatial reasoning ability and geometry where strong visuospatial skills predict how well students will complete 3D geometry tasks [18–20]. As educators become more aware of the need for spatial reasoning tasks, it is important to recognize the critical role mathematical modeling plays in the overall development of mathematical thinking.

The National Research Council report [1] urges educators to recognize the importance of developing spatial reasoning skills with students across all areas of mathematics. And the National Council of Teachers of Mathematics [21] suggests more spatial reasoning be integrated into the elementary mathematics curriculum to promote relational thinking skills. Mathematical modeling may be a key component to help students explain their thinking when representing algebraic concepts.

Mix and Cheng [22] found that students with strong spatial reasoning skills do well in mathematics [23]. Spatial reasoning is a critical element for developing ways students think about equations. Given the opportunity, students' spatial reasoning skills can increase when practice is integrated and supported throughout mathematics instruction [24]. By the time students reach kindergarten, their spatial reasoning skills predict their overall mathematical success [25]. Therefore, students' educational experience in elementary school should have an intentional focus on improving spatial reasoning skills.

The focus of the next section is to highlight the connection between spatial reasoning and spatial orientation on a number line, gesture, visualization, and mental rotation. For instance, a crucial component to understanding ordinality (the position of a number in relation to its location on a number line) and magnitude (the size of a number) is the development of a spatial representation of numbers in connection to the symbolic representations [26]. The number line has been shown in cognitive studies to be important for the development of numerical knowledge [27–29]. Ramani and Siegler [30] report that students who play board games such as Chutes and Ladders increase rote counting skills, number identification, and the conceptual understanding of numerical magnitude. Additionally, activities which include puzzles, video games, and blocks with significant connections to spatial reasoning skills and mathematical competency improve accuracy of symbolically representing a number line [31].

Problem-solving tasks regarding orientation, transformations, and movement of shapes create an opportunity among students and the teacher to engage in rich, mathematical discourse. As students discuss their thinking, they will use their hands to gesture while attempting to convey their thoughts surrounding the task. Gesturing allows students to explain the visual imagery taking place inside their head as they work on problem-solving specific tasks [32]. Students' gestures represent the movement of the transformation and create an avenue for their thinking to emerge through the discussion. Alibali and Nathan [33] found gestures to be an excellent tool for teaching students how to solve spatial transformation tasks by placing an emphasis on the importance of moving the pieces without the actual physical movement. In essence, they used their hands to gesture what their mind was creating and conveying mathematical thinking.

The ability to gesture what the mind is thinking is dependent upon students' ability to visualize mathematical transformations [34]. The ability to think relationally requires students to visualize how numbers can be manipulated and rearranged in an equation [35]. Therefore, visualization is a key component across mathematical topics [34]. Spatial visualization tasks require students to create an image in their mind, hold the image, and then mentally transform or manipulate that image to be different. Some examples of these types of tasks include composing and decomposing pattern blocks to determine a new composed image, imagining transformations and perspectives of a three-dimensional cube, or activities that involve mentally folding a two-dimensional shape to form a new three-dimensional shape. In addition to spatial visualization, mental rotation has also been shown to increase student performance in mathematics [8].

Students who are allotted time to practice mental rotation have demonstrated the ability to solve a series of multi-step word problems [36]. Mental rotation consists of the ability to look at an object or picture of an object and visualize what it might look like when rotated in 2D or 3D space. The most recent study of spatial training with mental rotation was conducted with young students developing number sense, counting sequence, fact fluency, and missing term problems [8, 22]. Although the other areas showed improvement with the spatial training, missing term problems such as $2 + \_\_ = 6$ indicated the most significant effect size. Much like the relational skills needed to find the most efficient way to solve missing term problems, the completion of mental rotation tasks during spatial training helped to strengthen students' ability to visualize the necessary transformations of numbers within equations for simpler computation [8].

It is important to note that mental rotation and spatial visualization are both subsets to spatial reasoning and much of their characteristics overlap [34]. Developing both skills is a powerful way to connect back to the bigger idea of conceptual understanding for relational thinking, spatial reasoning, and equivalence [37, 38].

3. Relational thinking

In addition to spatial reasoning, relational thinking or early algebraic reasoning is critical for long-term success in mathematics. Students need time to develop relational thinking, with practice designed to explicitly examine the way in which numbers relate, and ways that those relations can generalize to other areas of mathematics [39–42]. One way to improve conceptual understanding is to increase the exposure of problem-solving tasks involving nontraditional equations. It has been shown that students as young as kindergarten and first grade have informal knowledge of number relations; however, the mathematics presented in traditional textbooks do not explicitly draw out these relations, allow time for the relations to organically emerge, or instruct students to determine how the ideas can be generalized (Blanton and Kaput [40]). Consequently, there is a need for mathematics instruction to incorporate more than just the traditional format of equations into daily lessons and include ways to represent relational equivalence [43, 44].

One aspect of relational thinking is equal sign. Most elementary students begin to develop their awareness of the equal sign's functionality at an operational level, where the equal sign acts as a symbol to perform a calculation or action [42]. When the bulk of instruction is focused on procedures and computing facts, many elementary students develop a shallow understanding of the equal sign and consider it an operational symbol [45, 46]. For instance, students with an operational view of the equal sign will reject any equations presented outside of the traditional format, a + b = c, and will define the purpose of the equal sign as a cue to perform the calculations on the left side of the equal sign to get an answer [47]. However, given more exposure to a variety of equations, students can become more flexible with their thinking and progress to different levels of understanding [40]. Mathematics instruction for early elementary classrooms should foster relational thinking by including tasks designed to draw attention to how numbers relate to one another and develop the flexibility to think of numbers in a variety of ways to establish the idea of equivalence [8, 48].

Matthews et al. [49] developed a construct map based on the research of Carpenter [47] and Hunter [50] to explain the continuum of relational thinking for students' thinking. The first level of student understanding is called rigid operational. Students at this level are calculating traditional or missing term equations. Traditional equations, written a + b = c, place the equal sign as a function for solving the addition problem a + b to produce an answer. This traditional format instills an operational view of the equal sign [51]. With exposure to nontraditional equations, such as a = b + c, students become more flexible in their determination of a correctly written equation. However, their view of the equal sign still remains as a cue for calculation. As students move into the basic relational stage, their flexibility to solve equations written with operations on both sides of the equals sign increases. However, it is not until the final stage, comparative relational when students consider the number relations on each side of the equal sign to determine equivalency and their need to calculate diminishes. This level of relational thinking demonstrates students' knowledge about how the equal sign relates to the entire equation, where they are looking for relatable numbers in the equation prior to solving the problem [52]. Identifying these relationships in equations and their connections with the numbers is a critical component of mathematical understanding. Developing and applying the knowledge of relational thinking to solve mathematical equivalence problems will increase early algebraic understanding [41, 44, 46, 53]. Students who think at the comparative relational level have a strong understanding of the equal sign and a deeper connection to algebraic reasoning [47, 50].

The natural tendency for students as young as kindergarten is to demonstrate an operational view of the equal sign; however, they do have the capabilities to think relationally if given the opportunity [45]. Therefore, relational thinking skills should be explicitly taught at an early age to avoid a deep-rooted set of operational skills [54]. Relational thinking involves flexible thinking to determine how numbers can be manipulated before answering a problem. Using relational thinking to solve an algebraic equation requires the conceptual understanding that each time a number is manipulated the equation remains equivalent.

Providing students with a progression of nontraditional number sentences focused on numerical relationships and patterns will develop relational thinking. As a starting point for young students reversing the order of the number sentence to begin with the answer such as 3 = 2 + 1 presses students to accept that the answer does not always need to be after the operation [49, 55]. Next, students develop their understanding of the term equal as they begin to recognize that both sides of the equation compute to the same quantity through exposure to nontraditional equations written with the operations on both sides of the equal sign [47]. Students who possess the conceptual knowledge of equivalence recognize transformations can occur by adding the same number to both sides of the equal sign without changing the structure of the equation. For example, when asked whether the equation 18 + 3 = 16 + 5 is true or false, students who are taught to think about the relationship between 18 and 16, notice that 18 is 2 more than 16, and reason that it must be true because 5 is 2 more than 3. Unfortunately, if students are not taught to look at equations relationally, then the transformations between 18 and 16 simply become proceduralized and learned as memorized rules [52]. This strategy shows a level of relational thinking in which students use number relations to make the problem more manageable. Thinking relationally, therefore, is different from applying a collection of memorized mathematical rules and procedures [56]. Students who think relationally identify number relations and reason about which transformations make sense in a particular problem [42].

Providing students with true or false equations can be another way to press students to think about number relationships. Equations such as 14 + 18 = 13 + 17 are more compatible with instructing students to see number relationships because a numerical answer is not required. Engaging students in a discussion of how the numbers relate to each other to determine whether the equation is true or false strengthens their conceptual understandings of equivalence (Carpenter [47]). Students with sufficient conceptual knowledge of how these number properties are applied have the understanding to transfer their procedural knowledge of mathematical equations to algebraic thinking [48]. Meaningful discussions about number relationships and the transferability of those ideas helps students make more mathematical generalizations [39].

4. Enactive, iconic, and symbolic representations

Bruner's modes of representations begin with the enactive, which includes manipulatives, or concrete, physical objects. The second representation is iconic, which represents any visual representations like diagrams, number lines, bar models, and graphs. The third representation is symbolic, which are abstract symbols like equations and algorithms. According to Bruner [2], students access their background knowledge of the representations to help make connections when the abstract symbols are isolated from other contexts. Concrete materials provide an opportunity for students to build background knowledge with iconic images depicting the meaning of the abstract symbols. When new abstract symbols are introduced, students can use their visual background knowledge as a retrieval mechanism to help remind them of the relevant concepts.

Instructional tasks heavily focused on abstract symbols tend to draw out the use of rote, memorized skill practice, which has been shown to compete with the development of spatial reasoning skills [57]. One way to help students make connections between numbers and symbols is to incorporate concrete materials for students to manipulate during their practice and application [58]. Including concrete manipulatives for mathematical tasks has been shown to improve student understanding and retention of the practiced concept [59]. The use of concrete materials in isolation does not always guarantee that students will flexibly transfer the concrete representation to the symbolic representations [60]. Solving problems strictly in symbolic form leads to inefficient solution strategies, entrenchment of operational procedures, and inconsistent errors [42, 54, 57]. As a whole, mathematics instruction that isolates the symbolic representations leads students to manipulate symbols without conceptual understanding and a weakened ability to solve problems outside of their procedural understandings [61]. Alternatively, instruction designed to include a progression of representations beginning with an enactive or physical model to then an iconic or visual representation to a symbolic form can support a deep understanding of the mathematics [2, 62, 63].

Many students have difficulty in understanding concepts without being able to first visualize an idea in their mind [3]. Visualization helps students use figures or shapes in their mind to recall, understand, make connections, clarify, and remember new information [64]. Mathematics curricula loaded with only symbolic representations require students to memorize procedures, denying the student an opportunity to utilize their visual thinking in the process of building conceptual understanding. However, including visual representations into daily mathematics lessons can support the learning process and increase conceptual understandings [65].

Strong visualization and spatial reasoning skills contribute greatly to students' ability to organize the structure of equations and mathematics [66]. Mathematical models can be a way to connect one's visualization to their understandings of the problem [67]. The model connects the visualization into the spatial layout of an equation so students can devise a solution to solve the problem [68]. As students visualize the problem, they flexibly decode the context into the spatial layout of an equation [69].

When given the opportunity, students can develop the necessary spatial skills to visualize mathematics. Gesturing assists students to communicate their thinking. Mental rotation and spatial visualization can strengthen students' ability to solve nontraditional equations. Therefore, promoting spatial reasoning and modeling (EIS) early on in students' learning can promote mathematical competency and algebraic thinking.

5. Developing mathematical thinking

Curriculum should include ways to promote spatial reasoning through mathematical modeling to develop students' conceptual understandings [47, 70]. Mathematical tasks should include both traditional and nontraditional equations [44, 46]. The use of mathematical modeling should connect through a progression of enactive models, iconic models, and formal, symbolic models. Iconic models are one way to introduce spatial reasoning tasks and can be integrated throughout the instructional year to increase students' flexibility with the structure of equations and mathematical competency [8, 34].

The Developing Mathematical Thinking Institute (DMTI) offers a comprehensive curriculum designed to encompass all of these components for students to develop procedural and conceptual understandings. The DMTI curriculum is an alternative to the typical curriculum for teaching mathematics to help teachers develop a different approach to how mathematics is taught [71].

The DMT framework consists of five key elements for teachers to reflect upon as they plan, prepare, and instruct mathematics lessons: taking student's ideas seriously, encouraging multiple solution strategies and models, pressing students conceptually, addressing misconceptions, and maintaining a focus on the structure of the mathematics [72, 73]. Using students' informal strategies values their thinking and gives the teacher insight as to the level of understanding each student has. Teachers use the five elements of the DMT to develop more efficient strategies and multiple models for solutions to mathematical problems. Students are encouraged to talk with others about their thinking, compare solutions, and make corrections to their errors. One of the most critical components of the framework is to draw attention to the structural components in mathematics.

One of the ways the DMTI curriculum builds student thinking is through the inclusion of Bruner's [2] enactive, iconic, and symbolic models. Each module is comprised of lessons with tasks centered on the EIS framework to develop a strong foundation for the development of conceptual understanding and for solving problems [72]. For example, students in first grade are given a contextual problem about 10 children playing in sandbox, where they need to determine whether six of the children are boys, and then how many children are girls? Students first demonstrate their thinking using unifix cubes, followed by drawing an iconic bar model to match their unifix cubes model. The symbolic representation of the numbers is then attached with labels. For example, to highlight the variety of ways to represent the number 10, students are asked to demonstrate the other possible representations for making 10 following the EIS progression. Modeling all of the possible combinations for 10 emphasizes the idea of equivalence, and using the EIS progression helps all students to visualize how the numbers relate to one another. **Figure 1** provides a sample solution for the students to use as a model.

As students become fluent with facts within 10, they are introduced to the variety of ways to compose the teen numbers using units of tens and ones. For example, one task is to represent each teen number using units of one. Eventually, students begin to recognize the inefficiency of counting each unit of one. At that point, the teacher introduces a more efficient way of building the teen numbers by using a unit of 10. Over time, students independently build efficient models for larger numbers based on their previous experiences building with units of one. Once again, tasks such as these expose students to relational thinking and highlight the structure of equivalence through the use of mathematical modeling.

The DMTI curriculum encourages students to represent solutions to contextual problems, explain their solutions, and then generalize their understandings to other concepts (see **Figure 2**). An example of this is with contextual compare problems presented in Module 3 where students represent the number of blocks used to build two different towers. The task states that one tower is eight blocks tall, and another

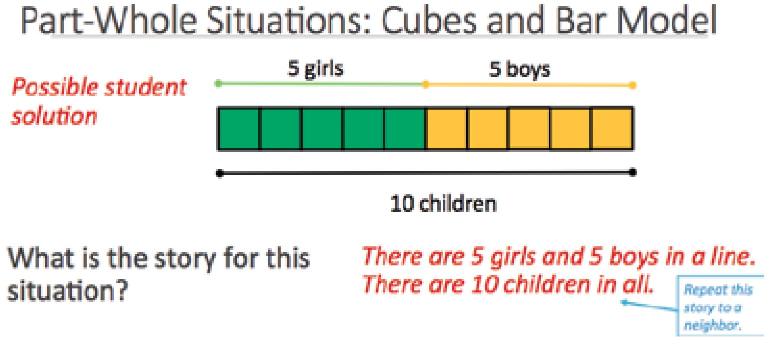

Figure 1.
Sample solution for making 10 in Module 3 of the DMTI curriculum.

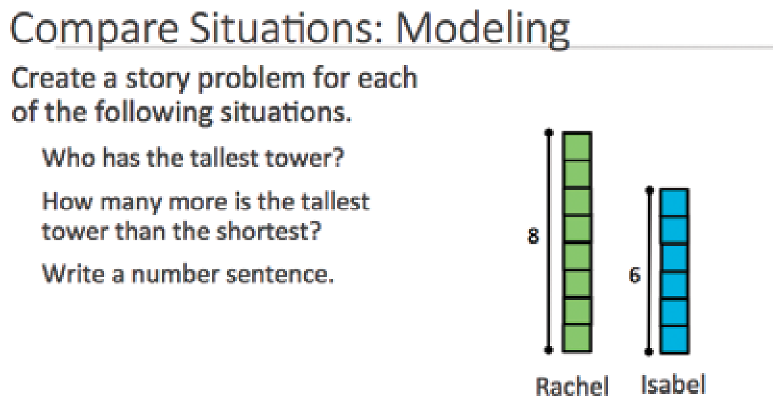

Figure 2.
Example of student work mat from Module 3 of the DMTI curriculum.

tower is six blocks tall. Students are asked to represent both towers using unifix cubes and determine whose tower is tallest and by how much. Next, students draw an iconic representation of the towers, paying attention to the spatial relationship between the number seven and four. The drawing should depict that one tower is taller than the other, and the enactive model is used to determine the difference between the numbers seven and four. Last, students connect their understandings of the relationship between the two towers back to the symbolic representation by notating 8–6 = 2. As students fluently build models to represent the context, they are then asked to look at a given set of numbers, build the models with unifix cubes to match, draw an iconic representation of the models, and create their own story to match their model. Students work in partners to listen to the story, but then also explain the relationships between the two towers. With this activity, students often times gesture with their hands to explain how many more blocks are in one tower than the other tower.

As suggested by NCTM [21], the DMTI curriculum intentionally focuses on building students' conceptual understandings of mathematical concepts through spatial reasoning tasks. Each task presents students with meaningful problem-solving situations where they are encouraged to begin to represent their thinking through enactive mathematical modeling, followed by an iconic representation depicting their thinking, and lastly with a connection to the symbolic representation of the problem. Students are encouraged to communicate their thinking with partners to check for understanding or assessing any misconceptions that may arise. The structural components are intentionally highlighted within each lesson to foster deep conceptual understanding and help students generalize their knowledge to other tasks throughout the year. Overall, the DMT framework delivers a comprehensive curriculum designed to increase students' mathematical understanding and improve spatial reasoning.

6. Summary

Most elementary students begin to develop their awareness of the equal sign's functionality at an operational level, where the equal sign acts as a symbol to perform a calculation or action [42]. When the bulk of instruction is focused on procedures and computing facts, many elementary students develop a shallow understanding of the equal sign and consider it an operational symbol [45, 46]. Mathematics instruction for early elementary classrooms should foster relational thinking by including tasks designed to draw attention to how numbers relate to one another and develop the flexibility to think of numbers in a variety of ways to establish the idea of equivalence [8, 48]. Mathematical tasks should include both traditional and nontraditional equations [44, 46].

As educators become more aware of the need for relational thinking tasks, it is important to recognize the critical role spatial reasoning and mathematical modeling play in the overall development of algebraic thinking and the equal sign. The National Research Council report [1] and the National Council of Teachers of Mathematics [21] suggest more spatial reasoning be integrated into the elementary mathematics curriculum to promote relational thinking skills. Spatial visualization, gesturing, and mental rotation have been shown to increase student performance in mathematics [8].

Mathematical modeling gives students a visual representation to explain their mathematical thinking [74]. The use of mathematical modeling should connect through a progression of concrete representations, visual or iconic representations to more formal, and abstract representations [62]. We will examine whether curriculum that supports students' conceptual understandings through the integration of relational thinking, spatial reasoning, and mathematical models by incorporating Bruner's EIS framework improves students' spatial reasoning and relational thinking.

7. Overview of the study

This study was conducted to investigate whether there was a significant difference in first grade students' performance in spatial reasoning when they learn to construct and compare numbers using iconic modeling. The study examined spatial reasoning for first grade students whose teachers either received a curriculum built on the use of enactive, iconic, and symbolic representations (EIS group) and an adopted traditional curriculum (traditional group). Students in both groups were tested using the Primary Mathematics Assessment Screener [75] in September, prior to the mathematics instruction, and again mid-May after the mathematics instruction. Student performance was compared across time. Thus, this study used a 2 (EIS group versus comparison group) × 2 (pretest versus posttest) design. The dependent variable was the students' knowledge of spatial reasoning measured with the PMA-S. The goal of this study was to determine whether student achievement on the PMA-S differed between the EIS and traditional groups and whether achievement differed across time. The following research question was investigated: What is the effect of integrating iconic representations through student drawings in conjunction with the enactive, iconic, and symbolic teaching methodology into mathematics instruction on first grade students' spatial reasoning and relational thinking performance?

The study consisted of first grade classrooms from five school districts. Two of the school districts serve between 15,650 and 26,240 students, and three of the districts serve between 600 and 1725 students. There were over 2600 students with Limited English Proficiency (LEP) comprising approximately 8% of the total districts. In these districts, the student demographics were 79.3% white, 10.3% Hispanic/Latino, 5.9% Asian, 3.3% black, 0.9% Native American, and 0.8% Pacific Islander. First, grade classrooms were chosen on the basis of similarly matched demographics related to students who received free and reduced lunch assistance. There were 10 teachers in the EIS treatment group and 12 teachers in the traditional comparison group. The treatment group used the DMTI curriculum [76], and the comparison group used Bridges in Mathematics [77], and Math in Focus, Singapore Math [78].

The Primary Mathematics Assessment [75] is a formative assessment that includes a screener and six diagnostic measures. The PMA-Screener (PMA-S) builds a profile of students' strengths and weaknesses for six dimensions: number sense and sequencing, number facts, contextual problems, relational thinking, measurement, and spatial reasoning.

One of the diagnostics includes a series of questions for shape composition. There are three subsections which include—shape composition without the need to rotate, composing a figure requiring overlapping of pieces during translations, and composing a figure by filling in a missing space.

A two-way design was used to explore the main effects on the different treatments, EIS instruction and Traditional instruction and their interactions under different conditions, pretest and posttest. The research question was analyzed using a 2 × 2 analysis of variance (ANOVA) to explore whether scores on the pre and posttest was dependent upon the type of instruction. Repeated measure analysis of variance (ANOVA) allows a look at change over time using the PMA-S given two times over 9 months of instruction with different conditions (EIS and traditional instruction). Main effects and interactions were analyzed on the independent variables (EIS and traditional instruction and time) from the dependent variable PMA-S scores.

8. Findings

A two-way repeated measure ANOVA was conducted to determine whether there was a significant difference in growth between the EIS group and the traditional group for relational thinking and spatial reasoning. The PMA-S screened four other subset dimensions, facts, context, sequence, and measurement, which were not included in the design of the study.

For the relational thinking subtest, there was a main effect for TIME with a statistically significant difference for both groups (EIS and traditional)—scores increase from pretest to posttest, $F(1, 449) = 105.2$, $MSe = 0.9$, $p < 0.001$. There is also a main effect for groups with a statistically significant difference between EIS and traditional, $F(1, 449) = 5.6$, $MSe = 1.2$, $p = 0.019$.

There was a statistically significant interaction between both groups and time on relational thinking, $F(1, 449) = 13.2$, $MSe = 0.9$, $p < 0.001$, $\eta^2 = 0.03$. This indicates that the difference between the change in students' knowledge of relational thinking in the EIS and traditional groups was dependent upon the type of mathematical instruction. Based on the profile plots of estimated marginal means of relational thinking in **Figure 3**, EIS (group 1) and traditional (group 2), EIS and traditional groups' trajectories indicate different patterns of mean scores over time. The p-value for the two-way interaction effect is <0.001, indicating mean relational thinking changed differently over time depending on whether students were in EIS or traditional.

To better understand the interaction, tests of simple effects were conducted. These results showed for the EIS group, scores on the relational thinking scale increased significantly from pretest to posttest, $t(242) = 10.2$, $p < 0.001$. For the traditional group, scores on the relational thinking scale also increased significantly from pretest to posttest, $t(242) = 4.6$, $p < 0.001$. Thus, for both groups, scores increased from pretest to posttest. The EIS and traditional groups were also compared separately on the pretest and then on the posttest. These results showed that for the pretest, the groups differed significantly, $t(449) = 4.5$, $p < 0.001$. For the posttest, the groups were not significantly different, $t(449) = 0.53$, $p = 0.6$. For the pretest, scores were greater for the traditional group than for the EIS group.

Taken all together, the results of these analyses show that scores on the relational thinking subtest scores did not differ across groups. However, significant

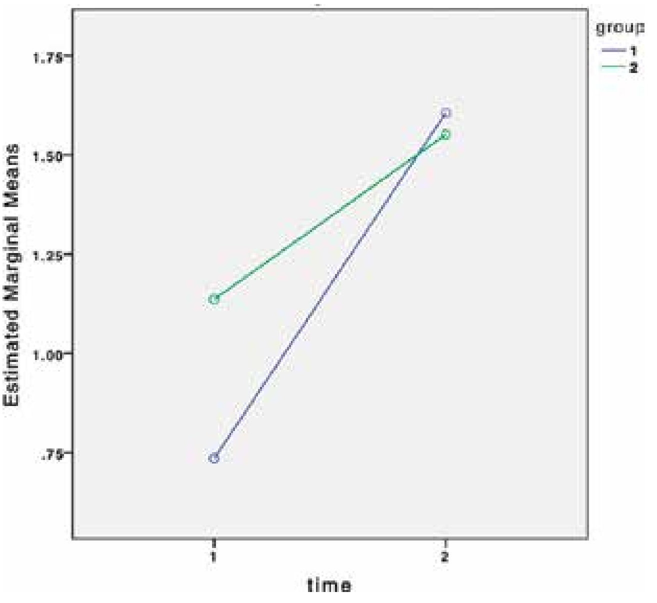

Figure 3.
Estimated marginal means of relational thinking.

interaction suggests that the change from pretest to posttest was not the same for the two groups. As seen in **Table 1**, the change was greater for the EIS group than for the traditional group. The EIS group began the study with significantly lower scores on the relational thinking subtests. The EIS group shows statistically higher gains than the traditional, thus confirming EIS has an effect.

For the spatial reasoning diagnostic, there was a main effect for TIME with a statistically significant difference for both groups (EIS and traditional)—scores increased from pretest to posttest, $F(1, 449) = 85.2$, $MSe = 0.6$, $p < 0.001$. There was also a main effect for groups with a statistically significant difference between EIS and traditional, $F(1, 449) = 3.9$, $MSe = 0.9$, $p = 0.05$.

There was a marginal significant interaction between both groups and time on spatial reasoning, $F(1, 449) = 3.3$, $MSe = 0.6$, $p < 0.071$, $\eta^2 = 0.01$. This indicates that the difference between the change in students' knowledge of spatial reasoning in the EIS and traditional groups was dependent upon the type of mathematical instruction. Based on the profile plots of estimated marginal means of spatial reasoning (**Figure 4**), EIS and traditional groups' trajectories indicate slightly different patterns of mean scores over time.

To better understand the interaction, tests of simple effects were conducted. These results showed for the EIS group, scores on the spatial reasoning scale increased significantly from pretest to posttest, $t(207) = 7.4$, $p < 0.001$. For

Relational thinking				
	Pretest		**Posttest**	
Group	**Mean**	**SD**	**Mean**	**SD**
EIS	0.74	0.77	1.61	1.2
Traditional	1.14	1.1	1.55	1.1

Table 1.
Relational thinking descriptive statistics.

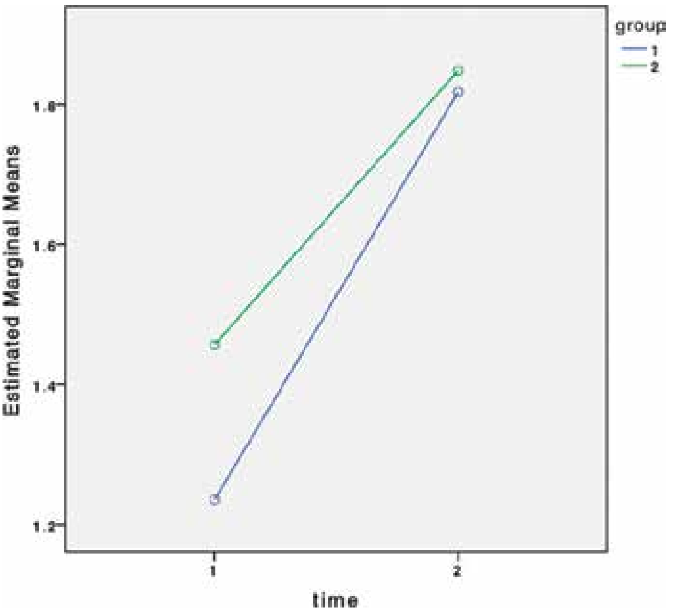

Figure 4.
Estimated marginal means of spatial reasoning.

the traditional group, scores on the spatial reasoning scale also increased significantly from pretest to posttest, $t(242) = 5.5$, $p < 0.001$. Thus, for both groups, scores increased from pretest to posttest. The EIS and traditional groups were also compared separately on the pretest and then on the posttest. These results showed that for the pretest, the groups differed significantly, $t(449) = 2.8$, $p < 0.01$. For the posttest, the groups were not significantly different, $t(449) = 0.36$, $p = 0.72$. For the pretest, scores were greater for the traditional than for the EIS group, and on the posttest, scores were the same across both groups.

Taken together, the results of these analyses show that scores on the spatial reasoning subtest were equal on the posttest across both groups. However, the marginally significant interaction suggests that the change from pretest to posttest was not the same for the two groups. As seen in **Table 2**, the change was greater for the EIS group than for the traditional group. The EIS group began the study with significantly lower scores on the spatial reasoning subtests. The EIS group shows statistically higher gains than the traditional, thus confirming EIS has an effect.

In summary, the instructional method (EIS vs. traditional) did have a significant effect on first grade students' spatial reasoning. The study demonstrated statistical significance between the treatment groups who implemented the EIS instruction and comparison group who used traditional mathematics instruction. The next

Spatial reasoning				
	Pretest		**Posttest**	
Group	**Mean**	**SD**	**Mean**	**SD**
EIS	1.24	0.803	1.82	0.871
Traditional	1.46	0.905	1.85	0.912

Table 2.
Spatial reasoning descriptive statistics.

section will provide details of the interpretation of findings, practical implications for educators, and recommendations for further study.

9. Interpretation of findings

The primary focus of the study was to look at the effects on students' conceptual understandings of relational thinking and spatial reasoning when integrating the EIS representations into first grade mathematics lessons. As Cheng and Mix [8] revealed through their research, the need to integrate spatial reasoning tasks is critical for the development of students' conceptual knowledge. Similar claims can be made based on the results of this study.

The EIS group performed statistically higher in relational thinking than the traditional group, doubling mean scores from pretest (0.74) to posttest (1.27). Previous work has shown students who are instructed to solve equations strictly in symbolic form struggle with algebraic thinking [79]. Integrating EIS representation into first grade mathematics lessons with a balanced set of equations has shown to be effective at developing students' relational thinking and spatial reasoning.

As Cheng and Mix [8] revealed through their research, the need to integrate spatial reasoning tasks is critical for the development of students' conceptual knowledge. Similar claims can be made based on the results from this study. We conclude that the integration of spatial reasoning had positive effects on first grade students' spatial reasoning skills, relational thinking, the development of conceptual understanding, and mathematical competency.

The findings support the notion that the integration of EIS representation into mathematics lessons offers students sufficient conceptual knowledge to develop number operations and mathematical competency [48]. Gain scores in facts and context are found to be consistent with earlier works from Carbonneau and colleagues [61], who suggests mathematics instruction should refrain from isolated skill and procedural practice in lieu of the development of conceptual understanding. Curriculum designed to include a progression of enactive, iconic, and symbolic models supports students' conceptual understanding [2, 62, 63]. Students in the EIS group were instructed to enactively build and iconically represent their math facts simultaneously. In doing so, they increased their conceptual understanding of the mathematics. K-12 reform has included an integration of meaningful lessons designed to enhance algebraic thinking across all mathematical domains, and altering the curriculum to include spatial reasoning tasks has shown to improve mathematical performance [54]. Our investigation has demonstrated a positive effect on students' spatial reasoning, relational thinking, and overall mathematical competency when first grade mathematics lessons integrate EIS representations.

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Chapter 9

Predictors of Early Numeracy: Applied Measures in Two Childcare Contexts

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Abstract

The purpose of the current research was: (1) To assess differences in early numeracy, phonological awareness, receptive language, executive functioning, and working memory for children in two childcare settings (family and center); (2) To determine whether applied measures of phonological awareness and executive functioning could serve as predictors of numeracy performance. Children (N = 89) ranging in age from 39 to 75 months were recruited from state-licensed childcare centers and family childcare homes. Teacher ratings of executive functioning were significantly related to early number skills, phonological awareness, and receptive language, but none of the parent ratings were significantly related to the child scores. The overall model did not differ between center and family childcare children. Phonological awareness was a significant predictor of number skills for both younger and older children. Receptive language skills were the best predictor of early numeracy performance for younger children and the best predictor for older children was phonological working memory measured by a non-words repetition task. These results suggest a connection between children's numeracy skills and a developmental change from receptive language skills to phonological working memory skills.

Keywords: childcare, early numeracy, executive functioning, phonological awareness, working memory

1. Introduction

A strong case exists for the need to understand the relationships between the factors that influence and are influenced by children's understanding of mathematics. Children's mathematics skills at school entry predict future mathematics skills [1], and overall school achievement [2, 3]. It is well known, in fact, that early mathematics skills are usually more powerful than early reading skills in predicting later school success [1, 2, 4]. Perhaps this is because developing skills in mathematics helps children learn certain problem solving and reasoning skills essential for success in other academic areas [5].

In addition to children's mathematics skills linguistic skills play a significant role in their academic success [6–7]. Currently, the connections between mathematics and linguistic skills are not well understood either by researchers or other significant adults in preschool children's lives. For example, parents downplay the role of early mathematics skills and emphasize the importance of preschool children's linguistic skills over their mathematics skills [8] as do family home care providers, [9] and teachers of preschool children [10].

Executive functioning is another influence on children's academic performance, including mathematics and reading [11, 12]. Executive functioning skills are those that direct problem solving and help regulate behavior and are more predictive of academic success than intelligence tests [13].

Given the importance of children's early mathematics skills to their later mathematics achievement [5] and the strong likelihood that early childhood educators can positively influence young children's mathematical development [10] we were interested in examining the predictive relationship of linguistic skills and executive functioning on young children's mathematics performance. Because in the early years much of the research has focused on young children's number skills we will do the same, while recognizing that mathematics includes more than numeracy.

2. Predictors of early numeracy performance

2.1 Phonological awareness

Children's recognition of and facility in using the units of sound that compose language, for example syllables and root words, is called phonological awareness. Phonological awareness is predictive of both children's reading performance [14] and early mathematical performance [15, 16]. How well phonological awareness predicts later mathematical performance varies with task difficulty. For example, both Krajewski and Schnieder [6] and Michalczyk et al. [17] report that phonological awareness directly influenced children's learning of the sequence of number words, but Cirino [18] found it only indirectly influenced more advanced use of number words and small sum addition. In contrast, other researchers have found that phonological awareness is not a better predictor of children's mathematics achievement than other linguistic skills, working memory skills, or counting skills [19, 20]. Given the variability in the research literature the nature and strength of the relationship between phonological awareness and number skills is still in question.

2.2 Executive functioning

The processes and skills that are often classified under the executive functioning umbrella include (a) working memory, (b) ability to shift attention, and (c) ability to focus attention (inhibition control) when planning, solving problems, and acting out goal-directed thoughts [21–23]. Clements et al. [21] suggest that early mathematics influences executive functioning and executive functioning influences early mathematics. If this is the case activities that promote acquisition of early number skills are likely also to promote executive functioning and vice versa.

2.3 Working memory

Working memory is one of the components of executive functioning. However, it is of particular interest because there is evidence that different types of working memory have specific connections to young children's mathematics performance. Rasmussen and Bisanz [24] separated working memory into 3 components and demonstrated that visual and spatial working memory predicted performance on nonverbal arithmetic problems for preschool children. For children in first grade phonological (verbal) working memory was the best predictor of performance on verbal arithmetic problems. In some cases, researchers have included both measures of phonological awareness and working memory and found that each has a unique relationship with number skills. Kleemans, Segers, and Verhoeven [25] found that general intelligence, phonological awareness and grammatical ability were correlated with the operations of addition and subtraction while the working memory measures, including repeating words and sentences and reproducing a visual representation with blocks, were related to subtraction.

On the other hand, some researchers have found no effects or limited effects of phonological awareness on mathematics ability when working memory measures were included. Passolunghi et al. [19] found that working memory and counting predicted first-grade children's performance on a mathematics achievement test, but measures of phonological awareness were not significant predictors.

3. The current study

Much of the current research indicates that both phonological awareness and executive functioning measures, including working memory, predict young children's performance on number tasks. If we can demonstrate that one or both support young children's number skills we can make recommendations about appropriate curriculum and home activities. Therefore, one purpose of the current study was to identify the best predictors of early numeracy performance when parent- and teacher-rated executive function, phonological (verbal) working memory, linguistic skills (receptive language), and phonological awareness are included.

We included a measure of receptive language, which assesses children's understanding of the meaning of language rather than their ability to produce it, because it is possible that children's understanding of the meaning of language is more influential on their number skills than their use and recognition of language sounds (phonological awareness). Although Austin et al. [26] found receptive language predicted children's early number skills they also found this result was likely due to the influence of phonological awareness. In this study we included measures of executive functioning to provide a more stringent test of the influence of phonological awareness.

Many of the measures we used in this study were based on regularly occurring activities in the preschool classroom and home environments. The BRIEF-P [22] is composed of ratings by parents and teachers and was used to assess executive functioning. Executive functioning skills may be enhanced through practice [11, 21] making it even more authentic to assess them in the home and childcare environments where most practice likely takes place. Due to the many connections between phonological (verbal) working memory and mathematical performance [19, 24] we also included a second measure of phonological working memory, the repetition of words and non-words [27].

The PALS (Phonological Literacy Screening) [28] has multiple tasks covering literacy skills that are often taught in preschool settings. If this more ecological measure of phonological awareness is related to young children's early number skills then it would provide the type of information that could assist educators in creating a streamlined curriculum where mutually supportive concepts are taught [29].

Another purpose of the study was to examine the influence of type of caregiving environment. Many children are in out-of-home care, either center care or family childcare. Significant differences have been found between care types regarding school readiness scores (e.g., [26]), caregiver behavior, and the caregiving environment (e.g., [30]). It is unclear whether skills develop differently for children in separate types of childcare. As a result, we wanted to know if the relationships among the measures in this study would differ between setting since their caregiving environments may provide different support for learning number skills.

Our research questions were as follows:

1. Do scores on early numeracy, phonological awareness, receptive language, executive functioning, and phonological working memory differ in this study between children in center care and from those in family childcare?

2. Which of the applied measures (phonological awareness, executive functioning, or phonological working memory) is the best predictor of performance on number tasks? Does the predictor change when looking at different age groups?

4. Method

Demographic information for the child, family, and caregiver was collected. Child information included age, gender, and ethnicity. Family information included partnered status of primary caregiver/parent, age of parent(s), number of children in family, whether the family received state funding/services, parental education, family income, hours worked per week per parent, and primary language spoken in the home. Caregiver information included type of childcare (family or center), years in business, program size, enrollment, and whether the program was non-profit.

4.1 Participants

4.1.1 Children

Eighty-nine children (n = 42 females), 39 to 75 months (M = 54.9, SD = 8) in age, participated in the study. Mean age did not differ significantly between boys (M = 55.43, SD = 8.14) and girls (M = 54.24, SD = 8.00), or between childcare center (M = 55.60, SD = 6.90) and family childcare (M = 53.73, SD = 9.66). Fifty-five children (62%, n = 26 females) came from three state-licensed childcare centers; 34 children (38%, n = 16 females) from eight state-licensed family childcare programs. Seventy-six children (85%) were Caucasian, reflecting the homogeneity of the region. Eight parents (9%) described their child's ethnicity as Latino/Hispanic, Asian/Pacific Islander, or 'other.' Five parents (6%) declined to report child ethnicity. Seventy-eight children (88%) spoke English as a first language.

4.1.2 Parents

The education level of both parents was higher for center care families (Mothers center care: M = 1.94, SD = 99, Mothers home care: M = 0.78, SD = 0.19, $t(73)$ = 4.9, p = 0.001; Fathers center care: M = 2.09, SD = 1.07, Fathers home care: M = 1, SD = 0.23, $t(60)$ = 3.73, p = 0.001), and fathers of center care children (M = 38.42, SD = 8.04) were older than fathers of family care children (M = 32.47, SD = 5.49, t (41) = 2.67, p = 0.05). Parents of children in family care programs worked more hours, per week, on average however the difference was not significant. Yearly family income did not differ between center and family care families and ranged between \$30,000 and \$50,000.

4.1.3 Caregivers

Thirty center and family childcare programs were approached about participating in the study: 77% agreed to participate. The children that met participation criteria were from the three childcare centers and eight of the 20 family childcare programs. The three childcare centers that participated averaged almost 30 years (range: 2–81 years) in operation, the average capacity was 90 children (range: 45–173), and the average career ladder level was 6.33 (range: 0–10), 10 being the highest possible, with level determined by training participation. One center was accredited by the National Association for the Education of Young Children (NAEYC).

The 8 family childcare programs that participated averaged 12.25 years (range: 4–24 years) in operation and the average career ladder level was 8.5 (range: 6–10). Three programs were accredited by the National Association for Family Child Care (NAFCC).

4.2 Measures

4.2.1 Parent and caregiver measures

Behavior Rating Inventory of Executive Function-Preschool Version (***BRIEF-P***): The BRIEF-P [22], is an age- and gender-normed clinical measure designed to be completed by the child's parent/guardian and/or out-of-home caregiver, with 63 questions distilling to five subscales: Inhibit, Emotional Control, Shift, Working Memory, and Planning and Organizing. Each subscale has a summary score, with higher scores indicating more concerns about behavior. Gioia et al. [22] reported internal consistency for the composite score (parents: 0.95; caregivers: 0.97), correlation between parents and caregivers ($r = 0.17$, $p < 0.01$), and test-retest reliability (parents: 0.90; caregivers: 0.88).

4.2.2 Individually administered child measures

Phonological Awareness Literacy Screening, Pre-K (***PALS***): PALS [28] is an assessment of phonological awareness in eight areas: name writing, upper-case and lower-case alphabet recognition, letter sounds, beginning sound awareness, print and word awareness, rhyme awareness, and nursery rhyme awareness. Cronbach's alphas range from 0.75 to 0.93.

Peabody Picture Vocabulary Test-Third Edition (***PPVT-III***): The PPVT-III [31] measures receptive vocabulary abilities for children as young as 2 years 6 months old. Children are shown four pictures simultaneously and asked which picture best represents a certain word. Reported split-half reliability is 0.94.

Test of Early Mathematics Ability, Third Edition, Form B (***TEMA-3***): The TEMA-3 [32] is an assessment of children's verbal and nonverbal numerical knowledge (age: 36–107 months), with items for young children (e.g., nonverbal problem solving, counting small numbers of objects, cardinality, etc.) and for older children (e.g., writing single-digit numerals, simple word problems, magnitude comparisons, etc.). Reliability (0.80–0.90) and criterion validity correlations with other norm-referenced mathematics scales (0.54–0.91) have been reported.

Phonological Working Memory: Two direct, verbal assessments of children's phonological working memory were used, each with five one-, two-, and three-syllable words, for a total of fifteen real words and fifteen non-words [27]. Hereafter, the real words measure will be referred to as the real words repetition task and the made-up words measure will be referred to as the non-words repetition task.

First the real words repetition task was presented, then the non-words repetition task. The assessor told the child 'I will say a word and I would like you to repeat it.' If the child had a problem with immature articulation, this was taken into consideration. The reliability for this study was 0.80.

4.2.3 Assessment protocol

Three graduate students individually assessed children at the child's out-of-home care program. Training meetings were held to discuss assessment administration and to recognize test fatigue. The same graduate student administered all assessments with a particular child in two sessions within a one-week time frame. The order of exposure to assessments was randomized based on child preference (in order to maximize cooperation, the child was asked whether they wanted to do numbers or letters first).

5. Results

The results are organized by research question. Because our outcomes variables were raw and not age normed, age was a covariate in our models. For descriptive statistics for child measures by gender and childcare type, see **Table 1**. For correlations between variables, see **Table 2**.

	Childcare centers (n = 55)			**Family childcare (n = 34)**		
Variable	**Boys (n = 29)**	**Girls (n = 26)**	**Overall**	**Boys (n = 18)**	**Girls (n = 16)**	**Overall**
TEMA-3 (standard)						
M	100.46	104.31	102.31	98.94	91.19	95.18
SD	13.19	12.58	12.92	17.88	12.29	15.69
PPVT-III (standard)						
M	110.04	104.81	107.52[a]	105.12	98.56	101.94[a]
SD	16.53	11.05	20.62	10.09	13.90	12.35
PALS (total raw)						
M	66.89	75.31	71.02[a]	63.78	42.56	53.79[a]
SD	34.14	34.07	34.04	41.26	35.19	39.44
Verbal Working Memory (raw)						
M	28.61	28.42	28.52[b]	26.17	27.56	26.82[b]
SD	1.52	1.58	1.54	3.94	1.86	3.18
BRIEF-P Planning & Organizing/Working Memory (raw)						
M	32.48	30.35	31.47[b]	42.85	35.75	39.44[b]
SD	8.13	5.15	6.91	12.27	6.80	10.50

[a]Means *differ at* p *0.05.*
[b]Means *differ at* p *0.01.*

Table 1.
Descriptive statistics for child measures by gender and childcare type.

DOI: http://dx.doi.org/10.5772/intechopen.81065

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Child age	—																			
2. Gender	−0.08	—																		
3. Center or home	−0.11	−0.00	—																	
4. Marital status	0.10	0.04	-0.26^{*}	—																
5. Mother age	0.23	0.02	-0.28^{*}	0.25	—															
6. Mother workweek	−0.17	−0.01	0.10	−0.15	−0.13	—														
7. Father age	0.23	−0.02	-0.39^{*}	0.10	0.87^{***}	−0.09	—													
8. Father workweek	0.11	0.23	0.21	−0.03	0.09	−0.07	−0.02	—												
9. # Siblings	0.03	−.09	−.14	0.19	0.42^{**}	−0.01	0.48^{**}	−0.14	—											
10. Subsidy	−0.04	−.09	0.15	-0.58^{***}	−0.25	−0.16	−0.22	−0.26	−0.08	—										
11. Mother education	0.13	−.08	-0.50^{***}	0.20	0.35^{**}	−0.13	0.31^{*}	−0.10	0.01	-0.48^{***}	—									
12. Father education	0.13	−.02	-0.43^{***}	0.21	0.58^{***}	−0.03	0.53^{***}	0.05	0.28^{*}	-0.38^{**}	0.71^{**}	—								
13. Income	−0.01	0.11	−0.20	0.68^{***}	0.51^{**}	0.16	0.58^{**}	0.15	0.41^{**}	-0.72^{***}	0.45^{**}	0.53^{**}	—							
14. TEMA	0.72^{***}	−0.05	−0.18	−0.04	0.19	−0.14	0.20	0.25	0.07	0.01	0.20	0.36^{**}	−0.00	—						
15. PPVT	0.55^{***}	−0.21	−0.21	−0.01	0.20	−0.01	0.19	0.02	−0.10	−0.10	0.38^{**}	0.41^{**}	0.02	0.70^{***}	—					
16. PALS	0.49^{***}	−0.04	-0.23^{*}	−0.04	0.13	−0.07	0.13	0.22	−0.08	−0.08	0.25^{*}	0.33^{*}	−0.01	0.73^{***}	0.64^{***}	—				
17. Verbal WM	0.27^{*}	0.09	-0.34^{**}	−0.05	0.40^{**}	0.03	0.52^{***}	−0.06	0.23^{*}	0.23^{*}	0.19	0.29^{*}	0.06	0.44^{***}	0.43^{***}	0.42^{***}	—			

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
18. Teacher BP WM	−.10	−0.19	0.39***	−0.22	−0.07	0.17	−0.07	0.04	−0.16	−0.16	−0.39**	−0.28*	−0.15	−0.22	−0.06	−0.13	−0.09	—		
19. Teacher BP PO	−0.19	−0.16	0.38**	−0.25*	−0.27	0.22	−0.25	0.06	−0.18	0.19	−0.42***	−0.38**	−0.21	−0.29*	−0.08	−0.18	−0.19	0.82***	—	
20. Teacher BP P&O/WM	−0.15	−0.21	0.42***	−0.19	−0.22	0.17	−0.27	0.05	−0.20	.024	−0.43**	−0.37*	−0.17	−0.29**	−0.09	−0.20	−0.27*	0.86***	0.94***	—

*p *0.05*

**p *0.01*

***p *0.001.*
Note: Raw scores used.

Table 2.
Correlations between variables.

5.1 Question 1: Do Children's scores differ by care type on early numeracy, phonological awareness, receptive language, EF, and WM measures?

Teacher BRIEF-P, but not parent scores, were significantly related to the TEMA-3, PPVT-III, and PALS; therefore, parent BRIEF-P scores will not be discussed further. Correlations between phonological working memory and the BRIEF-P working memory subscale were not significant, suggesting the measures assess two separate aspects of memory.

A 2 (Gender) X 2 (Caregiving Type) ANOVA was run to determine significant differences in children's scores on all measures. The main effect of gender was significant for PPVT-III standardized scores, $F(1, 87) = 3.92$, $p = 0.05$, with boys' scores significantly higher. The main effect of caregiving type was significant for: PALS, $F(1, 86) = 5.16$, $p = 0.03$; PPVT-III, $F(1, 87) = 4.13$, $p = 0.05$; phonological working memory, $F(1, 87) = 10.79$, $p \leq 0.001$; and BRIEF-P Working Memory/Planning & Organizing, $F(1, 79) = 14.39$, $p \leq 0.001$, with childcare center scores significantly higher for PALS, PPVT-III, and phonological working memory. BRIEF-P scores were significantly higher for children in family childcare, with higher values indicating more concerns. The interaction (Gender X Caregiving Type) was not significant for any of the measures. No significant differences were found between English-First-Language children and ESL children ($n = 3$) for any of the measures used.

5.2 Question 2: Which of the applied measures (phonological awareness, executive functioning, or phonological working memory) is the best predictor of numerical performance? Does the predictor change when looking at different age groups?

Since the BRIEF-P Working Memory and Planning and Organizing subscales were highly correlated, the two scales were combined according to the BRIEF-P protocol. For clarity of communication, we will refer to this combination as BRIEF-P Working Memory/Planning & Organizing subscales. Raw scores were used for all variables and age was corrected within the models.

5.2.1 Predictors of early numeracy performance

Regression analyses using the enter method were performed to determine which linguistic and working memory measures predicted TEMA-3 performance and to determine if care type was a significant predictor (see **Table 3** for regression results). All four models indicated a significant effect: Model 1, including age, care type, BRIEF-P Working Memory/Planning & Organizing subscales, and real words repetition task; Model 2, which substituted non-words repetition task for the real words repetition task; Model 3, which added PPVT-III; and Model 4 which included PALS. The best fit was Model 4 and accounted for 76% of the variance in TEMA-3 performance, with age ($t[71] = 4.60$, $p < 0.001$), PPVT-III ($t[71] = 2.45$, $p < 0.05$), and PALS ($t[71] = 4.95$, $p < 0.001$) as significant predictors.

5.2.2 Differences between age groups

We separated our sample into two groups by age (see **Table 4** for regression results). The younger group ranged in age from 39 to 55 months ($n = 44$, $M = 48.14$, $SD = 4.75$); the older group ranged in age from 56 to 75 months ($n = 44$, $M = 61.59$, $SD = 4.00$). Regressions were performed to explore differences between outcome variables for the two age groups. Using the enter method we found Model 1 and

Variable	B	SEB	β	R^2	adjusted R^2	F for change in R2
Model 1				0.57	0.55	32.74*
Age	0.76	0.09	0.68*			
Teacher WM/PO	−0.16	0.08	−0.17**			
RWRT	1.12	0.61	0.14			
Model 2				0.58	0.56	34.44*
Age	0.72	0.09	0.63*			
Teacher WM/PO	−0.16	0.08	−0.16**			
Non-Words Repetition Task	1.01	0.42	0.19**			
Model 3				0.68	0.66	39.33*
Age	0.50	0.09	0.44*			
Teacher WM/PO	−0.17	0.07	−0.17**			
Non-Words Repetition Task	0.45	0.39	0.08			
PPVT	0.17	0.04	0.40**			
Model 4				0.76	0.75	46.41*
Age	0.39	0.08	0.34*			
Teacher WM/PO	−0.10	0.06	−0.10			
Non-Words Repetition Task	0.28	0.35	0.05			
PPVT	0.09	0.04	0.20**			
PALS	0.10	0.02	0.42*			

*$p < 0.001$.
**$p < 0.05$.

Table 3.
Regression analyses with all ages combined for variables predicting the TEMA.

Model 2, which included the executive functioning measures, was only significant for the older group. Model 3, which added the PPVT-III, was significant for both groups. Model 4 added the PALS total score and provided the best fit for both age groups.

6. Discussion

Our first research question was: Do scores on early numeracy, phonological awareness, receptive language, EF, and working memory differ between children in center care and those in family childcare? The answer to this question was yes. The center care children performed better on the PALS, PPVT, and Phonological Working Memory and scored significantly lower on the BRIEF-P, a measure where higher values indicate more problems. This result is typical of other studies conducted in the United States. Such differences have been attributed to the limited number of materials found in family childcare and to differences in the quality of caregiver behaviors [30]. In this study the difference in scores might also be attributed to the higher level of education for center care parents.

Our second question was: Do applied measures of phonological awareness, executive functioning, and phonological working memory predict early numeracy performance? The best predictors of early numeracy performance when both age groups were combined were the linguistic measures of receptive vocabulary and

Variable	B	SEB	β	R^2	Adjusted R^2	F for change in R2
Younger age group (age M = 48 months, range 39–55 months)						
Model 1				0.06	0.01	1.10
BRIEF-P WM/PO	−0.14	0.11	−0.21			
RWRT	0.36	1.04	0.06			
Model 2				0.10	0.05	1.90
BRIEF-P WM/PO	−0.12	0.11	−0.19			
Non-Words Repetition Task	0.71	0.56	0.21			
Model 3				0.53	0.49	12.95***
BRIEF-P WM/PO	−0.15	0.08	−0.24			
Non-Words Repetition Task	−0.08	0.43	−0.02			
PPVT	0.21	0.04	0.69***			
Model 4				0.65	0.61	15.69***
BRIEF-P WM/PO	−0.10	0.07	−0.16			
Non-Words Repetition Task	−0.16	0.38	−0.05			
PPVT	0.126	0.041	0.41**			
PALS	0.09	0.03	0.46**			
Older age group (age M = 61.59 months, range 56–75 months)						
Model 1				0.24	0.19	5.7**
BRIEF-P WM/PO	−0.19	0.16	−0.17			
Non-Words Repetition Task	3.02	0.94	0.46**			
Model 2				0.28	0.24	7.11**
BRIEF-P WM/PO	−0.12	0.16	−0.11			
Non-Words Repetition Task	3.11	0.86	0.51**			
Model 3				0.42	0.38	8.83***
BRIEF-P WM/PO	−0.16	0.14	−0.14			
Non-Words Repetition Task	2.08	0.85	0.34*			
PPVT	0.21	0.07	0.42**			
Model 4				0.61	0.56	13.30***
BRIEF-P WM/PO	−0.04	0.13	0.03			
Non-Words Repetition Task	1.53	0.75	0.25*			
PPVT	0.09	0.06	0.17			
PALS	0.13	0.03	0.52***			

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

Table 4.
Regression analyses with separate age groups for variables predicting the TEMA.

phonological awareness. Further insight into the relationships between the predictor measures and children's numeracy performance is informed by the analyses that looked at the two age groups separately. As would be expected, younger children scored lower on the TEMA, PPVT, and PALS than the older children. Using numeracy performance (TEMA) as the outcome variable only the PPVT and PALS accounted for a significant proportion of the variance for younger children. However, for the older children, who were passing more advanced numeracy items on the TEMA, the PPVT was no longer significant, but instead the PALS and the non-words repetition measure were significant. This suggests that receptive language is more influential for lower level number tasks, but not more advanced tasks. Examples of lower level number tasks on the TEMA were nonverbal items, counting small numbers of objects, and answering questions about cardinality for small numbers. Higher level number tasks involved using number symbols, solving simple addition problems, and comparing numbers to make decisions about size. It appears that as children get older and are able to succeed on more advanced number tasks receptive language accounts for less variance while phonological awareness (PALS) and phonological working memory (non-words repetition task) account for more variance.

Of the three measures of phonological working memory only the non-real words repetition task was predictive of older children's numeracy performance. The real words repetition task, non-words repetition task and the Teacher-rated BRIEF-P subscale of Working Memory were not significantly correlated suggesting that they each tapped different characteristics of phonological working memory. This variation is not surprising given that the BRIEF-P rating is based on the teacher's impression across the weeks and months of working with the child while both the real words repetition and the non-words repetition tasks are on-the-spot measurements based on the child's accuracy at that moment. It is also the case that the non-words repetition task is carefully designed to include certain combinations of language sounds rather than actual words and that is not the case for the Brief-P subscale of working memory.

The non-words repetition task is frequently used to assess language acquisition, and to diagnose and understand the characteristics of language impairment because it measures both phonological working memory and several other phonological components that underlie the learning of words [33]. Success on the non-word repetition task requires children to identify the units of speech (phonemes) that compose words and depends on recognizing the lawful combinations of language sounds. A bi-directional relationship between receptive vocabulary and the non-words repetition task exists with the skills measured by the non-words repetition task supporting vocabulary growth up to age 5. By age 5 children's vocabularies have reached sufficient size to support the skills of identification of language units, processing and combining language sounds that the non-words repetition task measures [33].

Our results are consistent with the literature on the relationship between receptive vocabulary and the non-words repetition task. The shift from the PPVT predicting younger children's number skills to the non-word repetition task predicting older children's number skills occurs at about the same time that receptive vocabulary more strongly supports the skills measured by the non-words repetition task. One possible explanation is that the concept of a unit is common to both phonological working memory and number skills. As children are improving in their identification and use of language units their number skills, which are also based on understanding units [34], are also improving. Another possible explanation is that a larger vocabulary contains more advanced words, which supports both phonological working memory and number skills. Although the PPVT does not include many words that are specific to number it is possible that as children's vocabularies grow that more number words are included. Purpura and Logan [35] found that a number specific vocabulary predicts young children's number performance. It is not possible to select from these explanations, or other possibilities based on our research. Further research is needed to examine the relevance of the connection between the non-word repetition task and children's number skills.

7. Implications for curriculum

We agree with Krajewski and Schneider [6] that phonological awareness and early number skills should be taught together early in the preschool years in order to reinforce skill development. An added bonus, as noted by Krajewski and Schneider, is that phonological awareness skills are also necessary to the development of reading so early exposure facilitates the development of two key skill domains. Additionally, it appears from the work of Chu et al. [36] that both numeracy and preliteracy skills, such as recognition of the alphabet in preschool, predict achievement in numeracy and reading by the end of kindergarten. A strong case is emerging for the importance of learning about numeracy in preschool in order to support the development of both numeracy and reading.

With respect to executive functioning, especially phonological working memory, we agree with Clark et al. [11] and Clements et al. [21] that intentional training and practice, presented in a developmentally appropriate way, could scaffold children's development of the executive functioning skills that are specifically geared to learning number skills. Phonological working memory involves remembering the units of language. As children become more proficient with phonological awareness moving to an emphasis on explicit identification of the units of language is appropriate.

7.1 Influence of type of childcare setting

Type of childcare setting is a demographic characteristic not often included in research on children's number skills. While there were significant differences between program types for children's scores, there were no differences in the predictors for type of childcare setting. The same patterns held for both center and family childcare children. This particular finding has never before been reported in the literature, to our knowledge and suggests that the same types of training and curriculum are likely to be effective for children in both settings.

7.2 Applied measures

Many studies use laboratory measures for phonological awareness and executive functioning. Our work demonstrates that applied measures of phonological awareness and executive functioning which are composed of activities that could be observed or implemented by teachers serve as predictors of early numeracy performance. Both the PALS and BRIEF-P are measures that can be used by teachers, and our discussion of curriculum implications above indicates how the information gained from these measures could help teachers plan both curriculum and intervention. The measure of phonological working memory, the non-words repetition task, is one that can also be readily understood by teachers and used as the basis for classroom activities.

8. Limitations

There are several limitations to this study. First, the sample was cross sectional in nature. It would be beneficial to study the same children over a period of time to see the impacts that developmental changes in phonological working memory, executive functioning, receptive vocabulary, and phonological awareness have on number skills and vice versa.

Another limitation is the fact that the childcare center children were drawn from just three centers, limiting the independence and variability of this subsample. The family childcare sample was a bit more variable with children recruited from eight family care programs. However, in the region of the country in which this study took place family care programs are more plentiful than childcare centers. Many parents have a strong personal preference for family childcare over childcare centers, believing that it is preferable to find a family childcare provider whose values align with those of the family. Conducting similar research in another region is an important step in replicating our results.

A final limitation might have been our sample size and lack of statistical power to detect small effects. We might not have had sufficient statistical power to detect smaller relationships.

9. Conclusions

Best practices for encouraging the development of preschool mathematics are still emerging. The National Mathematics Advisory Panel [29] expressed concern that some preschools and childcare programs emphasize isolated, unconnected skills that do not support early mathematics development as well as other strategies. They argue for a developmental approach with curriculum progressing logically from less sophisticated topics into more sophisticated ones. Understanding the relationships between early mathematics development and other cognitive domains can improve our understanding of how young children develop foundational mathematical skills; likely identifying areas that use similar strategies [21].

Our work contributes to understanding the connections between young children's number skills, their linguistic skills, and executive functioning. The PALS, a measure of phonological awareness, predicted both the younger and older children's number skills. It was significant in all combinations of predictors and for both age groups. This result replicated the work of others who have reported the effect of phonological awareness on children's number skills [6, 17, 18].

Additionally, our results demonstrate that receptive language is a closely related influence on younger children's number skills. However, this pattern changed for older children and one of the components of executive functioning, phonological working memory, was more influential than receptive language on their number skills. The predictive relationship between the non-words repetition task and older children's number skills indicates that similar skills are involved. One likely candidate is the concept of a unit.

Although the children attending family childcare scored lower on many measures there was no evidence that the relationships between phonological awareness, executive functioning, and number skills differed so the same curricular approaches should work for both. Curricular support for building children's vocabulary and discrimination of language sounds could provide the foundation needed for the further development of phonological memory [33] and number skills. In addition, curriculum for older preschool children could focus on acquisition of units of language and as well as units for counting and for measuring.

The successful use of applied measures in this study provides a promising pathway for future research examining the connections between young children's number skills, linguistic skills, and executive functioning. In addition, the use of behaviors that can be easily observed by teachers makes it easier to provide useful guidance for improving education for early childhood teachers and parents.

Acknowledgements

We thank the Utah State University Agriculture Experiment Station for their support. Thanks to the parents, children, and providers who participated in this study, to Krista Gurko and Alexander Fronk who assisted with data collection, Roxane Pfister for assistance with data analysis.

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Chapter 10

Black Students' Rich Mathematical Experiences: Mathematics Concepts and Xhosa Cultural Games for Reception Class

Nosisi N. Feza

Abstract

Poor mathematics performance and low socio-economic status variables in South Africa are skewed towards a black child due to the history of colonization and apartheid. These variables then become labels that nurture assumptions that mathematics is for the elite and belongs to the West, and therefore these students' mathematical prior knowledge and experiences are ignored. Mathematics is a problem-solving tool. Disregarding mathematics learnt from cultural artefacts and community engagements due to socio-economic status is disempowering. Such symbolizes power of privilege that recognizes Western culture versus lack of property ownership experienced by Africans, which unconsciously translates to lack of confidence in their own heritage. This paper presents and explores cultural games played by these students during playtime and in their communities with the aim of eliciting mathematics embedded and attained while engaging in the game. The paper recommends cultural relevant pedagogy that integrates mathematics learning with students' cultural artefacts for ownership of knowledge and recognition of pluralism for economic and development initiatives globally.

Keywords: cultural games, inclusion, cultural relevant pedagogy, critical race theory, ownership, esteem

1. Introduction

Distancing mathematical knowledge to a certain group of children and human beings has history. Mathematics in the past was only learnt by monks and noblemen. With time, traders participated due to discoveries they observed in different cultures and because of status they obtained through trading [1]. Even then, some cultures' mathematics were recognized and documented, while others were labelled as applied mathematics giving them a lower status than pure mathematics. This discriminatory behaviour still exists in the field and continues to exclude. South African black children like all children in the world experience mathematics from their mother's womb, where they explore and navigate such space to a level where they know and feel safe in it. The loud cry they make during birth is caused by the realization that the new space is cold as they feel the temperature, they also feel that it is big as they are unable to touch, and then as soon as they are picked up and wrapped, they feel safe again. This indicates the exploratory nature of the human being and their spatial abilities. However, the society enters this life and starts undermining and discriminating what is already there by grouping children according to their geographical existence, race and socio-economic status.

It is difficult not to align these discriminatory behaviours with entitlement, privilege and property ownership [2]. These mathematical intuitions develop naturally for children; they start engaging in games that use mathematical abilities. Ref. [2] uses critical race theory to analyse these experiences of exclusion adjourning from land rights and ownership of land. Landson-Billing proposes using US law that ownership of land goes a long way in developing one's identity in the society. Land ownership seems to be physical; however, it contributes heavily on the psychological being and esteem of human beings. Hence, black children's games are excluded in the society because this group of human beings has no privilege, no property ownership nor esteem. Since, they are already excluded these games are never brought into class because whose games are they, matters in the discriminatory society. This is a global issue because cultural games that are recognized are those from the West such as chess because of white privilege, while on the other hand, there are African games like "umrabaraba," a logical game that was used during trade in Africa. There are other logic games such as stick fighting of the Xhosa boys and girls in South Africa. Their character is similar to those that are globally recognized but carry no property right with them and therefore excluded. This exclusion translates to classrooms where children enter classrooms labelled by default that they have no mathematical skills and knowledge from their communities and therefore learning provided to them is not connected with their mathematical knowledge they bring to school.

Hence, only if they are resilient will they succeed in mathematical learning; otherwise their self-esteem and identities are not integrated with mathematical creation [3]. This paper aims to bring forth the cultural games played by Xhosa children with their mathematical skills and the knowledge they develop.

2. Mathematical exclusion

Ref. [4] gives detail account on mathematics exclusion of young black children in South Africa. In her paper she revealed that classrooms are not resourced for mathematics stimulation for young children rather they are boring formal classrooms for adults. In addition, her paper highlights that teacher qualifications are informal and vary in terms of quality with high learner-teacher ratio. These findings are supported by [5] revealing that learners from low socio-economic backgrounds attend schooling in low socio-economic schools with no resources and teachers with inadequate qualifications for mathematics teaching. Ref. [3] list a number of "vulnerabilities" South African black and coloured students possess that hinders success in learning mathematics such as homes with no resources, schools with no resources, peers with similar challenges and language of instruction not the same as home language (p. 355). These studies show how exclusion in mathematics learning is systemic.

A commissioned review of early childhood provision in South Africa revealed that the history of segregation played a significant role in excluding young children in quality mathematics instruction [6]. In addressing this injustice post 1994, the South African government through social development opened preschools for black children with a focus of care and social development. This provision did not provide for mathematics stimulation but focused more on welfare addressing poverty. The positive outcome from this review were the universality of the reception class which assured that all 5- to 6-year-old students receive stimulation to date. The current challenge though is that teachers who teach these students are informally trained with varied quality of training by non-governmental organisations; hence, their classroom practices lack quality and purpose [4, 7, 8]. This indicates that education system drags itself in addressing issues of inequities in the education. This slow movement is resulting to graduates of poor quality that are also unemployable. This issue is an emergency as it is an economic factor that will scar the system for a long time and lead to more poverty experiences; currently the job losses per day are increasing, and the buying power is decreasing heavily.

It is important to note that the poor quality of teaching students receive is not the only factor of exclusion. Their cultural experiences also are not regarded as contributing knowledge to the mathematical learning experiences. Furthermore, English continues to have power over learning in general; hence, mostly language is becoming a barrier towards excellent performance for those who learn in language different than their own. A summary of literature that discusses the language exclusion in mathematics teaching and learning is discussed and shared below.

2.1 Language exclusion

Trends in International Mathematics and Science Study (TIMSS) 2015 results indicate clearly that students who write test in their spoken language at home perform far better than those who are tested in a foreign language. [9] revealed a significant difference of ($p = .008$) that was observed between a group of students whose proficiency in English was nurtured in an intervention and those who were in the control group, an indication that English holds a key towards successful access to mathematics learning for students. These findings reveal already that students with home language other than English are automatically excluded from learning; hence, an added challenge to them is to be proficient in English. This relationship between English language of instruction and students' proficiency in English has been highlighted in the US research too for students whose home language is not English [10–13]. Student participation and comprehension in mathematics learning are hindered by poor English fluency, and it impedes engagement with mathematical ideas [14, 15]. Hence, poor fluency in English excludes students from mathematics successful experiences. Ref. [16] asserts that language is a socio-cultural tool that allows students to gain access to ideas. This socio-cultural tool develops as an external tool while the child is born. Through interaction and observations with adults, the child begins to internalise vocabulary s/he hears; in doing so this, vocabulary becomes an internal tool to use to engage. Vygotsky then argues that when this vocabulary is used, it is no longer an external tool but an internal one. All children gather this language tool from their immediate environments and from their homes, and this tool becomes their cultural capital [17]; they use to make sense of the world. [18] highlights the importance of language in teaching and learning mathematics; they mention that the use of sociocultural theory in teaching mathematics is highly important as it embraces the language of the student and make connection for successful learning.

South Africa is one of the countries that has tried to address the language issues of multilingualism. However, the country struggles to align its language policies with the practice for the benefit of the students. [36, 28] revealed how South African young children get exposed early to English numeracy. This creates challenges to the teaching as educators who teach these students also lack foundational mathematics language in their own home languages similar to the students [36]. These are the results of the South African apartheid system that created deeper wounds to the education of the black child. The identity of teachers that has been determined by fluency in other people's languages such as Afrikaans and English has created teachers who are not proficient in any language as their home languages were never used as cultural capital. Research cannot only focus on students when addressing language proficiencies; teachers also need intervention that can develop their esteem and pride of their home languages too.

2.2 Racial exclusion

Ref. [19] asserts that race is overlooked when discussing challenges observed in mathematics performance. This paper supports this assertion by supporting it with empirical evidence. For example, South Africa started participating in the TIMSS study in 1999 observing the trends of reporting the challenges of poor performance that were aligned with disadvantage learners, overcrowded classrooms and lack of resources [20]. However, revisiting these findings the students who were in overcrowded classrooms, disadvantaged and in schools with no resources were all black. The next trend of reporting this participation again highlights inequities and lack of foundational knowledge due to poor early mathematics exposure [21]. Again who were the learners who were mostly affected by the inequities, who lack foundational knowledge and also are exposed to poor mathematics instruction? The response is again black students. The 2011 and 2015 TIMSS findings did not bring anything different; although again race is not mentioned, the same black students are the ones who continue to perform poorly. Ref. [22] argue that within mathematics learning and research, there is a silent privilege that needs to be exposed. Critical race theory unravels and unpacks how white privilege continues to close access and opportunities to those who are non-white. Also it unravels how this privilege prevails through entitlement and unfounded generalisations that align whiteness automatically with success.

In the context of South Africa, research is taking too slow in unravelling racial issues that are highly embedded on educational practices including methodologies used to address educational issues. South Africa has top performing students in the National Certificate that come from low social backgrounds studying in under- or unsourced schools. However, these students repeatedly demonstrate that resilience is innate to them and therefore poverty, and discrimination cannot impede their performance. Research needs to tap on these students' traits and learn from them the qualities that they possess to be able to nurture other students from similar backgrounds.

Therefore, this racial exclusion demands more research to be conducted. This paper will only contribute by exposing black children's cultural games that have potential to nurture and influence black learners' identities within mathematics learning and experiences. By doing this it is encouraging more exploration of cultural artefacts and practices that influence mathematical growth and thinking.

2.3 Economic exclusion

Students reject a school science that is disconnected from their own lives, a depersonalized science, where there is no space for themselves and their ideas (p. 13).

The UNESCO [23] shared the above quote with the aim of asserting educators and researchers that scientific knowledge that does not align with one's experiences and thought has no place in students' conceptualization of the world they want to conquer. The global community faces challenges of attrition of scientists due to the fact that only the elite and the haves receive quality stimulation, while the majority who lives under poor socio-economic situation are deprived from such experiences.

Socio-economic variable has rooted itself in the centre to obstruct or allow quality mathematics experiences. Internationally, research has revealed how the socio-economic variable plays a significant role in the provision of quality mathematics instruction. Lack of resources generally indicates economic exclusion. This economic exclusion begins from home where parents are sometimes jobless or earn below poverty levels. Ref. [24] states that this variable is a cruel unjust variable. Lack of resources for learning influences the quality of mathematics instruction negatively [25–27]. In addition, [28] reveal that quality educators highly influence mathematics learning of students from low socio-economic homes. This finding argues for quality human resources to be provided to all students for mathematical experiences that are successful. Refs. [29, 30] describe quality mathematics teachers as teachers with excellent content knowledge of mathematics, who have insight into mathematics progression and who are able to develop self-regulation in students.

The best performing countries in the world make sure that they choose the best performing graduates to join teaching [31]. This also means that these teachers will earn equally with their colleagues in other fields. Countries that perform poorly do the opposite. If providing students with high-quality education has the gains, research has already been proven. Why do systems continue treating education as a "Cinderella" of the systems? Economies need engineers, scientists, innovators and inventors who will produce those high-skilled citizens if the teacher in the classroom is not a high performer him- or herself. Educational systems need to be reflective and truthful to themselves if growth is the agenda of their missions. Otherwise, the current practices look like they are planned and have a purpose that is negative to the societies.

3. Capital-/asset-based approach in teaching and learning of mathematics

Refs. [24, 32, 33] have proven that young students have demonstrated that they have high capabilities in mathematics regardless of their socio-economic background, ethnicity and geographical origins. These researchers propose the use of students' capital/assets in nurturing mathematics knowledge. Capital/asset refers to their ways of knowing and communicating and experiences that are mathematical and have been ignored. Ref. [34] indicates that there are diverse mathematical experiences from different cultures that nurture mathematics in early ages. Some cultures develop spatial reasoning first through hunting, while others develop measurement concepts through construction, and others develop diverse concepts through games, etc. If this is the case, tapping into these diverse mathematical experiences and heritage is more capacitating for students from these cultures. It develops ownership of mathematical knowledge and allows for more creation and activity. Ref. [35] argues that drawing knowledge from the students' languages and cultural-rich knowledge when teaching them creates healthy nurturing learning environments. Such environments will create spaces where mathematical creation of knowledge belongs to all, and the disadvantaged groups of students will take active participation in such creation and bring forth diverse-rich innovations in mathematics. This chapter focuses on exploring the cultural capital of Xhosa students in the Eastern Cape of South Africa. While doing so it also presents the mathematics embedded in the cultural games explored.

A lot of research has been conducted under ethnomathematics trying to find cultural experiences with mathematics. However, mathematics knowledge was not exposed, and that resulted in integration that had some flaws. The focus was the cultural practices than the mathematics embedded in them [17]. Teacher empowerment becomes very important in understanding play with a purpose. Games are fun and occupy students longer developing their concentration abilities; they need structure and reflection. Amount of skills and knowledge attained from them has to be assessed and evaluated. Some games allow for developmental levels and that needs to be integrated in the games played in the classroom. Games develop interest and pleasure to students something that lacks in current classrooms.

This chapter contributes in bringing fourth cultural games into the learning and teaching of mathematical concepts in the classroom and proposes that researchers use these games in their interventions.

4. Research design

This paper is a qualitative inquiry paper with a purpose to observe and gain insight on students' games inside and outside schools. Therefore, the data was collected and analysed qualitatively.

4.1 Context

Six primary schools in the Eastern Cape of South Africa were visited during playtime. Two of them were rural schools and four were township schools. All six schools provide education to black students from low socio-economic backgrounds; in the South African language, they are quintile 1 schools, fully funded by the government. Grade R/Reception year students' informal play during playtime was observed and documented and some pictures taken. The researcher engaged with students sometimes playing with them to get clear understanding of the games and the rules and procedures of the games.

In addition, the researcher made visits to one of the townships where the schools are situated during weekends to observe children play and document their games with the aim of triangulating with games observed from schools following similar procedures to collect the data.

4.2 Consent

Parental consent in the township was negotiated differently through engaging with parents and asking for voluntary participation of their children. This forced the researcher to only observe children from one street as in the possible second street, some parents were unavailable for consent. The children were made aware that the researcher is interested to learn their games and negotiated with them and got their ascent. The agreement was that children should play games they wish to play and be free. It was emphasized that when they lose interest in playing, they should feel free to stop playing anytime.

4.3 Rapport

Before the researcher could be able to collect data, she first needed to develop trust with the parents of the children by visiting the homes of 5- to 6-year-old children in the streets and talk to the parents about what she plans to learn from the children. The engagement with the parents who were mostly mothers made them to revisit their childhood games and compare them with what they see as children play. Issues of safety were also discussed. In a way the time the researcher was going to spend observing their children became the safest time. This made their children's cousins to join during the researcher's visits. The advantage for the researcher is that some of the parents knew her as she grew in the same township. Some parents trusted her when she introduced herself; as they always listen to a radio programme, the researcher leads in discussing about educational challenges in the South African Broadcasting Corporation (SABC) "Umhlobo Wenene" radio station.

4.4 Duration

This data was collected over a period of 6 weeks, each school visited three times a week during the 30 minutes break time. This consisted of 9 hours spent on schools and 6 hours spent on the street in the townships on weekends. In total 15 hours was spent collecting data.

4.5 Analysis

The data from schools and the township consisted of field notes, pictures and audio of students' discussions. The field notes were typed, while the audio was transcribed and typed; the pictures were saved for reference and presentation. For each setting the data was organized in the separate file for analysis. The researcher analysed each data teasing out the game, rules and procedures. Once the structure was there, the researcher teased out the mathematical activities that were observed from each game and listed them with observed skills. This data was analysed continuously after each observation to make sure that if there are challenges, the researcher is able to address them during the next visit. A structured analytical memo was developed for each game observed. All analytical memos were developed for each game from the school setting and also to the township setting. The data was then triangulated making confirmations and checking for differences if they were any. The differences were then discussed with the students during the visits for confirmation and identifying if the setting influenced the differences.

After data collection, the structured analytical memos from school data were triangulated with the structured analytical memos from the township. This data was then shared with teachers to try the games and elicit all skills they observed and knowledge from the games. Their notes were then triangulated with the researcher's notes to write the final report. Students were frequently interviewed for clarity and consensus during triangulation time. It is important to share that due to the excitement of being observed, students went overboard to play many games; some were not experts at playing. This required the researcher to only focus on the games that students mastered in their age group and focus on analysing those; hence, only nine games were documented properly and analysed properly during this study. Also the purpose of this paper was to highlight the games that develop their mathematical knowledge and skills during early years. The other observed games had a lot of potential, but young children have to master them first before they could make the mathematical contribution embedded in them.

5. Findings

The findings had nine games that were discovered when they were grouped according to skills and concepts they developed. In avoiding repetition only one game per group is presented especially the games that cover most skills in a group. Each game is presented with knowledge gains and skills it develops (**Figures 1**–**4**).

5.1 Upuca

Upuca, the name of the game, is a traditional game among Xhosas as well other Africans in the Southern African countries with different names per culture. The

Figure 1.
Young children playing with stones and circles drawn on the floor.

Figure 2.
Young children planing with tins and a ball.

game uses small stones and can be played by a number of children taking turns; the smaller the group, the better. A circle is drawn on the ground where these stones are put in. The surface has to be smooth on the ground to be able to play. A player has to have one bigger stone, a spherical stone called "ingqanda" in his/her hand.

5.1.1 Procedure

The game starts at the beginning in ones until stones are finished. Then the second round will be in twos led by the winner, then threes, fours, until tens. The winner is always the one with many stones during counting time when stones are finished:

1. The player throws the spherical stone vertically while moving stones out of the circle fast and catch the stone on its way back.

2. The next step is to throw the stone again vertically while pushing back to the circle, the stones leaving only one outside the circle.

3. The player continues until s/he did not catch the stone back or left more stones than required outside the circle or unable to leave one stone outside. A good player might play until all the stones are finished.

Then they will move to the next round of playing in twos repeating the procedure. To move to the next round, all players should have at least managed to collect

DOI: http://dx.doi.org/10.5772/intechopen.81039

Figure 3.
Young children playing with a board with squares and a die.

Figure 4.
Young children holding each other's shoulders forming a train.

ten stones not less. If less, you still stay in the previous round of collecting ones, while others move to collecting twos.

5.1.2 Mathematical concepts and skills that can be learned

5.1.2.1 Concepts

The game develops the following:

- Object counting—one to one correspondence.
- Skip counting in ones, twos, threes, fours, fives to tens sequentially.
- Subitising is nurtured automatically as the player needs to spot groups of numbers before selecting with the hand.

5.1.2.2 Skills

It is a good game for developing the following skills:

- Eye and hand coordination
- Time control
- Hand motor skills

5.2 Black toti

Black Toti is a children game played in South Africa; its popularity to other African countries is not known. A square is drawn with a small chord in each right angle of the square. Tins of different sizes are collected and put on top of each other so that they balance at the centre of the square to form a pyramid. There is also a ball to play with. It is important to note that the tennis ball is not a favourable one for this game as it runs too far. Most children prefer the plastic ball for this game, or they create their own with plastic bags. In some cases, they use the tennis ball.

5.2.1 Procedure

The game is played by three players in a team with ten cans in different sizes and a plastic ball/homemade ball/tennis ball. One player must have a ball and stand along the border of the square and hit the cans with the ball. S/he starts running to the chords counting as she/he reaches each chord around the square. S/he has to run fast as to reach 24 in counting. At the same time, the opponents' role is to run after the ball to pick it up to hit other players who are trying to rearrange the tins. The runner has to count to 24 before the tins are balanced; if not, they lose the game; if they finish 24, the game is over, and they have a point as a team.

5.2.2 Mathematical concepts and skills that can be learned

5.2.2.1 Concepts

- Develops sorting
- Counting and balancing
- Logic
- Time management

5.2.2.2 Skills

- Running fast
- Concentration

5.3 Umrabaraba

Umrabaraba is an African logic game that can be adapted according to the age group of players. A 3 by 3 square is drawn. One vertical and one horizontal line are drawn inside the square and meet at the centre. Two diagonal lines are also drawn inside the square to meet at the centre.

5.3.1 Procedure

Only two players at a time play as opponents. Each player plays with three counters of the same colour different from the opponent. Each player takes turn to place the counter. It is each player's role to block the other player from placing the three counters to form a straight line whether it is diagonal. The winner is the player who manages to place his/her counters on a straight line first.

5.3.1.1 Concepts

- Logic
- Probability
- Prediction

5.3.1.2 Skills

- Concentration
- Internal logical thinking

5.4 Itreyini

Itreyini is a cultural game that is called train in English. This game is played by 22 children. Two of these children are heads of two different carriages. The heads of the carriages secretly give each carriage a name. For example, the other might be a chocolate and the other a biscuit, and these names are kept secretly.

5.4.1 Procedure

All 20 children wait to be called to the heads of the train. Each child is whispered to choose between a chocolate and a cake. Once the choice is made, the child goes behind the head s/he has chosen. This continues until all 20 children have selected the head they belong to. Once the choices are made, the carriages are made of the children that have chosen each head. The time now to create a bridge by drawing a line on the floor comes. Each head together with their carriages try to pull each other; the ones that crossover the line belong to the group on the other side. There is a strategy implemented during the pulling time. Those children who are stronger are the ones who must always be directly pulling the head, and the tiny ones are always at the back until the game is over.

5.4.2 Mathematical concepts and skills that can be learned

5.4.2.1 Concepts

- Adding
- Subtracting
- Balancing

5.4.2.2 Guessing

- Motor skills

6. Conclusion

Generally African cultural games explored in this paper develop logical thinking, numeracy, problem-solving skills, measurement and spatial reasoning. The "umrabaraba" game challenges the mind into making predictions and look at probability. Numeracy that develops from "black toti and upuca" nurtures meaningful counting, and concepts such as one-to-one correspondence, cardinality and skip counting, an indication that the numeracy levels observed by [35, 36], can be aligned with this exposure. The "black toti" game demands planning, motor skills, self-regulation, teamwork and time management. These games together with others are a cultural capital to African students. When cultural capital becomes a vehicle in accessing knowledge that knowledge is owned, and the esteem of the individual is elevated [33]. Ref. [2] indicates that ownership is the key to access and esteem in learning mathematics. This paper recommends that cultural relevant pedagogy is employed if mathematics access and knowledge are really universal. Pluralism in mathematics learning is dragging, while the society is currently challenged economically in providing jobs and increasing economies. The current challenges of the globe need citizenry that uses logical thinking so as to create innovative ideas in dealing with the emerging unique challenges of the globe. All mathematics curriculum expectations for Grade R are covered and beyond in these games. The way forward is inclusion of ideas and ways of learning and teaching mathematics. Students' cultural capital should be capitalized in their learning of mathematics experiences [33].

Acknowledgements

I would like to acknowledge two community retired teachers Mrs. Nomfusi Klass and Ms. Nomvuyo Njovane and Ms. N Bambiso, a colleague from the University of Fort Hare for assisting with data collection in the schools. I would like to humbly thank teachers of Grade R learners in the Eastern Cape specifically in Queenstown for sharing their views about games with me during data analysis. I would also like to thank their principals for accommodating me during playtime of their youngest students and the trust they had in me. Parents in my home township showed appreciation and belief in education and trusted me with their young ones. I would like to thank them and their precious young children. In addition, I would like to thank the National Research Foundation (NRF) of South Africa for funding the study this paper contributed to.

Conflict of interest

I have no conflict of interest to declare and have followed ethical procedurtees in conducting this research.

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Section 5

Technology

Chapter 11

Tourist or Traveler? Unpacking Informal Conversations between Teachers and Young Children across Diversity

Raeshell L. Randazzo and Martha J. Strickland

Abstract

The world is in the midst of a dramatic demographic shift: culturally, ethnically, and socioeconomically. To address the needs of an increasingly diverse student population, research has examined the effects of teacher-student relationships. This chapter describes a study that used autophotography to examine the ways teachers engage in informal conversations with young children who come from different racial, ethnic, and socioeconomic backgrounds, around the child's own photos of home. Specifically, conversations were interrogated to identify what impacts the teacher-student interactions across differences. Using Gee's discourse analysis, this study explored how the teachers built or lessened what the children viewed as significant, how they distributed their social goods—influence, power, or status—and how they created or positioned identities within the conversations. The findings inform the mission of enhancing teacher-student relationships and content relevance through providing new insights into how teachers and young children interact, connect, and change within their conversations.

Keywords: diversity, autophotography, teacher-student relationships, conversations

1. Introduction

The United States is in the midst of a dramatic demographic shift that may necessitate similarly striking changes in how education is conceived [1]. Although historically a nation of White, European ancestry that privileged English-language speakers, twenty-first century America abounds with unparalleled diversity. Forty-two percent of the U.S. population, 142 million Americans, now self-identify as ethnicities other than White, non-Hispanic [2]. This compositional shift is due, in part, to international migration; nearly 14% of the current population was born outside the United States [3]. As of July 2014, nearly half (49.7%) of the nation's children under 18 years old are identified as other than White, non-Hispanic [4]. By the year 2030, it is predicted that international migration population growth in the United States will overtake that of the natural population consisting of more than 60% of the school-aged children identifying as other than White, non-Hispanic [4].

It is within this kaleidoscopic cultural context where we consider the ways in which teachers and students communicate. The students that schools must serve have changed markedly in terms of their world experiences, first languages, readiness for school, and range of learning needs. The teaching population, however, has not. While the actual number of teachers in the workforce has steadily increased over the past 10 years, the demographics of the teacher population have remained essentially homogeneous and unchanged. They are overwhelmingly White (82%), female (77%), monolingual English-speaking, and middle class [5]. Although teachers and administrators have acquired specialized knowledge of curriculum, assessment, pedagogy, data-driven decision-making, and learning theory, researchers note that they remain ill-equipped to address the manifest rift in understanding between school-home and teachers-students [6]. Today, educators have less in common than ever with the students, parents, and communities they serve, and more is at stake than perhaps ever before.

1.1 Teacher-student relationships

In an attempt to address the causative conditions for the aforementioned rift, researchers have studied the effects and significance of the teacher-student relationship [7–13]. One genre of studies focuses on understanding communication and interactions between teachers and their students. Nearly 20 years ago, Howes et al. [10] found that positive teacher-student relationships promote engagement in learning tasks and assist students in coping with the demands of school. Research has repeatedly confirmed that a positive teacher-child relationship is fundamental to a child's healthy development and academic success [14]. Effective communication is a key component of positive teacher-student relationships—essential for young children's healthy development and academic success [8, 9]. Roorda et al. [12] inform this study's focus in its aim to understand teacher-student interaction and communication and improve the quality of relationships in the classroom.

1.2 Teacher-student communication

Effective communication is a key component of productive relationships. Researchers have identified several areas in which communication between teachers and students can be compromised. First, misunderstanding between teachers and students is unsurprisingly widespread as teachers filter their interactions with students through the lens of their own culture values, beliefs, and practices [15, 16]. Miscommunication and misunderstanding is the result of differing cultural norms and reference points, linguistic norms, and norms of engagement with schools or what could be identified as what is valued or positioned as significant [17] Heath [15, 16] found that student cultural or subgroup norms may differ widely from institutional values of the school or personal values held by staff and faculty. Other families may hold active or passive views with respect to their participation in their child's education. Parents or caregivers may have a mistrust of authority and institutions or incomplete knowledge about how best to help their child [18]. Finally, incongruences may exist between school expectations and values and home realities [18]. The school or teacher may assume or expect a home to have a computer, Internet access, quiet time for and adult help with homework, and bedtime stories read by a parent. Those conditions may or may not exist. When schools fail to understand the students they serve, research notes that communication breakdown, disengagement, and school failure may result [18]. As such, researchers continue to call for research that explores discourses critical to enhancing relevance in the classroom: those of teachers, students, family, community, and educational institutions, and how those perspectives can be leveraged to foster mutual understanding across differences.

2. Purpose/objectives

The purpose of this study was to examine the ways teachers engage in informal conversations with young children who come from different racial, ethnic, and socioeconomic backgrounds, around the child's own photos of home. Specifically, conversations were interrogated to identify what impacts teacher-student interactions across differences. Using Gee's [1] discourse analysis, this study explored how the teachers built or lessened what the children viewed as significant, how they distributed their social goods—influence, power, or status—and how they created or positioned identities within the conversations. The findings inform the mission of enhancing teacher-student relationships and content relevance through providing new insights into how teachers and young children interact, connect, and change within their conversations.

3. Theoretical framework

This study is framed by a sociocultural approach to teacher-student relationships as understood through the writings of Vygotsky [19] and later neo-Vygotskian researchers such as Kozulin [20] and Wertsch [21]. Because social interactions within conversations, or dialog, are the primary point of investigation, Bakhtin's [22] dialogism was chosen to further inform the research.

The focal point in the sociocultural meta-narrative is that social interaction, embedded within social, cultural, and historical contexts and mediated by language and sign systems, is where shared activities are transformed into internalized processes and knowledge, or learning [19] For Vygotsky, semiotic mediation is the foundation for all manner of knowledge construction. Tools such as language, mathematics, diagrams, and works of art are products of the cultural, historical, and social contexts in which they exist. Language, according to Vygotsky, is central to learning as talking precipitates thinking [23]. Wertsch [21] added that these semiotic means comprise the tool kit that shapes individual cognitive development.

The diversity inherent in these tools, the contexts from which they arise, and the manner in which they are brought to bear on new settings is of particular consequence to educators working in diverse settings. The sociocultural approach hinges on the fundamental belief that internalization—that is to say learning—is a process of cognitive development rather than transmission. According to Vygotsky [19], students learn through making connections to new information using their tools within social interactions with teachers and peers.

3.1 Discourses and social language

In addressing the needs of students from diverse backgrounds, researchers have identified an opportunity for dialog and interaction to span the distance between the cultural models (experiences gleaned from everyday life) and Discourses (the socially acceptable use of language) [1] of students and teachers [24–27]. According to Gee [1], "A Discourse is a socially accepted association among ways of using language and other symbolic expressions, of thinking, feeling, believing, valuing, and acting" (p. 154). Language allows individuals to take on socially significant identities as they express who they are, what they are trying to do by saying it, and who they are trying to be by saying it [1]. A primary Discourse, like one's primary cultural model, functions as a base for future learning. Individuals learn new Discourses throughout their lives and those Discourses, in turn, shape (or re-shape) the primary Discourse. Individuals can, and do, operate across several Discourses, though not all Discourses are used equally.

A critical component of every Discourse is its associated social language. Social languages are the various registers that speakers employ to negotiate the identities and goals of the discourse in a given context [28]. Each person uses different social languages depending on the occasion, location, or context. These variations allow a speaker to switch between (or blend) Discourses. In some instances, the social languages among various Discourses are successfully blended, and in others the social languages are compartmentalized for use in specialized locations and contexts. Some primary Discourses underpin and inform all the secondary Discourses acquired later in life. As Heath and Street [29] emphasized, social language is germane to education settings because the research demonstrates that fluency and breadth in language use, styles, and modes translates to later academic and professional achievement. Students acquire this knowledge and skill through social interaction and language practice.

Therefore, informing this study is Gee's Discourse Analysis [1], which suggests that in every dialogue speakers and listeners build significance, politics, and identity. To explore significance building, one examines the cues in language that build or lessen significance which are based on what is explicitly stated or what is implied by the speaker/writer or inferred by the listener/reader. Politics building within dialogs involves examining how influence, power, acceptance, and status (social goods) are distributed or withheld during the dialog [1]. Identity building is the third focus. Language in dialogs also exhibits which identities are being identified, attributed to or built for others, and/or how a speaker or writer defines his or her own identity in relation to others and in a given context [1].

3.2 Student identity and voice

Classroom conversation research also touches on children's perceptions of self and others [30]. Children's perceptions of their social position in the classroom, the nature of their relationships with others, and their expressions of personal identity are all tied to communication. Dialog promotes children's self-expression in their interaction with adults [31], but, according to Mannion and I'Anson [32], that adult interaction must be complementary and dialogic.

3.3 Dialogic discourse

Dialogic discourse is a critical component of teacher-student relationship building and student expressions of personal identity and voice. Several studies that are focused on dialogic classroom interaction inform this study. Christoph and Nystrand [33] found that the potential for dialog between teachers and students is largely dependent on the relationships between the teacher and class and the willingness of the teacher to take a risk in engaging in dialogic talk, with its inherent unpredictability, with students.

Hayes and Matusov [26] work illuminates the need for teachers to share power within teacher-student conversations by balancing teacher and student talk. Further, Hayes and Matusov [26] found that children participate more readily in conversations when they initiate the topic and when the conversations are personally relevant. Baraldi's [31] research on the conditions of self-expression in classroom interactions drew from nearly 100 h of videotaped and transcribed conversations between teachers and students at 12 elementary and middle schools. His research demonstrated consistent attempts by teachers to employ monologic patterns of discourse to guide conversation toward normative cultural expectations or achievement and learning expectations. Teacher monologs do not foster student self-expression or identity development. Many researchers have focused on children's talk in the classroom and how this talk, incorporating home and community funds of knowledge [34] opens up third spaces for the student's voice and identity to be heard, explored, and valued [35–37].

4. Method

This mixed-method study was conducted in a diverse, at-risk public elementary school located just outside an urban center. All five of the first-grade teachers, 29–43 years old with an average of 8 years teaching experience, consented to participate in the study. Four teachers self-identified as White, non-Hispanic females. One teacher self-identified as a bilingual (Portuguese and English), multiethnic male. All teachers lived in suburban communities outside the school district bounds, and with no experience living in urban settings. Their cross-cultural experiences were limited to foreign travel. Of the 81 first graders, 68 parents' consents were received and 60 children returned cameras. To garner informal teacher-student conversations while providing the children with the tools to present themselves and converse within their context of expertise, an autophotography method was employed in which the child talked with their teacher about the photos they took of their context outside of school [38–40]. Forty-six children (Black, 32%; White, 23%; Hispanic, 17%; Multiethnic, 28%) were present and able to participate on the days when the autophotography conversations took place. Each student received a disposable camera and verbal instructions for its use. Students were instructed to take photographs of people, things, and places of importance to them. The researchers clarified student questions about the subject of their photos with specific examples such as a photo of family, a pet, a room in the home where the child spends time, or a favorite toy. Cameras were sent home in a bag containing a memo to remind parents that their child was to take photos of people, places, activities, and things the child chose and return the camera within a week. Students took the cameras home to capture images, and several days later returned the cameras to be processed. Cameras were processed at a local drugstore.

Subsequently, each teacher was afforded time outside of the classroom in an informal, quiet space to listen to their students narrate their photos. The expressed goal was to get to know each child better. Each child, without exception, eagerly entered the room to look at their photos spread out on the table in front of the teacher. The child was invited by the teacher to choose photos to talk about with the teacher. No additional protocols were given.

The teacher and student then engaged in a conversation about the selected photographs. Each teacher-child conversation lasted an average of 6 min, with some as brief as 3 min and some lasting nearly 15 min. As the conversations were recorded, two researchers observed and recorded field notes. In all, 46 conversations were audio recorded and transcribed verbatim, noting extraneous noise, pauses, laughter, interruptions, and turn-taking. A follow-up. 30-min focus group with all the participating teachers was also conducted for clarification of the data. For the purpose of this study, the 46 transcripts were stratified by teacher and by each child's ethnicity/racial background (FRL).

For this study, a random sample of 25 conversations—5 transcripts from each of the 5 participating teachers—were analyzed, guided by Gee's discourse analysis [1] three building tasks: significance, politics/social goods, and identity. These three building tasks were positioned as initial nodes for the first round of coding using Dedoose software. Demographics data, including ethnicity, race, socioeconomic status, and gender were entered for all participants. Frequency counts and categorizations of language use and grammatical structures were employed to add richness of understanding and "layering of meaning" [29] (p. 93) to the qualitative analysis.

5. Findings/results

The teacher-student conversations, when analyzed using Gee's [1] Discourse analysis, reveal different areas of significance, and imbalance in terms of distribution of social goods. The findings also expose the dialogical and intersubjective (i.e., development of mutual understanding) synopsis appearing between the social languages of teacher and student as situated within the classroom context [21].

Within the qualitative data analysis, Gee's [1] building tasks were applied as a priori codes to explore what topics were granted significance, what themes emerged from the conversations, how social goods were distributed or withheld by teachers, and what identities were advanced through students' narrations of their photos. The episodes chosen are illustrative excerpts of the teacher and student conversations.

5.1 The building and lessening of significance

Gee [41] viewed significance building as how meaning and significance are assigned to different topics within the discourse. This uncovers not only the situated meanings and values attached to words and phrases, but also the reinforcement or transformation of cultural models during the interaction. Therefore, in this study, as teachers talk with the students, their verbal responses signify the value they place upon what is being said and shown, and how that value is positioned within the conversation.

First, the resulting topics and themes speak to what was positioned as significant and what was not. Within the teacher-child conversations, five common topics emerged (**Table 1**). These included, in descending order of frequency: *family*, *play*, *pets*, *friends*, and *places*. Each child, without exception, talked about the *family* members in his or her life. They shared details about their favorite pastimes and games. All the children included photos of their *pet*, offering anecdotes about each pet. Many children included photographs of their *friends.* Finally, they talked regularly about the places that were meaningful to them. Bedrooms, kitchens, family rooms, classrooms, houses of grandparents, horse stables, and places visited on vacation were all shared with enthusiasm with the teachers. Therefore, the student

Speaker	Topics	Themes	Stance
Child	Family Play Pets Friends Places	Kinship Amusement	Affective

Table 1.
Common topics within teacher-child conversations, child topics in descending order.

themes that emerged were Kinship and Amusement, reflecting their affective stance toward interpersonal relationships and play.

Within the teacher utterances, topics were distinctly different. In descending order, the most common topics were: teacher knowledge; living arrangements; rules and roles of the home; and how time is spent. A preponderance of teacher statements included "I don't know," "I didn't know that," or a variation thereof (**Table 2**). The topic associated with these statements is teacher-owned knowledge. All teachers within the study steered the conversations to discussions of what they knew or did not know about the children and their families. All teachers queried the children on living arrangements. This is noted in such statements as, "Is it just you and your mom in the house, then?" and "Who sleeps here?" Roles and rules of the home were also prevalent within these conversations. Teachers shifted the children's affective topics about cuteness of their puppies to discussions of the particulars of pet care and nutrition, including: how many animals are living in the house, and if the pet is fed properly. Teachers also asked about chores and responsibilities noted in such statements as: "Do you clean up?" and "Do you change diapers?", as well as adult roles in the home seen in such statements as: "Does Mommy read to you?" and "Does your Dad play the Xbox a lot?" Teachers also asked about how the children spent their time outside of school. Therefore, the themes that emerged from the teachers' topics were knowledge and examination.

According to Gee [1] when speakers build significance in dialogs, they may use grammatical devices or words to achieve their goals. After the first cycle of initial coding revealing the topic and themes, the following three grammatical devices emerged as markers for significance building or lessening: emphatic auxiliary verbs, intensifying adverbs, and downtoners.

5.1.1 Lessening significance with emphatic auxiliary verbs

When a speaker or writer uses emphatic auxiliaries, that is to say, adding vocal emphasis to an auxiliary verb, significance building or lessening can take place. Auxiliary verbs include all forms of *do*, *is*, *am*, *be*, *will*, and *have* and are followed by another verb in order to form a question, a negative sentence, or passive voice. When a speaker or writer stresses an auxiliary verb, it indicates that he or she is attempting to assert a position, correct someone else's understanding, or contrast a position with something else. Auxiliary stress can also be employed for affective emphasis when using, for example, *do*, *is*, *has*, and *can*, to show enthusiasm or to confirm something a speaker or writer already knows by following the statement with a question tag such as "You *did* make your bed, *didn't* you?"

Throughout the conversations, teachers used emphatic auxiliary verbs most often to lessen significance by repeatedly questioning the truthfulness of a student's story. **Table 3** presents the incidence of teacher emphatic auxiliary verb usage by student ethnicity and socioeconomic status across all 25 transcribed conversations. Of all instances of auxiliary verb usage, 56.4% were found within conversations with students identified as Multiethnic. Seventy-eight percent of emphatic auxiliary

Speaker	Topics	Themes	Stance
Teacher	Teacher knowledge Living arrangements Rules and roles of the home How time is spent	Knowledge Examination	Cognitive

Table 2.
Common topics within teacher-child conversations, teacher topics in descending order.

Markers of significance	SES	Black	White	Multiethnic	Hispanic
Teacher use of emphatic auxiliary verbs	FRL eligible	5	4	19	2
	FRL not eligible	0	0	3	6
Teacher use of intensifying adverbs by student	FRL eligible	32	0	19	16
	FRL not eligible	0	0	1	9
Teacher use of downtoners	FRL eligible	5	0	4	3
	FRL not eligible	0	0	0	0
Teacher use of deference politeness	FRL eligible	22	0	39	6
	FRL not eligible	0	0	3	5
Teacher use of vernacular	FRL eligible	67	7	63	22
	FRL not eligible	0	0	1	13

FRL: free and reduced lunch.

Table 3.
Markers for significance building or lessening.

verb uses were with students identified as eligible for free and reduced lunch (FRL). Further, emphatic auxiliary usage of the questioning, correcting, and asserting variety are used more often with Black and Multiethnic students as well as with students who are identified as free and reduced lunch eligible. Affective, enthusiastic auxiliary verbs were used more often with Hispanic students and students identified as not eligible for free and reduced lunch.

5.1.2 Significance and insincerity with intensifying adverbs

Speakers or writers can also build significance by using intensifying adjectives and adverbs that emphasize (*really*, *for sure*, *certainly*, *obviously*, *so*, *totally*, *very*). Ironically, the overuse of intensifiers or use of repeat intensifiers such as, "That photograph is *really*, *really* awesome," lessens the perceived sincerity of the sentence.

Notably, the majority (87%) of intensifying adverbs were found in conversations with the children from low-socioeconomic status homes. Also, repeat intensifiers, markers of insincerity, were found most often found in conversations between teachers and Black children eligible for free and reduced lunch. **Table 3** depicts intensifying adverbs spread throughout conversations with students of all ethnicities except White. The majority (87%) of intensifying adverbs were found in conversations with students from low-socioeconomic status homes. Repeat intensifiers, markers of insincerity, were found most often found in conversations between teachers and Black students eligible for free and reduced lunch.

5.1.3 Undermining significance with downtoners

Speakers and writers may also use degree adverbs known as downtoners (*somewhat*, *fairly*, *relatively*, *slightly*, *nearly*, *almost*, *kind of*, *sort of*, *pretty*) to diminish or undermine significance. According to Biber and Conrad [42], the common conversational downtoner *pretty* (as in *pretty good* or *pretty cool*) functions as an evaluator and may imply the speaker or writer is judging the action or item rather than affirming it. Downtoners—degree adverbs—worked similarly to lessen significance by hedging compliments with a negative modifier.

While downtoners were found in conversations between teachers and Black, Multiethnic, and Hispanic students, they were absent from the conversation between a teacher and the single White student in the sample. Downtoners were found in more than half (57%) of the conversations with students eligible for free and reduced lunch (**Table 3**). No conversations between teachers and students ineligible for free and reduced lunch contained downtoners.

5.2 The granting of social goods

Gee [1] states that in conversations, social goods are identified. These are statements that identify something as good or acceptable to the social group [1]. Throughout the transcripts, teachers granted *social goods* to the children through approval and verbal praise of the student's work, photographs, family, or a positive response to the content of the photographs. Many instances of approval were granted for what was noted as *correct* behavior such as listening, working on schoolwork, or paying attention. Far fewer instances demonstrated the granting of social goods based on student interests, talents, or interactions with peers. Key words indicating granting of social goods include such terms as: good, correct, smart, and "I like…" In the following episode, the teacher grants social goods to the student, positioning him as a good listener and student.

Episode Seven:

T: Oh, I see. Okay. What else do you want to show me? Any other pictures? Looks like you have a lot of daycare pictures. Did you take a lot of pictures at daycare? Yeah? Do you like that picture? **That's a nice picture**. Do you like that? Picture of you. **That looks great.** Wow, looks like **you're being a good listener** in that picture. **Doing your work**. **I love it.** Any other pictures you want to show me? Look at all these. Did you see these yet? Where's this at?

C: Daycare.

T: Daycare? What is it? ABC Academy?

C: Sunnyside.

The following is another episode illustrating granting of social goods as the teacher compliments the student on his attitude about practice, perseverance, and hard work. Not only does she grant social goods, she reinforces a prior implied social good that based on her experiences in the past with the student, she would expect him to respond as he did.

Episode Eight:

T: So what do you like about basketball so much?

C: Because we win every single game.

T: [laughs] 'Cause **you're on a good team**. Well, what if you didn't win all the time?

C: Then…I would just keep on playing until I get gooder.

T: Oh! **That's a really good attitude**. **I would expect that from you**. **That's awesome.**

5.3 The politics of politeness

Following Gee's [1] protocols, the transcripts were also coded for politeness to provide a richer picture of the politics in this classroom setting. Solidarity politeness indicates the goal of solidarity between speaker/writer and listener/reader [1]. Instances of joking, attending to listener needs and wants, avoiding disagreement, claiming in-group membership, and showing exaggerated interest in a student or the student's interest are markers for solidarity politeness. Deference politeness works to maintain distance and privacy for the speaker/writer and independence/autonomy for the listener. Instances of ambiguity, avoidance, apologies, formal constructions, statements of rules, and *not* making assumptions about the listener were noted and coded.

The data indicate that deference politeness was used about half as much as solidarity politeness. Deference was nearly twice as likely to be found in conversations between teachers and multiethnic students than Black students and nearly four times as likely compared to Hispanic students. Within the single conversation between a teacher and White student, there were no instances of deference politeness recorded (**Table 3**). Similar to many of the indicators for Significance, the language markers of deference and solidarity varied depending on the gender, ethnicity, and socioeconomic status of the student. When viewed according to socioeconomic status deference politeness is revealed to be more prevalent in the teacher utterances in transcripts of Black and Multiethnic students. One outlier, the male teacher, used Deference Politeness with a bilingual, female, Hispanic student. This, perhaps, reflects a more formal orientation that this particular teacher has toward all students. Further analysis of the data revealed marked use of deference politeness in conversations between female teachers and male students.

5.4 The building of identities

Building identities, as conceptualized by Gee [1], is examined by looking at the speaker's use of language that reveal their roles, beliefs, values, feelings, and cultural knowledge. According to Holmes [43], when formality increases between interlocutors, social distance is maintained. Further, Holmes [43] noted that when speech diverges within a conversation, that is, when a speaker deliberately chooses a style of language not being used by the listener, it often signals that the speaker wants to demonstrate cultural distinctiveness, deference, or an identity separate from that of the listener. Within the transcripts, instances of formal, academic language and informal, vernacular language were coded. Across all 25 transcripts, 221 separate instances of social language were noted. The vast majority of these were Informal/Vernacular Language (173 codes; 78%). Just 48 instances of formal language were found. However, in transcripts where formal, academic language was noted, it was used repeatedly and tended to stifle teacher-student interaction (**Table 3**).

To understand how Identities were shaped and interacting within the conversations, I asked: How do teachers and students shape their Identity (or Identities) within the school context using academic or vernacular social languages? Gee [1] suggests the analysis of formal, academic language and informal, vernacular language within conversation to determine what identities are being put forward. Teachers' utterances were a mix of both formal and informal languages. Several teachers heavily used "gonna," "wanna," and other informal constructions in their exchanges with students. These constructions position the teacher as approachable and friendly and making an attempt at connection. Academic language was used less frequently across all conversations. In instances when it was used, however, it tended to chill conversation, with students replying in single word utterances.

6. Discussion

The findings, when juxtaposed against the present understandings of teacher-child relationships, with a focus on communication, point to a simple distinction. The informal dialog afforded by autophotography between teachers and their students who come from different racial and ethnic backgrounds provides an authentic opportunity for developing understanding. Within conversations, language can be used to build or lessen significance, grant or withhold social goods, and create or position identities. Given that opportunity, teachers relied on their tacitly held cultural models and relied on assumptions and preconceived notions about students from ethnicities and cultures different from their own to drive conversation.

6.1 Address communicative divide

While topics varied across the conversations, the underlying conclusion of the data was that there existed a communicative divide, along ethnic and socioeconomic lines, between teachers and the children. Whereas, the children were providing openings for authentic dialog, the teachers were not open to what those children offered in terms of new understandings.

Emerging from these findings is a theme which is best portrayed in a metaphor: In relating to those unlike ourselves: we can be travelers or we can be tourists. Chesterton [44] in the chapter “The Incomplete Traveller” from his autobiography “Collected Works: The Autobiography of G. K. Chesterton, Volume XVI” observed that “*The traveller sees what he sees; the tourist sees what he has come to see*” (p. 301).

The question of difference between the notions of *traveler* and *tourist* has been exhaustively explored in travel and tourism research [45–49]. In essence, a tourist wants the familiar in strange locales. They meet others like themselves and their journeys are scripted and planned out with itineraries that leave little room for exploration. There is safety in being a tourist, with staying on the beaten path, with the control that comes from knowing what to expect. Travelers, by comparison, are open to the experience as a journey of self and welcome unexpected discoveries and impromptu interactions because there is always something to learn from every new experience.

Based on the findings of this study, it may be suggested that the teachers are approaching these photos and narrations from a tourist perspective. They know what they have come to see, so, invariably, that *is* what they see. They look to make sense of what they see through the lens of their own prior experiences. In doing so, they frequently lessen the significance of what students value as they simultaneously withhold social goods such as acceptance and approval. In the meantime, they collect facts and information, meant as way finding for their own intercultural tourism.

The teacher’s approach to the children conformed to what researchers [50–52] would call a tourist orientation. To extend the metaphor, teachers packed a symbolic suitcase filled with their expectations, biases, and misconceptions about others and brought it along on the narrative journey of autophotography with their children. As such, the teachers sought to confirm what they thought they knew about the children, their families, and their home lives.

Additionally, the teachers used the contents of their suitcase to lessen significance and withhold social goods from certain children who told stories that did not conform to the teachers’ normative expectations. The teachers, as tourists, redirected conversations to ones that they were comfortable discussing, and in doing so, frequently missed the opportunity to learn something from the conversation. By contrast, the children approached the conversations, and school more generally, as travelers. They were open to the interaction with the teachers and readily shared themselves through their photos.

The theoretical framework of sociocultural theory proposed that social interaction, embedded within social, cultural, and historical contexts and mediated by language and sign systems, is where shared activities are transformed into internalized processes and knowledge [19]. The data findings reveal that while the autophotography was a shared activity, in the sense that two people participated, it was not a learning experience as a sociocultural theorist would identify it. The teachers, who in this setting were positioned as the learners as they interacted with the students' stories, reflected little or superficial transformation or internalization of knowledge; they approached conversations with predetermined ideas about how things were and how things ought to be. They presented an approach to student diversity that Cai [50] and Fang et al. [51] would identify as superficial, intercultural tourism.

The literature pointed to teacher-student conversations as vital to bolstering academic, social, and behavioral outcomes. Recognizing the importance of students participating in meaningful conversation within the school context [27], autophotography was chosen as the vehicle to open the dialog. According to this study's analysis of the words of the 30 participants in this study, teachers and students approached informal conversation about the photos in distinct ways: teachers with an orientation toward knowledge and examination; and students with an orientation toward Kinship and Amusement. While topics varied across the conversations, the underlying conclusion of the data in this research study is that there exists a communicative divide, along ethnic and socioeconomic lines, between teachers and students. Teachers had distinct ways of relating to students that were different from themselves. They were not open to what those students offered in terms of new understandings.

6.2 Foster dialogic conversations

The potential of teacher-student talk to enhance teacher understanding of their approaches to conversation and connection cannot be overstated. This study suggests that a shift in perspective from tourist to traveler is required to turn the lens of inquiry and introspection within. The word travel comes from the French word *travail*, meaning, "to labor." And indeed, the kind of metaphoric travel suggested here requires hard work. The present education context is rife with disconnections between teachers and the children in part due to increasing socioeconomic and cultural diversity. This study's findings introduce a turning of focus from cultural knowledge to feedback tools, facilitated self-reflection, and instruction on dialogic methods [53].

As teachers attempt to build relationships and connect with children from backgrounds different from their own, this study's findings speak to a persistent need to foster dialogic communication in the classroom through affective engagement and reflective work. In schools that are struggling academically and where a focus on scripted instruction and data are the de facto norm, there is a marked lack of the kind of dialogic conversation that encourages the development of student voice and the inclusion of student identity. Understandably, the testing and reform context and its time constraints complicate the efforts of educators and researchers interested in moving away from behavioral approaches and toward sociocultural approaches to intercultural communication and improving teacher-student relationships. However, with nearly half of all the nation's school-aged children of diverse ethnic and cultural origins [4] and more than 80% of the teachers are White [5], the rift in understanding between teachers and students can no longer afford to be ignored.

7. Conclusion

Assuming the traveler stance, teachers may advance the relational and interpersonal aspects of education that this study seeks to address. Considering the complexities of contexts and one's own identity and interactions while traveling is not easy. One must juggle the sometimes-perplexing demands of unfamiliar people, cultures, languages, customs, traditions, and beliefs—much like in many classrooms across the country. Through the use of autophotography, this study informs the mission of enhancing teacher-student relationships and content relevance, promoting the traveler stance that revels in the differences of other people and places and welcomes those interactions that enrich their lives.

Acknowledgements

This work was generously funded by Penn State Harrisburg.

This work could not have been accomplished without the participation of the teachers and children heard in this study, the support of Penn State Harrisburg's Teacher Education Program, and the support of friends and families who kept us going throughout this research and writing process.

Conflict of interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Chapter 12

Evaluating a Course for Teaching Advanced Programming Concepts with Scratch to Preservice Kindergarten Teachers: A Case Study in Greece

Stamatios Papadakis and Michail Kalogiannakis

Abstract

Coding is a new literacy for the twenty-first century, and as a literacy, coding enables new ways of thinking and new ways of communicating and expressing ideas, as well as new ways of civic participation. A growing number of countries, in Europe and beyond, have established clear policies and frameworks for introducing computational thinking (CT) and computer programming to young children. In this chapter, we discuss a game-based approach to coding education for preservice kindergarten teachers using Scratch. The aim of using Scratch was to excite students' interest and familiarize them with the basics of programming in an open-ended, project-based, and personally meaningful environment for a semester course in the Department of Preschool Education in the University of Crete. For 13 weeks, students were introduced to the main Scratch concepts and, afterward, were asked to prepare their projects. For the projects, they were required to design their own interactive stories to teach certain concepts about mathematics or physical science to preschool-age students. The results we obtained were more satisfactory than expected and, in some regards, encouraging if one considers the fact that the research participants had no prior experiences with computational thinking.

Keywords: Scratch, preservice kindergarten teachers, programming, computational thinking

1. Introduction

According to the twenty-first century skills framework, digital literacy is an important skill for students to develop so as the ability to encode and understand code is becoming more and more a fundamental skill to master to participate actively to our digital society and economy [14]. National and European policies acknowledge the need to equip all citizens with the necessary competences to use digital technologies critically and creatively [28, 38]. As Wing [47] states "to reading, writing, and arithmetic, we should add computational thinking to every child's analytical ability" (p. 33). Hence, its integration throughout all educational levels, as well as the early ages, is considered valuable. Evidence shows that even children as young as 4 years old can engage in core computational thinking skills, provided they work with a developmentally appropriate tool that supports such learning [21, 34, 42].

Yet, the introduction of computational thinking (CT) in compulsory education requires support measures to prepare teachers [9]. Teachers themselves often have no formal education in computing and cannot communicate to their students' enthusiasm or understanding about what happens inside a computer to make it work [46]. Many primary teachers are unlikely to have the appropriate skill set to teach this new technical subject [6, 22]. Ref. [5] highlights that one of the obstacles to incorporating CT activities into the early childhood classroom is that early childhood educators have had little or no experience with technology concepts and processes. If teachers are to help young children learn CT concepts as well as STEM subjects (science, technology, engineering, and mathematics), their professional development ought to help them to explore content and teaching methods [11, 29]. This is considered important as children's experiences of science even at primary school inform their decisions about studying science, which impacts on the supply of STEM professionals [24].

Therefore, there is a need for widespread professional development to support in-service and preservice teachers in gaining the necessary experience, technical skills, confidence, and understanding of suitable pedagogies to implement this new curriculum successfully [6]. For these reasons, CT and programming is taught in many parts of tertiary education that are not necessarily directly relevant to or focused on information technology or STEM. These faculties include pedagogical departments in which students have a first familiarity with CT and programming either for their direct educational use or to be able to produce interactive and multimedia learning materials [16]. Many researchers have already used Scratch at the university in introductory programming courses, and their experiences report on students' high motivation and sometimes also on higher performance [25].

The rest of the paper is structured as follows: in the next section, the advantages of choosing Scratch as an introductory programming environment are outlined; the second section presents the methodology of the Scratch course employed in this article; and the third section documents the results. The final section discusses the results obtained, outlining the limitations and recommendations for future research.

2. The advantages of visual programming: Scratch

The inclusion of programming topics in the initial grades of school gives rise to debates about the best ways to teach these contents [17, 30, 32]. In recent years, new programming languages have been designed to be visually programmed without the need to learn the syntax, as it is the case with traditional languages [26].

Visual block-based programming environments are increasingly being used in introductory computer science lessons across elementary school grades. These environments, and the curricula that accompany them, are designed to be developmentally appropriate and engaging for younger learners [45]. Within these rich environments, the experience of coding can become playful and creative. They offer many opportunities for learning and personal growth, exploration, and mastery of new skills and ways of thinking [8]. Block programming eliminates the frustrations of syntax errors which afflict novice learning traditional computer programming languages [35]. Visual programming involves dragging and dropping instruction blocks together to form a program in a graphical development environment. The advantages of visual programming are [12]:

- Students do not need to learn syntax and cannot create syntax errors.

- Students can see what blocks (instructions) are available.
- Blocks often hide complex logic or operations in a single block.

The puzzle-like interface of these environments [10, 15, 33] allows novices to avoid syntax issues (e.g., semicolon use) and thus, allows them to focus on fundamental programmatic constructs (e.g., conditions, loops, variables). There is no typing error or misremembering of the syntax involved in the "bugs." The only possibility for an undesired outcome is the semantic error [43]. Since novices are not bullied by the compiler as they do not have to write codes following rigid syntactical rules, the programming is more meaningful and playful within Scratch [46]. This is a great relief for introductory programming and saves the learner much of the heartache traditionally forced on them by textual languages [46]. Given the large amount of software available and children-friendly programming environments such as Alice, Scratch, Greenfoot, and Kodu, teaching coding has become a more intuitive and engaging experience for young students [37] (see **Image 1**). In these graphical block-based programming environments, a novice programmer creates interactive applications by snapping together graphical pieces on the screen, like putting together a jigsaw puzzle. In addition, these environments are usually "low floor" and "high ceiling" and allow children to create their own complex computer programs, rich in sound and graphics [19].

On 15 May 2007, a revolutionary programming tool inspired by Logo (constructivist learning) was made available to the public. Scratch (https://scratch.mit.edu) is a free visual-based programming language environment especially developed for children and novices by the Lifelong Kindergarten Group of the MIT Media Lab. Like other visual block-based programming environments, Scratch presents a user-friendly visual language that encourages active methods, with a project-based learning and a role focused on student activity (see **Image 2**). Those

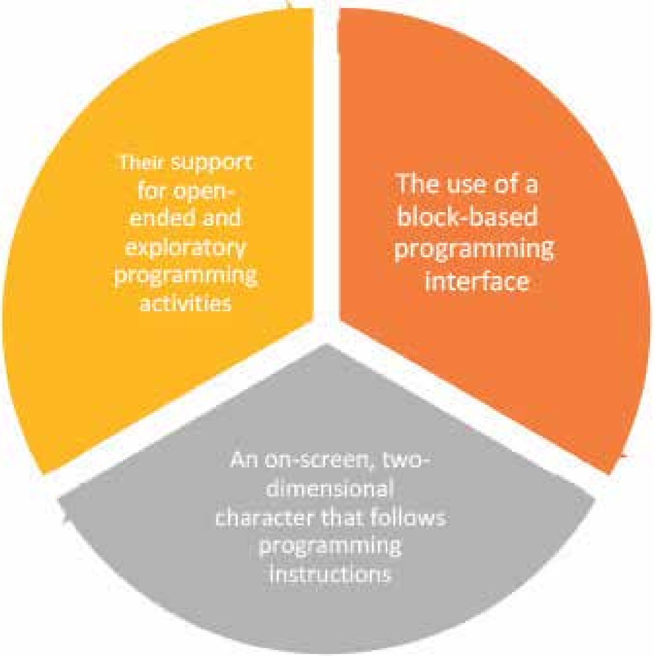


Image 1.
Key features of visual block-based programming environment (Adapted from [45]).

characteristics consist Scratch as one of the most popular tools used for introducing students to programming or better to CT (Evangelopoulou & Xinogalos, 2018). Scratch is designed to support children and novice learning through the process of experimenting and tinkering as it encourages learners to engage in creative learning experiences and express their ideas using code [44] enabling them to think creatively, reason systematically, and work collaboratively; all of which are essential skills required for the twenty-first century [20, 36].

Scratch can be used to program interactive stories, games, animations, music, and art [27, 31]. Those creations are called projects. A project is made up of sprites, which contain scripts, and they act on a stage [39]. The environment offers an online and an offline editor and an online community with millions of users sharing and remixing projects (Evangelopoulou & Xinogalos, 2018; [10]).

As Scratch has been developed with the aim of being very easy to use by anyone, regardless of age, background, or interests, it is being used by young people in schools, homes, and other learning environments around the world [44]. Only in August 2018, the Scratch website had almost 19 million visits with 115 million pageviews and 9 million unique followers! Also, Scratch is used at all levels of education across diverse fields, such as computer science, math, language, arts, social studies, and interdisciplinary projects (Evangelopoulou & Xinogalos, 2018; [10]). Even though it is claimed that Scratch appeals more to younger audiences [41], some universities (like Harvard, Berkley, and the University of California) have used Scratch as an introduction to programming [25, 43].

The next stage in the Scratch story is version 3.0. The beta version was released at https://beta.scratch.mit.edu/ on the first of August, and the official version will be available on January 2, 2019 [40] (see **Image 3**). Scratch 3.0 is written in HTML5. This means that with Scratch 3.0, the programmers will be able to play Scratch projects on their phone, create Scratch projects on their tablet, and control Scratch projects with their voice. There is also a version for kids for smart mobile devices, called ScratchJr (Scratch Junior) [10, 21, 22, 34, 42].

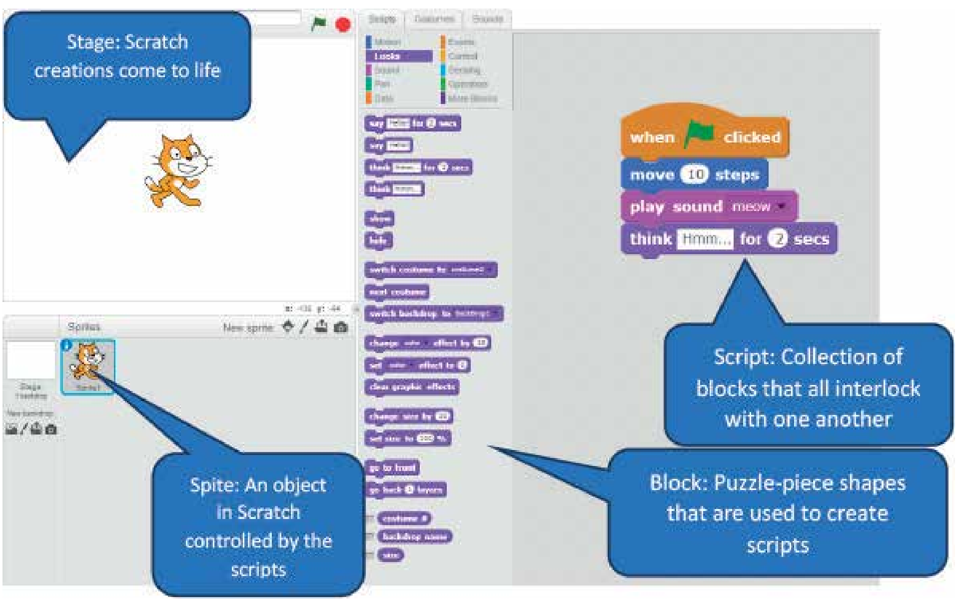


Image 2.
Scratch 2 layout.

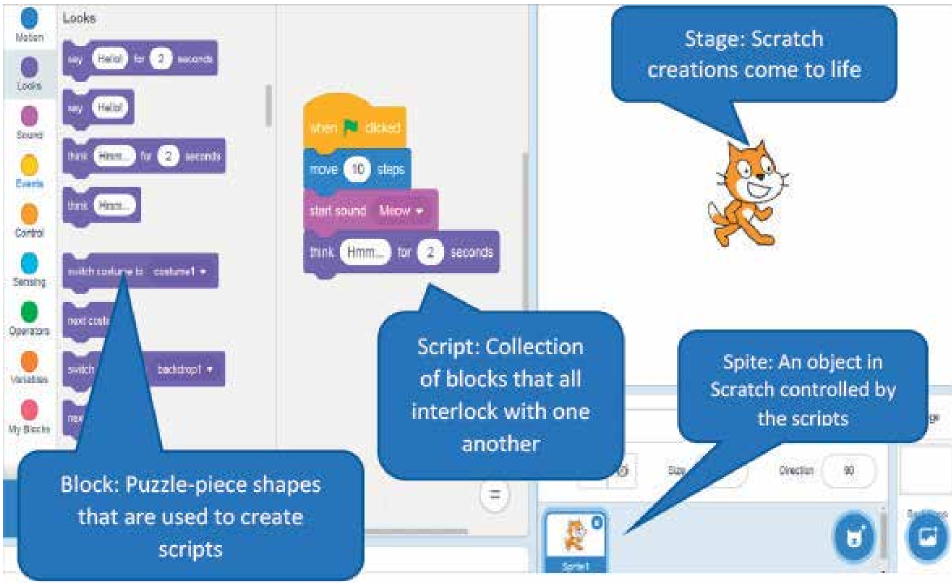


Image 3.
Scratch 3.0 layout.

3. Description of the course

3.1 The choice of the programming language

Novice programmers who are not interested in traditional approaches to coding become motivated when coding activities are introduced as a way to tell a story, or in connection with other disciplines and interest areas, such as music and art [44]. One of the main issues in the realization of the workshop was the choice of the programming language and how much time to allocate to the programming part [1]. As it is desirable that the preservice teachers be exposed to CT, and to its related concepts so as to be able to apply them effectively in the classroom and in learning activities, we decided to adopt Scratch as the introductory programming language environment at the Department of Preschool Education in the University of Crete. The reasons behind conception and design of this project are: we supposed that preservice teachers had different programming backgrounds and/or experience, and we felt that using Scratch as an introduction could be motivating, as it provides novices in programming with a meaningful and playful learning environment to create interactive games, animated stories, and simulations.

3.2 Objectives of the course

Technology and digital tools have become ubiquitous, but they can be ineffective or distracting if they are not integrated into the learning process in meaningful ways [5]. This paper presents an innovative approach that is guided by the constructionist philosophy developed by Seymour Papert. In constructionist learning environments, new knowledge is built through the programs created by learners [45]. In those environments not only can novice programmers design, build, and program their own interactive artifacts while having fun, but they can also learn how to work in groups and develop socioemotional skills [7]. In the process, they encounter powerful ideas from the realms of math, science, technology, and engineering [7].

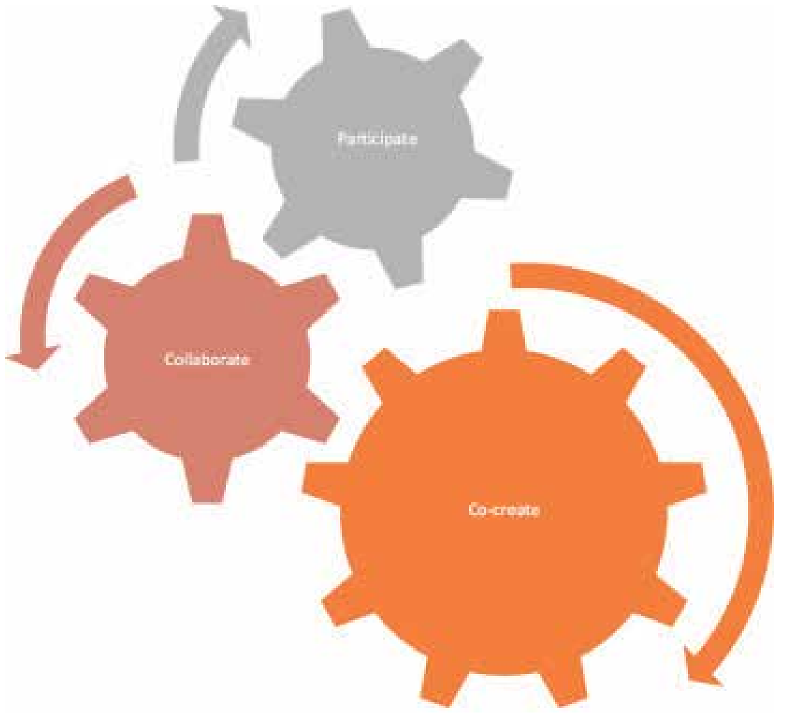


Image 4.
The trajectory of the course approach.

The course was developed to help preservice teachers introduce CS as a new subject to their students. It was also developed to demonstrate that even without a background or training in this subject, preservice kindergarten teachers have the ability to learn fundamental CS theory and concepts. It was focused on CS education in the context of developing higher-order thinking and problem-solving skills. We also wanted to encourage students to become innovative and think critically about how technology impacts their daily teaching techniques (see **Image 4**).

3.3 Course elements

Taking into account studies found in the literature [10, 43, 44], the course combines a little theoretical training with a strong practical component, encouraging the active participation of the trainee. Thus, the course elements are (see **Image 5**):

- Element 1. Scratch and applications built in Scratch. This element is divided into three parts:
  - The first one is about fundamentals and principles of CT.
  - The second part is about the Scratch environment, basic commands, control structures, and some advanced commands.
  - The third part is about the construction of projects in the form of animations, interactive stories, and educational games in Scratch. The Creative Computing Curriculum Guide (http://scratched.gse.harvard.edu/guide/) and the Scratch cards (https://scratch.mit.edu/info/cards/), a set of 12 cards which are available to download free from the Scratch website, were used as learning material, in order to help the students' teams to explore the features of Scratch on their own learning rhythm.

- Element 2. This element consists of building applications in the Scratch environment.

    - The students firstly were required to make their own version of the popular Angry Birds game. The idea was based on a similar project in the book entitled *Raspberry Pi Projects for Kids* [3]. In this game the player launches a bird through the air using a slingshot and attempts to hit all of the pigs at the other end of the level. This was a complex programming activity. In terms of the computational thinking framework, it involves the computational concepts of operators such as variables, control structures, keyboard-handling blocks, etc. The students had also to handle physics issues such as flight, gravity, and bouncing. For that reason, supplementary learning materials such as worksheets and group activity instructions were given to them. Furthermore, the educator advised the students how to manage the process of game development, working collaboratively, etc. Also, the educator offered his guidance to the students, helping them to complete their games and introducing even more complex CS concepts when needed.
    - Secondly, they were asked to create either an interactive story (based on an Aesop myth) or an educational game (trying to teach Greek language learning, math, or science). At the end of the semester, the students presented their projects. The program that each student created was also collected and analyzed to understand the outcomes of students' computational practices and their application of computational concepts.

3.4 Method

3.4.1 Participants

During the period between September 2017 and January 2018, 15 third-year female preservice kindergarten education students enrolled in a science education course entitled "Science education in early childhood" at a Greek university for

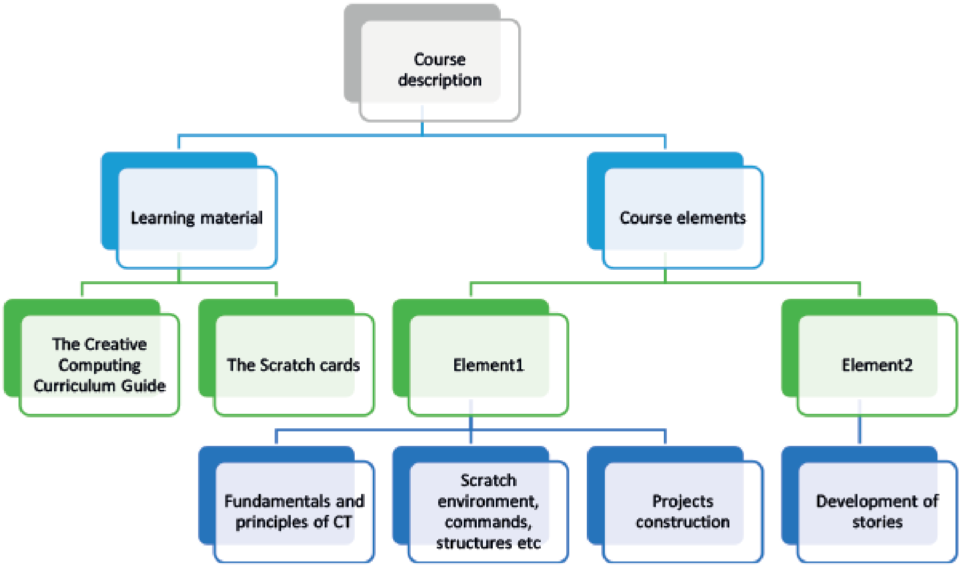


Image 5.
Course description.

13 weeks. The lessons were 3 hours per week. The course was offered as optional, and the students took part in the study after ethics approvals were received and all participants signed consent forms. All research participants had basic computer skills, but they had no previous experience with neither computational thinking nor the use of Scratch or any other programming environment.

3.4.2 Evaluation

In order to evaluate the course, we examined both cognitive (how effectively they learned) and affective (how enjoyable the experience was, and how motivated by it the students were) factors. Thus, in this study we collected both quantitative and qualitative data:

- The quantitative part was conducted in pretest/posttest quasi-experimental design. Moreover, to understand the learning of programming topics, we evaluated students' projects in terms of students' use of the elements of Scratch language as well as the project functionality and appearance. For that reason, students' project(s) were examined by using the Dr. Scratch tool.

- The qualitative approach used a short questionnaire and semi-structured interviews. Data were recorded through field notes, made by the researchers. This approach aimed at evaluating essentially three points:

    - The conception about the potential of Scratch and CT activities as a learning support tool
    - The intention to introduce a CT curriculum
    - The level of satisfaction about the course

The respondents were asked to answer both to closed questions (yes/not) and open questions ("Do you think that Scratch and coding activities can be a useful support learning tool? Why?," "Do you think about introducing some coding activities in your lessons? Why?").

4. Results

In this section we present and analyze the course results in terms of students' performance and satisfaction.

4.1 Performance analyses

Dr. Scratch is an online tool (http://drscratch.org/) that assesses Scratch projects with respect to seven "dimensions," namely, logical thinking (LT), data-information representation (IR), user interactivity (IN), flow control (FC), abstraction (AB) and problem decomposition, parallelism (PA), and synchronization (SN). A project can be graded (from 0 to 3) for each dimension in one of the levels, depending on the level of sophistication achieved by the project code [25, 26]. Thus, a total evaluation ranges from 0 to 21 (7 dimensions multiplied by [0–3]). We analyzed 15 different projects. The projects gathered were scored with values ranging between 10 and 20 (see **Table 1**).

Similar to other studies [27], this study revealed challenges with respect to the use of concepts, such as the parallelism and synchronization. Also, very few applications made use of random numbers and logical expressions. On the contrary,

Statistical measure	Dimension of computational thinking						
	PA	*LT*	*FC*	*IN*	*IR*	*AB*	*SN*
Mean	1.88	1.54	2.16	1.81	1.68	0.72	1.84
Std. dev.	0.38	0.29	0.41	0.32	0.29	0.22	0.41
Minimum	0	0	1	1	1	1	1
Maximum	3	3	3	3	3	2	3

Table 1.
Project score given by Dr. Scratch.

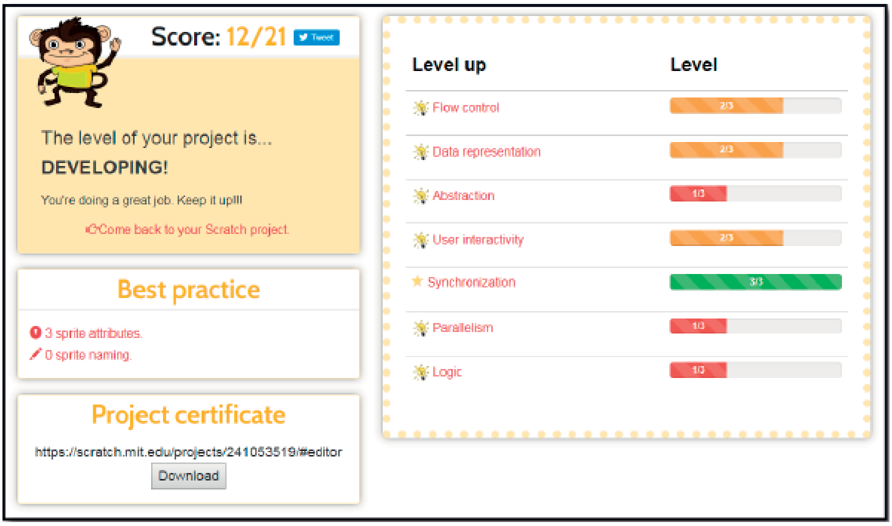


Image 6.
Example of Dr. Scratch project evaluation.

the frequently used coding concepts such as flow control and user interactivity reveal that the students in their projects make an adequate use of specific conditions and foresee users' interaction. Except the fact that Dr. Scratch provides feedback on several aspects which are related to computational thinking, the software categorizes the project developer skills in three different categories/levels: Basic, Developing, and Master. The 15% of the developed apps were "Basic," and 85% were "Developing." There were no projects on the "Master" level. **Image 6** shows an example of how Dr. Scratch categorizes developer skills. The screenshots of the graphical user interface, code parts, and Dr. Scratch scores of five randomly selected projects are displayed in the Appendix.

4.2 Students' self-efficacy analyses

To evaluate students' self-efficacy in utilizing programming and computational thinking within their future teaching endeavors, we adapted the Teachers' Self-Efficacy in Computational Thinking (TSECT) [4]. We used the first seven of the nine TSECT items (see **Table 2**). All items use a five-point Likert scale with options of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. TSECT was given as a pre- and posttest before and after the intervention. Questionnaire analysis was performed with SPSS 23.

Item	Wording
1	I feel confident writing simple programs in Scratch
2	I know how to teach programming concepts with Scratch
3	I can encourage a positive attitude toward programming to my students
4	I can become a mentor teacher and support my students to use programming as a tool to explore other topics
5	I'm sure myself to use programming as an educational tool within a classroom
6	I can adapt methods, lesson plans, and curriculum materials for using programming as an educational tool
7	I can create lessons plans using programming as an educational tool

Table 2.
Modified TSECT instrument items.

A t-test of the pre and post-survey TSECT scale revealed a statistically significant increase in TSECT from pre (M = 12.03, SD = 4.39) to post (M = 18.14, SD = 3.59), $t(14) = 3.98, p < .0001$. From the students' answers, we can conclude that after the intervention, they feel themselves confident enough to create projects and they plan to incorporate programming as an instructional tool in their future classrooms.

Furthermore, after completion of the course, the researchers conducted a focus group interview with a structured interview form. All the students noted that the added cognitive effort was worthwhile and decided to bring coding activities into the early childhood classroom. The students noted that they experienced a significant shift in mindset during the course. Before the course started, all students identified the lack of CT knowledge and skills as a major challenge. After the course, all of them could successfully define key CT concepts. They expressed a high degree of confidence that they taught the CT lessons effectively contributed to their learning. Moreover, all students noted that they made major leaps in correcting their misconceptions about what CT is and understanding fundamental CT concepts. After the focus group interview, the researchers noted that the majority of the students could explain what CT is and describe the main concepts covered during the course. It is also worth to mention that all students indicated that they would like to continue CT training in the following academic year, if that was possible. They also mentioned that they would recommend the course to other students.

4.3 Limitations

In this chapter, we studied how a course helped preservice teachers to learn and introduce CT concepts into their daily teaching practices as a new subject to their students. The programming and teaching behaviors that emerged still need to be validated through further studies. Furthermore, since the data was collected from female students from one university department, the findings should be applied to subjects from other disciplines with caution. Moreover, it may be useful to employ a mixed method approach that incorporates long-term practical research methods for a deeper investigation of factors affecting attitudes and intentions toward using Scratch in respect to the students' gender.

5. Discussion and conclusion

Discussions about the appropriateness of technology in early childhood are mostly put aside, and the pressing question is not "Should we introduce computers?" but "How should we introduce them?" ([11] as cited in [7]). If coding is conceived as a skill that must begin to be taught early in life [8], and new curricula worldwide in preschool and primary education is covering computational thinking, digital technologies and related areas are being introduced, many preservice teachers are having to undergo professional development to be able to deliver the new material [13]. There are a number of obstacles to bringing coding into the classroom. Even putting obstacles such as the cost to training, teachers have a tendency to teach the way they were taught, and systemwide reform is difficult to implement. To properly bring hands-on learning (or coding, robotics) into the classroom, the classroom must change from a teacher lecturing to a teacher being a mentor [7].

In this paper we described a course that we have developed at the Department of Preschool Education at the University of Crete in an attempt to help preservice teachers to learn CT concepts and programming. Owing to the fact that preservice teachers find it difficult to master the syntax of programming languages in general [23], we believe that the choice of visual programming language is an important factor in learning programming [18]. In this course we chose Scratch as the main programming environment to create an area for preservice teachers for their innovative ideas and a platform to cultivate preservice teachers' computational thinking.

The results, like other studies, show that by enhancing the course curriculum with Scratch and development projects in the Scratch environment, students' performance on CT improved significantly. Similar to Kim et al. [23] research results, we also agree that "Scratch helped pre-service teachers focus on what they could do with programming languages (p. 971)." Scratch helped preservice teachers to overcome their programming difficulties (e.g., syntax) and to focus on core aspects of computational thinking [23].

As it is widely known, changes in learning and teaching practice in class can precede changes in teachers' attitudes and beliefs. Thus, the changes in attitude noted in this study suggest that the preservice teachers believe that Scratch would be a useful tool to do their job and using Scratch would enable them to use technology more effectively [4]. Similar to the study of Arpaci [2], preservice teachers think that using Scratch would increase their productivity, enhance their effectiveness, improve their job performance, and ease their job. Another important thing to consider is that students with no prior programming experience noted that Scratch had assisted them in learning programming.

Based on the success of course, we made the following conclusions:

- We believe that training preservice kindergarten teachers to coding is the best strategy to ensure that all in-service kindergarten teachers will have a technological literacy and computational thinking skills. By introducing coding in university, students will have enough time and exposure to acquire solid computational thinking before they teach in kindergarten.

- The majority of preservice teachers are willing to invest time and effort in training related to CT skills. They recognize that they need to have a technological literacy and computational thinking skills to be prepared for the future.

- There are CT education resources such as lessons and teaching materials available online which are suitable for the novice programmers. Those lessons and teaching resources can be implemented as curriculum which reflects a scaffolding approach.

In future work, it would be an idea to plan out a more open-ended set of challenges, which would allow students to use most advanced CT concepts. Also, it would be a good idea to integrate in the course smart robots such as Bee-Bot and Kibo or Internet-connected smart toys such as Sphero. Also, as a new version of Scratch, Scratch 3.0 is on the way and it would be a good idea to integrate in a new course the use of smart mobile devices such as tablets as a part of new students' experience.

Acknowledgements

We like to thank all of the students involved in this project.

Conflict of interest

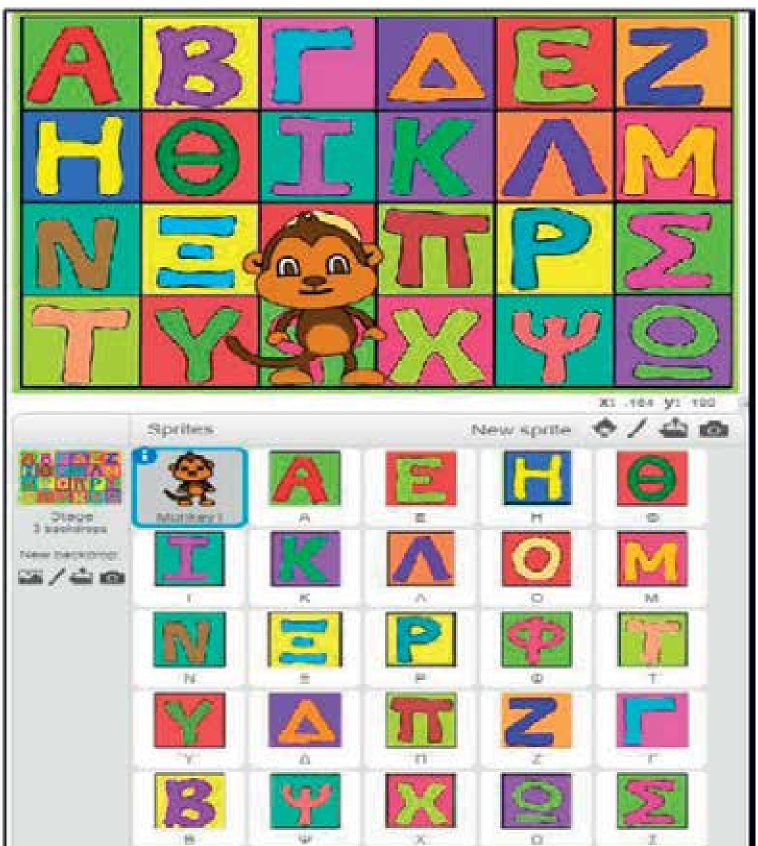
There is no conflict of interest to be declared.

A.Appendix

Example of the user interface, code, and Dr. Scratch scores in two randomly selected students' projects.

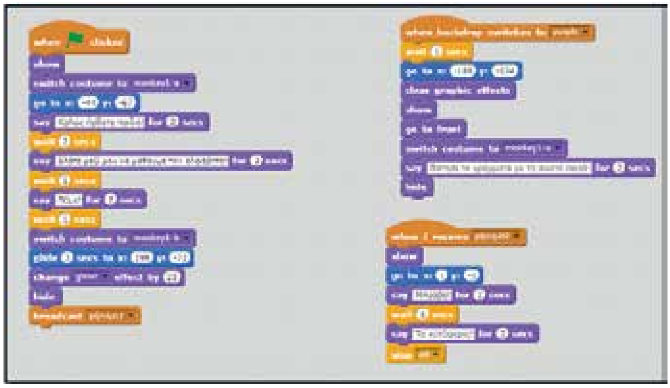
A.1 Project 1. Learn Greek alphabet

A. User interface



DOI: http://dx.doi.org/10.5772/intechopen.81714

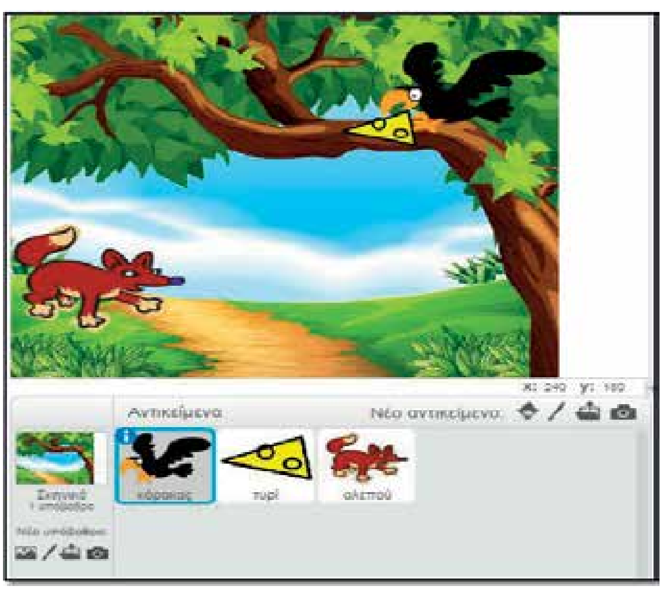
B. Code example



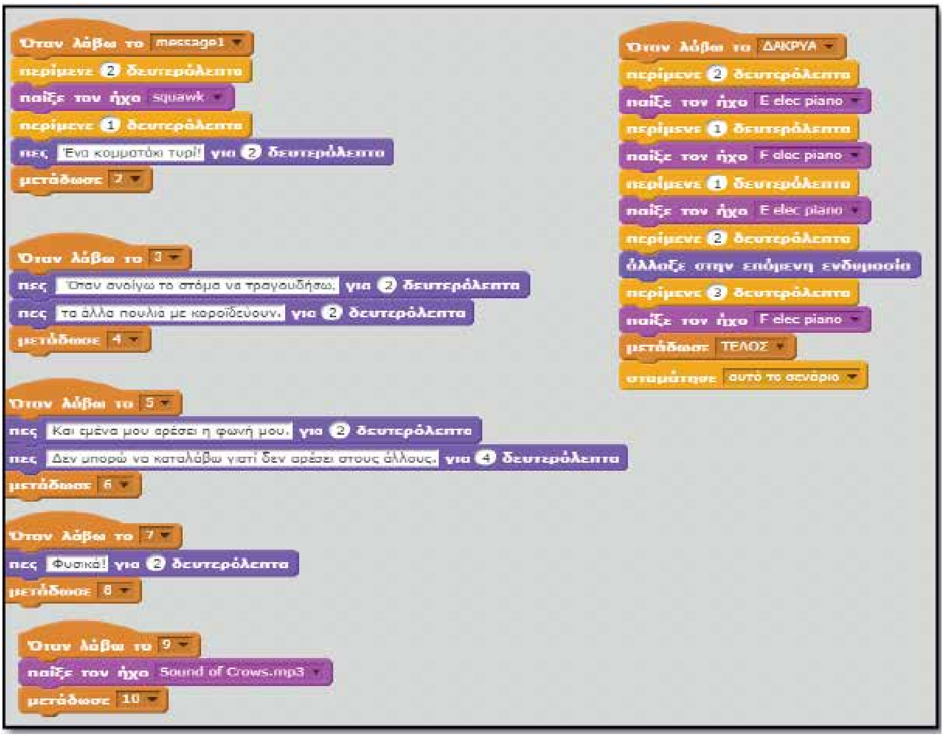
C. Dr. Scratch score

A.2 Project 2. The Fox and the Crow: An Aesop's Fable

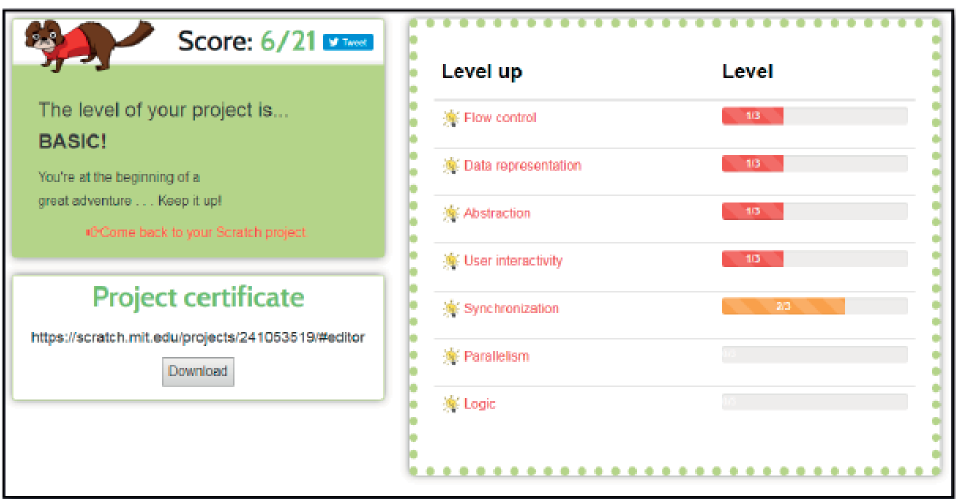
A. User interface



B. Code example



C. Dr. Scratch score



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Section 6

Literacy

Chapter 13

Screening Young Children at Risk for Reading Failure

Sotiria Tzivinikou

Abstract

Reading and reading difficulties are some of the most researched topics in the literature in regard to psychology and education. Additionally, some specific subjects such as prediction and prevention attract research interest as well. These issues are discussed in the present chapter that focused on the screening measures and their characteristics towards significance and effectiveness. More specifically, discrimination accuracy, sensitivity, and specificity as well as validity and reliability were taken into consideration. Some well-known studies were examined revealing a range of methodological issues, which affected the effectiveness of using measures in the extant research. Although the findings were consistent with literature, they continued to be scant and not widely accepted, affected by several limitations regarding the sampling and the experimental design.

Keywords: reading difficulties, screening, discrimination accuracy, sensitivity, specificity

1. Introduction

The reading struggling and prevention of reading failure are among the most important and well-studied subjects in the relevant literature. Two decades earlier, Joseph Torgesen, in his influential article "Catch Them Before They Fall: Identification and Assessment to Prevent Reading Failure in Young Children" argued that "*The best solution to the problem of reading failure is to allocate resources for early identification and prevention. The goal is to describe procedures … to identify children who need extra help in reading before they experience serious failure…*" [1].

Actually, in the following years, great emphasis has been placed on the issue of screening for at-risk children and important research findings have emerged, such as Ref. [2] findings showing that most children at risk for early reading difficulties could be effectively identified at the beginning of kindergarten. As the literature review shows, a lot of effective and precise screening tools and procedures have been developed in order to locate the at-risk children as soon and as precisely as possible.

2. Considerations on effectiveness of screening

It is widely accepted that diagnostic assessment is not practical for assessing all children for academic risk, while screening procedures could provide reliable and valid information regarding children's current academic skills and meet financial and time constraints [3]. However, screening is a preliminary process of identification that could identify those children who may be at risk of future difficulty in school and in need of further individual diagnostic testing. More specifically, it is a brief assessment that provides predictive information about a child's development in a specific academic area, in order to identify at-risk children that need extra support through early intervention. The screening measure is administered to all children and is used to identify an initial risk pool of children suspected of being at risk of developing reading disabilities. Screening information leads to the decision of risk for each child screened. Risk decisions are made by selecting a critical cut-point along a continuum of scores on a single or group of screening measures [4].

Screening may include parent interviews or written questionnaires and checklists, observation of the child, or use of specific screening tests. Because the earlier a learning disability is detected, the better chance a child will have of succeeding in school and in life, it is used mainly at the kindergarten or at the beginning of the first grade. Often, early identification is delayed, and as a result, the at-risk children might experience significant problems in learning to read. The consequences of these delays for the child include prolonged frustration, missed opportunities for special instructional interventions, and cumulative academic deficiencies, as well as lifelong secondary psychological problems.

From early years until now, there has been a common understanding of characteristics of effective developmental screening tests. These characteristics are an adequate standardization sample, low cost, ease of administration, appropriate content, and adequate validity and reliability (e.g., see [5, 6]). However, predictive validity or instrument reliability has also been cited as a major problem in screening for children at risk [7–10]. Ref. [11] stated "… *a test with a low predictive value is unlikely to be either efficient or useful*…" (p. 1583). An effective framework is usually appreciated based on the measures of relevance and utility. Relevance of the measures relates to the relationship between the measure and the purpose of the assessment on the one hand, and the utility of the measures on the other hand, which is usually evaluated by cost-effectiveness [12].

Screening studies discussed the outcome results as poor or good, with poor indicating a subject who exhibits the target disorder and good a subject who does not. The measurement is realized in two points of time. Based on the measurement results, four placements may occur; the subject may be placed in cell A: failed screen and poor outcome = true positive; cell B: failed screen and good outcome = false positive; cell C: passed screen and poor outcome = false negative; and cell D: passed screen and good outcome = true negative. The matrix is deceptively simple and easy to misinterpret, because cell information varies in relation to rows, columns, or the entire matrix [7, 13].

On the other hand, a vast majority of the studies recommended the assessment of accuracy in terms of sensitivity and specificity as appropriate indices to identify the capacity of an examined screening instrument (**Table 1**). These indices can be calculated using the formula: Sensitivity = TP/(TP + FN) and Specificity = TN/(TN + FP). Sensitivity and specificity are two sides of a coin. Sensitivity is related to the probability that a result of a test will be positive, when the criterion—in this case, disability—is present. Expressed as a percentage, sensitivity measurement results in a true positive rate. On the contrary, specificity produces a true negative rate expressed as a percentage, referring to the probability that a test result will be negative when the criterion—in this case, disability—is not present. The overall classification accuracy can be estimated using the Eq. (TP + TN)/(TP + FP + FN + TN) [5]. Positive likelihood ratio is the ratio between the probability of a positive test result given the presence of the disease and the probability of a positive test result given the absence of risk (e.g., [4, 8, 12, 14–28]).

Predictor (screen)	Poor outcome (criterion)	Good outcome (criterion)
Poor (Fail to screen)	(TP) True positive	(FP) False positive
Good (Pass to screen)	(FN) False negative	(TN) True negative
Sensitivity = TP/(TP + FN) Specificity = TN/(TN + FP) Classification accuracy = (TP + TN)/(TP + FP + FN + TN)		

Table 1.
Screening results table.

Using a risk index can serve as a good alternative to single cut scores. This index includes calculations as probability of being classified as at risk or not at risk. A weighted regression formula of predictors to a specific outcome determines the classification and the construction of the risk index. Moreover, the ability of a test to discriminate diseased cases from normal cases is evaluated using a receiver operating characteristic (ROC) curve analysis. ROC curves can also be used to compare the diagnostic performance of two or more screening tests [5, 29].

An ROC curve is provided by a screen that cannot discriminate between cases and non-cases. This is a straight line passing through the origin with unit slope, and effective screens will provide a convex curve above this line. Area under the curve (AUC), that is, the ROC curve, provides a measure of the screening test performance. This measure goes beyond sensitivity and specificity at a single threshold, integrating the full range of scores that need to be taken into account for making a decision about a threshold in order to separate illness from health. This practically means that a value of 0.5 (that is under the straight line of unit slope) indicates a lack of effectiveness, whereas a value very close to 1.0 is indicative of a very good screen.

Ref. [3] noted that the AUC is an indicator of a screening tool's overall ability to differentiate between children with lower-than-average emergent literacy skills and children with average or better emergent literacy skills, and it is calculated at all possible cut scores. Using optimal cut score statistics allows examination of the utility of the screening tool under the circumstances in which it would typically be used. Ref. [4] suggested that AUC values above 0.90 represent excellent diagnostic accuracy, between 0.80 and 0.90 represent good, 0.70–0.80 fair, and values below 0.70 are considered poor.

3. Single or multiple predictors and criterion measures

Large amounts of predictors have been proposed by researchers. Several pre-reading measures, when administered in kindergarten, are predictors of later reading abilities. These measures include letter name and letter sound knowledge, phonological awareness, verbal short-term memory, and rapid automatized naming [6].

Two related studies [23, 24] found that measures of letter naming, phonological awareness, rapid object naming, and non-word repetition at the beginning of kindergarten were very good predictors of reading outcomes at the end of the first grade. Ref. [2] further has shown that measuring at-risk children's response to supplemental intervention during kindergarten can improve accuracy of identification beyond that of early screening. Even when predicting performance on the state assessment in the third grade, Ref. [5] found that a comprehension measure was the best predictor. In addition, the review [34] revealed that risk factors associated with speech and language delay were male gender, family history, and low parental education.

Moreover, phonological awareness was recognized by Refs. [16, 17] as an important risk factor. However, Ref. [8], proposed as risk factors the letter-name knowledge, and the rapid serial naming, reference [20], proposed the Inittial Sound Fluency task of the DIBELS, reference [21], proposed the rapid naming objects, reference [22], proposed the Word Identification and Passage Comprehension subtests and the Word Attack subtest of the WJ-R., and final reference [19], proposed as risk factors the Letter-Name Fluency (LNF), and the Nonsense Word Fluency (NWF).

Additionally, most of the screening studies used multiple predictors, and all of them used phonological processing measures [8, 16–22]. Some of them used the total or part of a specific screening test in order to test their validity and reliability [20–22]. Some others used measures such as pre-reading behaviors, reading habits [18], or working memory [30]. Others used parents or self-reported questionnaires and checklists [31, 32], and finally some used teacher ratings [28, 33].

Similar risk indicators have been used in the context of the newest screening studies. For example, a multivariate screening battery was administered by Ref. [4] to 252 beginning first-grade children. The children had low initial reading abilities, and their reading outcomes were measured at the end of the second grade. Logistic regression analyses showed a high degree of accuracy concerning the prediction of reading outcomes. This screening model, which proved to be highly accurate, included measures of phonological awareness, rapid digit naming, and oral vocabulary.

Ref. [28] examined 240 fourth-grade children and they were classified as not-at-risk or at-risk readers based on a three-factor model reflecting reading comprehension, word recognition/decoding, and word fluency. More specifically, participants were assessed using measures of reading comprehension, oral language, word recognition, word decoding, phonological processing, auditory memory, and spelling.

As criterion measures, all of them used reading ability tested by a number of standardized and normalized reading tests. The most popular of them were the Woodcock Diagnostic Reading Battery; Woodcock-Johnson Psycho-Educational Battery-Revised; CTOPP; Reading-Gray Oral Reading Test; WRAT Spelling; and Peabody Individual Achievement Test.

4. Research design considerations and findings

Regarding the experimental design of the screening studies, it could be noted that a lot of these had longitudinal or follow-up designs and the other half had a cross-sectional one. Commonly, the follow-up studies had two phases with one-year interval. Others had different designs, for example, Ref. [21] included three phases and 16-month interval and Ref. [17] presented two phases and 4–6-week interval. These studies administered the set of predictors (tests or part of tests or single measures) and at the second phase, the criterion measures were administered, that is, the reading ability measures. The studies with cross-sectional designs administered the predictors and the reading measures at the same time.

There are two approaches to the study of reading disabilities. Firstly, the most common approach to reading assessment is to separate children into groups based on their reading scores. Consequently, it is important to determine if variables thought to be related to the development of reading skills are predictive of group membership, that is, they predict if the child belongs to the at-risk group or not. Secondly, the alternative approach is to consider reading as a continuum of abilities. Based on that, it is significant to determine if the variables thought to influence the development of reading abilities can predict the full range of the child's reading scores obtained. Concerning the significant discriminant function models regardless of which language measure was used, classification accuracy was about as good or better for the typical reading group as it was for the poor reading groups [34]. Screening studies mainly used t-tests, ANOVAs, MANOVAs; correlations; logistic regression; and discriminant analysis. Often, the cutoff scores used by the studies were arbitrary, usually recommended by the literature (e.g., [16]) or revealed by the statistic multiple analyses to give the best results [20, 31, 32].

Screening procedures that result in sensitivity levels at or above 90% and specificity levels of at least 80% are generally deemed acceptable ([29]). An alternative index of accuracy is the area under the receiver operating characteristic (ROC) curve. According to Ref. [29], an ROC curve is a plot of the true positive rate (sensitivity) against the false positive rate (specificity) for each of the cut points of a decision-making instrument. Therefore, the area under the curve (AUC) may be used as an overall estimate of the accuracy of an assessment. Values above 0.80 are considered good, while values above 0.90 are excellent [29]. Ref. [25] found that AUC was 0.84 when reading outcome was based on individual component measures of reading and 0.86 when reading outcome was based on a composite score for reading.

Ref. [3] had administered at two time points two screening tools to 176 preschoolers. Specifically, the study used the Revised Get Ready to Read! (GRTR-R) tool, the Individual Growth and Development Indicators (IGDIs), and a diagnostic measure. Comparing the two screening tools based on a receiver operating characteristic curve analysis, it emerged that, at optimal cut scores, IGDIs provided less accurate classification of children's overall emergent literacy skills than GRTR-R. However, neither measure was particularly good at classifying specific emergent literacy skills.

On the other hand, Ref. [23] examined if kindergarten measures of language ability predicted reading comprehension difficulties independently of direct word reading measures. In addition, they investigated if response to language intervention in kindergarten added to the prediction of third-grade reading comprehension. The participants were 263 kindergarten children at risk and 103 children for control group matched in age.

Ref. [26] examined and evaluated if and to what extent R-CBM and CBM maze were technically adequate to inform their use in the context of a universal screening program of reading in fourth and fifth grades. The results of the study suggest evidence of short- and long-term alternate forms of reliability, criterion validity, and predictive validity for both R-CBM and CBM maze. It is also supported that possibly the two measures are comparable for use in universal screening at those grade levels. Therefore, the study suggests that R-CBM and CBM maze could be used interchangeably for screening of reading outcomes.

Ref. [34] was a review aimed to update the evidence on screening and treating children for speech and language delay in children through 5 years of age. In 23 studies evaluating the accuracy of screening tools, sensitivity ranged between 50 and 94%, and specificity ranged between 45 and 96%. As noted above, 12 treatment studies improved various outcomes in language, articulation, and stuttering. There has been restricted evidence concerning interventions that provided other improved outcomes or adverse effects of treatment. Male gender, family history, and low parental education were the main risk factors that were related to speech and language delay. The use of various screening tools can lead to accurate identification of children who need/undergo diagnostic evaluations and interventions. Evidence, on the other hand, is not adequate concerning their applicability in primary care settings. In addition, some treatments for young children, who have been identified with speech and language delays and disorders, may be effective.

The recent study of Ref. [35] aimed at dyslexia's early detection via machine by observing how people interact in the context of a linguistic computer-based game. In order to train a statistical model that predicts readers with and without dyslexia using measures derived from the game, they examined 267 children and adults.

Specifically, the model was trained and evaluated in a 10-fold cross experiment. Using the most informative features, it reached an 84.62% of accuracy.

Another recent study of Ref. [12] focused on a year-end state reading assessment in two states. The study examined the predictive validity and classification accuracy of individual- and group-administered screening measures related to student performance. A total of 321 students participated in the study, and in the fall of fourth grade, they were assessed regarding word-level, text fluency, and reading comprehension. Logistic regression results, applying a multivariate approach, revealed minimal to no increase in classification accuracy over the single comprehension measure. Receiver operating characteristic (ROC) curve analyses determined local cut scores to maintain sensitivity constantly at 0.90; this resulted in a large number of false positives.

Referring to predictive accuracy, Ref. [16] in accordance with findings of the past decade found that both phonological awareness and letter identification yielded the highest overall results. Moreover, all the constructs were promising as far as the accuracy rates are concerned. The false positive rate ranged from 13 to 27%, depending on the construct. The false negative rate ranged from 0.06 to 0.21%. Researchers continue to struggle with high hit and miss rates in predictive accuracy. Most importantly, researchers must address the high rate of false negatives. As funds and resources to provide reading interventions are limited, this is of particular practical importance to ensure that the most appropriate students are served.

The study of Ref. [17] examined the convergent and concurrent validity of two recently developed measures of phonological processing, the TOPA and the CTOPP. Both of these instruments used in combination appear to be useful in the early identification of children at risk for difficulty in learning to read. Based on the results, however, the use of either, or both, of these instruments as sole predictors of reading outcome cannot be supported.

The study of Ref. [20] compared DIBELS test with CTOPP. Specifically, the concurrent validity and diagnostic accuracy of the published test DIBELS was examined and was compared to the well-documented published test of CTOPP. Results suggest that the DIBELS strongly correlates with subtest and composite scores of the CTOPP that are designed to measure phonological awareness and memory, and less strongly with rapid naming tasks.

The findings of Ref. [18] indicated that the accuracy of the discrimination was high, 89.7%, with a 6.2% false negatives rate. However, using the calibration data from the reference group to identify at-risk status in a different sample, the accuracy fell to 80.2% with a 10.2% false negative rate.

Ref. [31] found that the Adult Reading History Questionnaire (ARHQ) was valid. This was demonstrated by the high correlation between the ARHQ and diagnostic measures for adults ($rs = 0.57–0.70$). However, not every familial case is perfectly detected by ARHQ. Therefore, it would be more preferable and appropriate if clinicians and researchers used this questionnaire less as a diagnostic tool and more as a screening instrument.

The findings of Ref. [8] supported that letter name knowledge and rapid serial naming were most important in predicting later RD. The study had a sensitivity of 0.49 and specificity of 0.76. The findings of Ref. [21] were not consistent with the initial findings of the designers that the DEST was significantly and strongly correlated with later reading ability. Specifically, the rapid naming of objects variable emerged as a consistent predictor of later attainment, which predicted significant amounts of variability in reading and spelling, and the correlation coefficient were 0.344 ($p \leq 0.05$).

Ref. [22] examined the relations among standardized reading achievement tests, phonological awareness measures (CTOPP), and fluency rates (CBM, subtest of

Woodcock-Johnson Tests of Achievement-Revised) and how these measures relate to teacher ratings. The authors supported that measures of phonological awareness and reading fluency that provide further information may be included as part of reading assessment in addition to traditional norm-referenced measures of reading achievement.

Ref. [19] examined whether the measures could accurately identify poor readers in first grade. The sensitivity of phonological awareness was 42.9 and 66.7% for ORF and the WJ-R Word Attack, respectively, missing one-half and one-third of the students who later demonstrated reading problems. In addition, measures of letter name knowledge and letter sound knowledge were not sensitive in identifying students who were performing poorly on either first-grade reading criteria, with sensitivity of 57.1%.

Ref. [32] constructed a parent report checklist including information about the development history of the child and some indicators for reading problems. The author supported that this checklist was valid and reliable and it could be screened between RD and NRD with 97.2% discriminative accuracy.

In the study of Ref. [30], phonological awareness, distinctness of phonological representations, and phonological working memory were captured in the context of a series of tasks. Furthermore, a questionnaire was designed including two scales of self-reports: (a) one concerned with typical dyslexic symptoms and (b) one concerned with reading interest. The findings noted that the most powerful discriminator was the self-report data.

Ref. [36] examined the accuracy of teacher ratings. Therefore, kindergarten children identified by their teachers as making substandard progress toward one or more academic objectives performed significantly less well than a matched group of no identified children on tests of word reading, spelling, mathematics, and knowledge of letter names and letter sounds. Furthermore, by the end of the third school year, greater proportions of identified children than no identified children were receiving special learning assistance.

Another study examining teachers' rating was Ref. [33]. Kindergarten teachers appear to be better predictors of students who will not develop academic difficulty, as negative predictive values were consistently high regardless of the predictive variable. Variables associated with learning rather than behavioral or social variables may be better indicators of future academic achievement. The authors proposed that effective academic screening measures be used in conjunction with teacher ratings in order to maximize specificity in identifying children who are at risk for later learning disability early in their academic years.

More recently, Ref. [28] compared teacher ratings and reading factors as predictors for future reading competence. Specifically, they administered multiple measures of reading to 230 fourth-grade children. Teachers rated children's reading skills, academic competence, and attention. A three-factor model including reading comprehension, word recognition/decoding, and word fluency was used, in order to classify children as not-at-risk or at-risk readers. Predictors of reading status included group-administered tests of reading comprehension, silent word reading fluency, and teacher ratings of reading problems. The receiver operating characteristic curve (ROC) analysis yielded an area under the curve index of 0.90.

5. Screening in RTI context

The goal of universal screening is to promote the early identification of reading difficulties or potential reading difficulties. In order to prevent further difficulties, screening measures that detect a large proportion of at-risk students would be desirable so that appropriate remedial support can be provided to students.

Screening and identification of students with/at-risk for reading difficulties represent an important first step in RTI models, for k-2 grades, and, in addition, for students in upper elementary grades where there is a particularly large percentage of struggling readers [12].

As Ref. [37] noted, during the last decade, responsiveness to intervention (RTI) has become popular among many practitioners. Specifically, it has been used as a means of transforming schooling into a prevention system with multiple levels. In order to be implemented successfully, RTI requires ambitious intent, a comprehensive structure, and coordinated service delivery. The level of its effectiveness also relies on building-based personnel that has specialized expertise at all levels of the prevention system.

In that context, a direct route approach to screening is typically employed by schools. Based on this approach, students identified as at risk by a screening process are directly placed in intervention. Direct route approaches require screening decisions to be highly accurate. However, few studies that have examined the predictive validity of reading measures report achieving recommendations concerning classification accuracy.

Ref. [5] compared two approaches that aimed at improving the classification accuracy of predictors of third-grade reading performance. Findings indicated that relying on single screening measures does not result in high levels of classification accuracy. Classification accuracy improved by 2% when a combination of measures was employed and by 6% when a predicted probability risk index was used.

On the other hand, from an RTI perspective, Ref. [24] investigated whether measures of language ability and/or response to language intervention in kindergarten uniquely predicted reading comprehension difficulties in third grade. A total of 366 participants were administered a battery of screening measures at the beginning of kindergarten and progress monitoring probes across the school year. A subset of participants also received a 26-week Tier 2 language intervention. Participants' achievement in word reading was assessed at the end of second grade, and their performance in reading comprehension was measured at the end of third grade. Results showed that measures of language ability in kindergarten significantly added to the prediction of reading comprehension difficulties over and above kindergarten word reading predictors and direct measures of word reading in second grade.

6. Discriminative accuracy-sensitivity-specificity-ROC analysis

A screening test could be perceived as effective in case it is norm-referenced, and it has appropriate content, validity and reliability, and ease of administration and interpretation. It also needs to be quick and cost-effective. An additional criterion is related to its discrimination accuracy with emphasis on false negative and false positive rates [7, 11]. The accuracy of screening measures is important given the concern of either mislabeling a child or failing to detect a delay.

Continuous efforts for improvement of accuracy of screening instruments have been reported in the relevant literature. These include using a combination of assessments and assessing risk on a continuum rather than as "fixed" cut scores. In addition, the use of probabilities based on multiple assessments has the potential to enhance the accuracy of the screening process by making screening decisions based on multiple indicators as well as on what is known about the prevalence of the condition under question.

However, according to Ref. [38], the concept of validity has expanded beyond the traditional correlation coefficient between a criterion and the new measure. It was defined as not only the degree with which the measure assesses the construct but also “the adequacy and appropriateness of the inferences and actions taken on the basis of the scores” (p. 13). Validity thus includes social consequences and relevance/utility in addition to more traditional concepts. Furthermore, the same reference, [38], included reliability, content, and criterion validity as part of construct validity. So, even though only a few of the reviewed studies were interested in reliability of testing measures, in accordance to Ref. [38], a larger number of these studies were interested in the other aspects (e.g., [19]).

If a test is not valid, then, reliability is moot. In other words, if a test is not valid, there is no point in discussing reliability, because test validity is required before reliability can be considered in any meaningful way. The studies that had emphasized reliability after validity’s validation were Refs. [31, 32].

The validity of any predictive instrument depends in part on two key factors: sensitivity and specificity. To compute sensitivity and specificity using the formula mentioned above, the performance of each child on the assessments was first classified as above or below the cutoff score. A cutoff score is a value below which poor school performance may be suspected [14].

Ideally, the determination of an appropriate cutoff score should be based upon locally developed norms. Ref. [39] supported the use of local cutoff points as well: “in order to differentiate those ‘at-risk’ children a cutoff may use local norms for the best predictability for future achievement in that school system” (p. 15). Nevertheless, Ref. [40] argued “the cut-off point(s) between normal reading and disabled reading is always arbitrary” (p. 30). In addition, Ref. [7] agreed that often the cutoff point is an arbitrary value that has been adjusted to achieve the best results in predictive accuracy. Once outcome data have been collected, the cutoff score may be altered to achieve the best results.

Emphasis is placed on interpretation of sensitivity and predictive value, both of which reflect a screen’s ability to accurately identify or predict subjects who will have a poor outcome. Reported values above 0.80 are considered acceptable for these indicators [7, 14].

From RTI’s perspective, researchers have argued that high levels of sensitivity are necessary for universal screening measures [12, 37]. Although consensus has not been reached regarding optimal levels of sensitivity, acceptable sensitivity values noted in the literature range from 0.70 to 0.90 [12]. Relatedly, specificity levels of at least 0.70 are generally considered adequate for screening measures.

Related to the labeling issue is the false positive rate, the number of children identified in kindergarten who were not poor readers in first grade. This means that children who do not need intervention may be identified as in need for it. Administrators may be more concerned with false negative rates as in [9], but another negative consequence related to false positive cases is the additional cost of the intervention.

However, Ref. [1] supported a different point of view and noted that schools should provide this intervention to as many children as possible, if they desire to maximize their chances for early intervention with the most impaired children. This may seem as a waste of resources at first glance. On the other hand, many of the falsely identified children receiving intervention are likely to be below-average readers even if they may not be among the most seriously disabled readers.

In any case, a possible solution to the over-identification rate was proposed by Ref. [40] by using a two-stage screening process or to provide small-group diagnostic interventions in the first grade. Consistent with them, Ref. [1] reported a significant reduction in the percentage of false negative errors within the same sample of children by doubling the number of children they identified as at risk. About 10% of the children, who scored lowest on their predictive tests, resulted in a 42% false negative rate, while by using 20% of the children who scored lowest on their measures, the false negative rate was reduced to 8%.

Almost all of the studies used as predictors a battery of tests or multiple screening measures as Refs. [1, 9] proposed. However, some of the studies (e.g., see Ref. [18]) had used so many variables that the requisite general characteristics of the effective screening could be affected [7, 11]. So, there must be a balance between the demand of quickness, ease, cost-effectiveness, and other characteristics and the accuracy rate in order for a screening procedure to be possibly developed and accepted by the reading scientific community and educators, parents, and children.

A major contributor to the aspect of the discriminate accuracy is that often only a correlation coefficient between a group's scores on a preschool screening instrument and a later achievement measure is provided in the literature as evidence of the test's effectiveness. Such data, although important, provide information only on the similarity of the group's performance on both tests. A correlation coefficient provides no information as to the specific identification of the at-risk and not-at-risk children and the relationship between such status and the projected outcome of a group or poor reader [13].

Lack of discriminative accuracy data [17, 21, 22, 30] contributes to the difficulty of interpreting their findings in terms of screening effectiveness. Some studies had focused on these aspects and reported a range of accuracy and false positives, false negatives, and sensitivity and specificity. Better results (predictive accuracy over the 80%) regarding these aspects were reported by Refs. [18, 32]. Furthermore, Refs. [19, 33] reported a large number of cases; so, it was unclear which the best one was.

In terms of intervention programs designed to remediate deficiencies in at-risk students, false positives, although undesirable, are not critical. These children will receive a training program that they do not actually require. In some cases, the instruction could actually benefit the child's performance. Nevertheless, a concern of negative positives is that they place an increased demand on scarce resources [25].

On the other hand, a false negative error is more serious because these children do not receive the additional assistance they require at the earliest possible time, which makes their problems more difficult to remediate later [25]. A false negative classification will most likely deprive children of the benefits of early intervention because their test results incorrectly suggest that they are not at risk for learning difficulties. In such cases, the cost to the children may be devastating because they are likely to experience repeated failures and frustrations with academic tasks before they are actually identified and placed appropriately.

Is it possible for a screening measure to have a 0 false negative rate? Ref. [18] answered "no." Their explanations regard the different levels of readiness of children on their entry in school. In any case, scientific efforts will be continued in order to decrease the false rates of screening.

7. Conclusions

This chapter referred to the early identification and prediction of future low reading achievement and discussed the important aspects regarding effective predictors, the discrimination rate, and the sensitivity and specificity of the screening measures. However, because screening studies have usually used inconsistent measurement of risk factors, including heterogeneous patient populations, and inconsistently adjusted for confounders in multivariate models [34], their findings were not comparable.

For the best single or multiple predictors, there is evidence that batteries containing multiple tests generally provide better prediction than single instruments, but the increase in efficiency of multi-test batteries is generally not large enough to warrant the extra time and resources required to administer them [1, 5, 9]. Additionally, vocabulary measures proved to be one of the best unique predictors [23]. Moreover, Ref. [23] found that a measure of expressive vocabulary was a good predictor of reading comprehension status.

The most often measures that could be used as effective predictors were the letter name and letter sound knowledge, phonological awareness, verbal short-term memory, and rapid automatized naming [2, 4, 6, 23]. Very often, screeners were based on reading comprehension, word recognition/decoding, and word fluency [24, 28]. Additionally, some studies found as significant predictors the familial risk, and the child's specific characteristics, as well as his/her developmental and school history [32].

On the other hand, although Refs. [33, 36] found that teacher rating was a significant predictor that is consistent with a number of other studies, these ratings cannot substitute for early identification tests. Therefore, they proposed that combining test and teacher data would improve identification of kindergarten children at risk for reading failure. Recently, Ref. [28]'s findings were consistent with the above-mentioned studies.

A method used for validation of an early screening instrument should incorporate: (a) longitudinal design [6, 27], (b) independent assessments of kindergarten performance and learning ability separated by a temporal interval of specific time, [2, 21, 23, 24], (c) random sampling of children in a validation/cross-validation design, and (d) systematic assessment of predictive utility and validity [12]. There is clear evidence that early screening is a viable process, but this effort will only reach fruition, if research is conducted with appropriate rigor. However, there is a low incidence of educational handicaps, especially in the early grades. This means that a large sample size should be included for screening, and the formative evaluations should be age- and/or grade-specific and valid across grade levels for outcome comparisons.

More than a lot of the screening studies had longitudinal designs, and, the vast majority of the included studies did not adopt their proposed random sampling of participants. Therefore, a number of limitations emerged regarding the generalizability of the findings to other populations. The sampling of the studies was mainly constructed by self-selection of the participants or was a volunteer sample [8]. As Ref. [17] noted, the number of participants was modest and the sample was not selected randomly. Although the samples seemed representative of the school district from which they were selected, results may not be generalized to the larger population of young children or to specific subgroups. Quite a lot of the research was conducted with those methodological problems.

In summary, effective screening tools demonstrate high levels of sensitivity in correctly identifying those students who will actually encounter difficulties, as well as high levels of specificity in the accurate identification of those who are not likely to demonstrate reading difficulties. Ultimately, the goal is to maximize classification accuracy, a summative measure of the overall proportion of students who were correctly identified as at-risk or not at-risk on a screening measure.

8. Future research suggestions

The importance of early intervention has been proven by a large amount of research findings. In this context, the need for carefully designed and accurate screening measures emerges as crucial. Despite the recent interest and research on screening reading disabilities, the body of research on the effectiveness of these measures remains problematic in terms of methodology and the findings seem to be scant. Therefore, the development of a cost-effective and equitable screening, diagnostic, and supportive method that is acceptable by government, educational authorities, school, children, and parents still remains a scientific challenge.

Therefore, it would be useful to design a large longitudinal study with 3 years' interval. Existing research has often used small and non-representative group sizes; thus, there remains a need for further research emphasizing on appropriate sampling in order to make it easy to extrapolate findings to other sampling and generally other situations.

The development of screening tools that are valid, reliable, easy to manage and interpreted by educators with the highest accuracy, sensitivity and specificity, remains an extremely important necessity.

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Chapter 14

Emergent Reading and Brain Development

Yingying Wang

Abstract

Emergent reading emphasizes the developmental continuum aspect of learning to read and advocates the importance of reading-related behaviors occurring before school. Brain imaging evidence has suggested high plasticity of young children's brains, and emergent reading experience can shape the brain development supporting fluent reading. The brain imaging evidence elucidates our understanding of the importance of emergent reading from a neurobiological point of view. Future studies are needed to understand how emergent reading experience can become protective factor for children at risk for reading impairments. Future studies need to design early interventions to improve emergent reading experience which is a crucial period.

Keywords: emergent reading, brain responses, neural basis, development, shared book reading, developmental dyslexia

1. Introduction

Reading is a complex process involving multiple regions in the brain communicating with each other to facilitate effective reading. Learning to read can play an important role in academic success. There is a reciprocal relationship between language and reading learning where improvements in one can lead to an increased understanding of the other [1, 2]. This chapter focuses on the concept of emergent reading and brain imaging evidence related to reading acquisition and aims to elucidate our understanding of emergent reading experience and its relationship with brain development.

2. Emergent reading

2.1 What is emergent reading?

The term "emergent reading" is derived from "emergent literacy" and is used to advocate that the development of reading starts early in a child's life instead of school years. The emergent literacy includes both reading and writing components. The concept "emergent reading" emphasizes the developmental continuum aspect in learning to read, rather than an all-or-none phenomenon that begins only when a child starts school, suggesting there is a boundary between reading and prereading. For example, over the years, educators focused on identifying what skills a child needs to understand before he/she can learn to read through a formal reading curriculum. In contrast, an emergent reading perspective views reading-related behaviors occurring before school as essential aspects of reading. Besides, an emergent reading perspective views that language and reading develop concurrently and interdependently from an early age when children were exposed to social interactions in which reading is a component, and no formal instruction was involved.

Emergent reading consists of the skills, knowledge, and attitudes that are presumed to be developmental precursors to conventional forms of reading [1, 3] and the environments supporting these developments (e.g., home literacy environment, shared book reading, etc.).

2.2 Components of emergent reading

Based on the literature, the main components of emergent reading include vocabulary knowledge, decontextualized language skills, conventions of print, knowledge of letters, linguistic awareness, and phoneme-grapheme correspondence.

Vocabulary knowledge is important in emergent reading. Reading requires decoding of visual inputs into meaning. In the earliest stages, a child decodes a word letter by letter, links each letter into its corresponding sound, and combines all the letter-sounds to a single word. For example, in the beginning, a child decodes a word "cat" by sounding out /k/ ... /æ/ ... /t/. The next stage is to extract the meaning of the word, which is important since it motivates the child. If a child knows individual letters but does not know the meaning, he/she is unlikely enjoying the reading process since the child has no semantic representation through which a child decodes the phonological information. Research studies have shown that semantic and syntactic abilities play important roles in acquiring reading skills when the child is reading for meaning [4, 5]. A recent study investigated the relationship between semantic knowledge and word reading in 27 6-year-old children [4]. General semantic knowledge was assessed using standardized tasks in which children defined words and made judgments about the relationships between words. They have provided strong evidence that variation in semantic knowledge is associated with variation in word-reading performance.

Decontextualized language skills refer to the language used in story narratives and other written forms of communications to convey novel information to readers [3]. **Conventions of print** in English include the left-to-right and top-to-bottom direction of print, the sequence in which the print progresses from front to back across pages, the difference between pictures and print on a page, and the meaning of elements of punctuation. Knowing these conventions helps a child learn to read [3]. Decontextualized language skills in children are related to conventional reading skills including decoding, understanding story narratives, and print production [6].

Knowledge of letters is critical to learning the sounds associated with the letters. However, only teaching letter names may only increase surface letter knowledge and may not improve the abilities to learn to read [7]. Linguistic awareness involves the ability to take language as a cognitive object and to understand how language is constructed and to use language as a way of communication. Linguistic awareness develops over time, and a child may be aware of some rules (e.g., that words are formed from phonemes) without being aware of other rules (e.g., two words rhyme). Many studies have suggested that children good at detecting syllables and rhymes are better readers [8].

Linguistic awareness involves the ability to take language as a cognitive object and to possess information about the syntax. Most research on linguistic awareness has focused on phonological skills (e.g., phoneme isolation, phoneme deletion, etc.).

The relation appears to be reciprocal. Better phonological skills led to quicker learning to read [9–12], while learning to read improves phonological skills [13, 14].

Phoneme-grapheme correspondence represents the links between phonemes and alphabet letters. A child requires to understand both how individual letter sounds and how combined letters sound. This ability has been related to higher levels of reading achievement [10, 15].

Children learn these main components of emergent reading before formal schooling. These components are the building blocks that a child needs to learn to read. Becoming a fluent reader requires all these components, which can be divided into two interdependent sets of skills and processes. They are the process of decoding and comprehension. The process of decoding needs children's knowledge of rules for translating letters to sounds and sounds to words, while the process of comprehension needs children to find meanings for the words. Both are essential processes for reading. Difficulties in either process can lead to reading impairments.

2.3 Environments supporting emergent reading

Home literacy environment has been suggested to positively correlate to preschooler's language abilities [16, 17]. Home literacy environment characterizes the literacy-related interactions and resources at home, including shared book reading between parents and children (e.g., frequency, duration) and exposure to literacy materials (e.g., how many books at home, types of books). The American Academy of Pediatrics (AAP) advocates reading aloud to children every day, beginning from birth [18]. The AAP early literacy policy released in June 2014 urges pediatricians and policymakers to ensure that books are available to all families, particularly those with low income [18]. High et al. recommends that parents focus on the following activity: read together, rhyme and play with words, set consistent routines, reward with praise, and develop a strong relationship with the child [18]. Shared reading between parents and children can strengthen bonding and improve language skills and vocabulary knowledge. Dialogic reading, known as a shared picture book reading intervention for preschoolers, has been suggested to boost the preschooler's language abilities [19–21]. Moreover, the new understanding of brain development through neuroimaging studies has also suggested that the first 1000 days are the crucial developmental stage for later cognitive development.

Children's daycare and preschool environments are important for children's emergent reading experience [3]. Studies have identified that aspects of the curriculum, the environment, teach-child interactions, and teaching practices within the classroom are related to the cognitive ability and achievement of children [22]. When controlling for home literacy environment, children's daycare and preschool environments still predict children's cognitive and academic achievement scores.

2.4 Socioeconomic status

School readiness refers to a mismatch between what many children bring to their first school experience and what schools expect of them if they are to succeed and is strongly linked to family income [3]. Socioeconomic status (SES) is one of the strongest predictors of performance differences in children at the beginning of first grade [23]. Differences in SES could lead to differences in emergent reading experiences (e.g., language exposure at home, family stress, cognitive stimulation) that likely shape the early development of brain regions that are crucial for becoming a skilled reader [24, 25]. Children from low SES are at risk for DD and are also more likely to be slow in learning to read [26]. Moreover, Matthew effects in reading demonstrated that a child is a disadvantaged organism because of the low SES and genotype provided by the child's parents [27]. Many students with low SES entering school are significantly behind their more advantaged peers with high SES, and the academic performance gap widens over the course of elementary school [28, 29]. Children from families with different SES exposure to different experiences that support the development of emergent reading skills. Mothers from lower SES groups engaged in fewer teaching behaviors during shared reading than mothers from middle-class groups [30, 31].

2.5 Interventions to enhance emergent reading experiences

Various interventions targeting one or more components of emergent reading have been developed including dialogic reading, little books, phonological sensitivity training, and whole language instruction.

Dialogic reading is a program of shared picture book reading intervention for preschoolers, and it can substantially improve a child's language skills in preschool [19, 32–34]. Dialogic reading is different from the conventional shared reading during which the adult reads and the child listens. During dialogic reading, the child learns to become a storyteller, while the adult acts as an active listener, asking questions and prompting the child to increase the sophistication of descriptions of the material in the picture book.

Little books are small, easy-to-read books that contain simple words, simple illustrations, and repetitive text. Studies have shown that giving free little books to children from family with low and middle incomes facilitates better emergent reading experience and supports better reading outcomes [35–37].

Phonological sensitivity training is to teach children phonological sensitivity, which is one of the strongest predictors of later reading achievement. Interventions on phonological sensitivity training have been shown to be effective in beginning readers [38–40].

Whole language instruction focuses on the reading components including language units (e.g., words), semantic units (e.g., concepts), and contextual units (e.g., narrative) [41, 42]. Whole language approach advocates that there are strong parallel between the reading acquisition and oral language acquisition and believes that reading acquisition would occur as easily and naturally as language acquisition if the meaning and purpose of the text were emphasized. However, there is ongoing debate on whether whole language emphasis is effective approach [43]. More research is necessary to resolve this debate. Whole language is currently controversial approach to teach reading.

3. Behavior and brain connection

If cognitive behaviors are the immediate results of our brain states, then the most effective way of uncovering a cognitive behavior is to understand the brain states that would lead to it. Brain states are determined by the organization of synaptic connections between neurons that generate various patterns of activations. Thus, brain imaging can provide insights into the neural basis that would lead to the certain cognitive behavior.

When a child learns to read, he/she is more likely to show reading-related activity in the region of occipitotemporal cortex [44–47]. Two decades ago, brain research has suggested that the socioeconomic status (SES) modulates brain-behavior relationships in reading [25]. Specifically, as SES levels decreased, the relationship between the phonological language skill and functional magnetic resonance imaging (fMRI) data was stronger, whereas as SES levels increased, these brain-behavior relationships were attenuated [25]. Thus, a child's background and life experiences, as determined by SES, can systematically influence the relationship between emergent reading skills and reading-related brain activity. To better understand the importance of emergent reading experience, brain imaging evidence will be used to demonstrate the underlying neural basis supporting the developmental continuum aspect of learning to read.

4. Brain imaging evidence

Recent advances in neuroimaging techniques make it possible to identify the brain-based factors that facilitate successful reading outcomes. Importantly, brain imaging may provide innovative solutions to improve education curriculums and lead to improvements in reading results in young children.

Over the last decades, neuroimaging studies focused on identifying brain markers that are the cause of dyslexia (see reviews: [48, 49]). Although researchers are far from concluding that the brain markers causing dyslexia, we have learned about the neural basis of reading acquisition. For instance, a left-lateralized brain network, including temporoparietal and occipitotemporal cortices, is critical to facilitate skilled reading [50, 51] (see **Figure 1**). High white matter integrity in accurate fasciculus (AF) predicts better reading outcomes in children at risk for dyslexia [52]. AF is a tract connecting Broca's area and Wernicke's area, related to reading ability [53–55] (see **Figure 1**). If neuroimaging measures can identify children at risk for reading difficulties before they even start to learn to read in school, early emergent reading interventions can be applied to help them overcome the risk of developing reading difficulties in school years. Only a limited number of studies have specifically investigated the relationship between emergent reading environments and neuroimaging data.

Hutton et al. used StimQ-P questionnaire [56] to quantify the cognitive simulation at home and identified that functional magnetic resonance imaging (fMRI) data during a storying comprehension task presented stronger activity for those children with higher StimQ-P Reading scores [57]. They reported that higher StimQ Reading scores were associated with stronger activation in occipital cortices, including lateral occipital gyrus and precuneus, which can be attributed to mental imagery evoked during story listening [58]. Their study sample includes nineteen 3- to 5-year-old children from a longitudinal study of healthy brain development. In preschool children listening to stories, greater home reading exposure was positively related to activation of left posterior occipital fusiform, lateral occipital, posterior inferior temporal, posterior middle temporal, posterior cingulate, and angular gyri and left precuneus (household income is controlled). Their finding suggests that

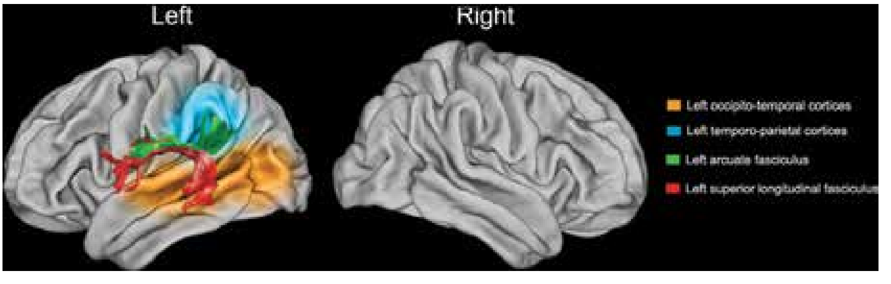

Figure 1.
Brain regions and white matter tracts related to reading on a 3D rendered brain. Red: accurate fasciculus (AF), green: superior longitudinal fasciculus (SLF).

brain-based markers exist as a result of parent-child reading in early childhood. Thus, emergent reading shall be promoted and may help shape the developing brain and better prepare a child for formal reading instructions in school.

Developmental dyslexia (DD) has strong genetic basis [59], and family history of DD can increase a child's chance to develop reading difficulties by 34–56% [60–62]. In order to identify children at risk for DD, familial risk can be used as a good indicator. One group led by Dr. Nadine Gaab in Boston Children's Hospital has done pioneer work in this research field [48, 52, 63–70]. For the first time, they examined the relationship between home literacy environment (HLE) and the neural basis of phonological processing in beginning readers with family history of DD (n = 29, first-degree relative who has reading difficulties) and without family history of DD (n = 21) [67]. This study aimed to identify brain mechanism of how HLE affects reading development in beginning readers. SES was controlled in this study in order to isolate the effects only by HLE. In reading-related brain regions (e.g., left inferior/middle frontal and right fusiform gyri), stronger correlations between HLE composite scores and brain activations were present in children without familial risk than those with familial risk. In the nonreading-related brain region (e.g., right precentral gyrus), stronger correlations existed in children with familial risk than those without familial risk. These findings suggest that genetic predisposition for DD alters contributions of HLE to brain activation. Specifically, typically developing children can benefit more from better HLE than children with familial risk for DD. Therefore, enhanced HLE is especially important for children with familial risk for DD to have the same impact as for typically developing children.

Shared parent-child reading is one of the important factors in emergent reading. A recent study demonstrated increased activation and functional connectivity in children who are more deeply engaged during shared reading in 22 mother-daughter pairs [71]. The same group also associated shared reading quality scores with brain activation, and they found a positive correlation between shared reading quality scores with activation in left-hemispheric regions supporting expressive and complex language, social-emotional integration, and working memory in 22 healthy, 4-year-old girls from low SES [72]. Their findings suggest that the use of shared parent-child reading is crucial for emergent reading experience, but the quality of this experience has also a strong impact on brain development. Especially for those at-risk families, improvements of the quality of shared reading can promote healthy brain development and better prepare a child for future success in school.

Morken et al. [73] used a longitudinal study design to examine the differences of cortical connectivity in the brain during reading tasks between children with dyslexia and children with typical reading development through dynamic causal modeling (DCM) [74]. They included five regions (inferior frontal gyrus, precentral gyrus, superior temporal gyrus, inferior parietal lobule, and occipitotemporal cortex) in their effective brain connectivity model [74]. They found that effective connectivity between the inferior frontal gyrus and the occipitotemporal cortex during reading tasks changes during reading acquisition. In addition, the group readers with dyslexia presented different developmental trajectory than the control group. The control group actually seemed to downregulate or stabilize connection strength over time, whereas the dyslexia group started out at a level well below the control group, followed by an increase in connectivity from 6 to 8 years and then a downregulation from 8 to 12 years. The general downregulation of connectivity in the control group might reflect that they need these connections to establish reading skills initially, and then, the connections are no longer needed after later automaticity is established. The dyslexia group showed late development of some connections in occipitotemporal cortices. However, they seem to show overcompensation around age 8, followed by normalization before age 12. Importantly, the dyslexia group was clearly lagging behind in the development of the brain networks at the age of 8 (emergent reading stage), suggesting emergent reading stage is critical.

Younger et al. also used a longitudinal study design and found decreases in connectivity for most connections from the first (T1) to the second (T2) time point about 2–3 years apart, regardless of changes in reading skill in 59 typical developing children [75]. But they found a significant decrease in the dorsal, decoding processing pathway from fusiform gyrus (FG) to inferior parietal lobule (IPL) for the group who improved more from the first to the second time point, suggesting that the improvements in reading skills lead to a decreased reliance on the dorsal pathway (decoding processing pathway) in the brain. The high and low improving groups did not differ in behavioral performance at T1, and high improvers showed greater connectivity between FG and IPL at T1 compared to the low improvers. The dorsal pathway facilitates phonological processing, which is necessary for development of the ventral pathway supporting automatic processing of visual word forms. However, there is no sequential relationship between the two routes. They may develop simultaneously.

Yu et al. studied 28 children over three stages (pre-reading, beginning reading, and emergent reading) and found decreases in neural activation in the left inferior parietal cortex (LIPC) during an audiovisual phonological processing task [69]. Seed-based brain network analysis revealed increases in connection strength in the brain network of children with above-average gains in phonological processing but decreases in connection strength in the brain network of children with below-average gains in phonological processing measured by Comprehensive Test of Phonological Processing (CTOPP). Moreover, the connection strength between LIPC and the left posterior occipitotemporal cortex (LpOTC, BA 18) at the pre-reading stage significantly predicted reading skills at the emergent reading stage.

5. Discussion

This chapter demonstrates the view of emergent reading and brain imaging evidence supporting advocacy for emergent reading. Emergent reading emphasizes the developmental continuum aspect of learning to read and the importance of reading-related behaviors occurring before school.

Both behavioral and imaging studies on DD suggest that early reading skills are essential to the later development of reading. Most children start formal reading curriculum in kindergarten; however, at that time, many factors (genetic, SES, HLE, etc.) have already affected the future reading development. Moreover, early interventions work more effectively.

Brain regions (left inferior/middle frontal gyrus, bilateral fusiform gyri, and right anterior superior temporal gyrus) were identified to be especially sensitive to differences of early language/literacy exposure in beginning readers [67]. A richer HLE corresponded to increased brain activations during a phonological processing task [67] and increased brain activations related to high reading proficiency [76] demonstrated the underlying neural basis of reading. Among the children with a familial risk for DD, only around 50% of them will develop DD. The imaging evidence implies that a rich HLE might be one of the protective factors in reading development especially for children with a familial risk for DD. Future longitudinal studies are needed to examine how HLE contributes to the development of reading networks in the brain and its role as a protective factor in general.

Advocating emergent reading can benefit all children who are learning to read and especially those who are also at risk for DD. It is clear that aspects of HLE (e.g., shared reading) before a child entering kindergarten or preschool benefit the later reading development.

6. Conclusions

Emergent reading experience is crucial since it affects the development of reading. The formal reading curriculum usually starts in kindergarten. Before kindergarten, genetic and environmental factors have already affected the starting point for children. Research studies on DD have provided a rich body of evidence that reading acquisition is influenced by complex genetic and environmental interactions [48]. Recent studies started to focus on the importance of home literacy environment and emergent reading stage using brain imaging evidence.

7. Future directions

There are still a limited number of longitudinal imaging studies on emergent reading. In the future, research shall focus on studying which intervention approaches in emergent reading stage work the best using both behavioral and brain imaging data. In addition, how brain imaging evidence can be used in designing optimized interventions targeting emergent reading stage.

Acknowledgements

Thanks to start-up fund from the Department of Special Education and Communication Disorders and Office of Research & Economic at the University of Nebraska-Lincoln.

Conflict of interest

No conflict of interest declaration.

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Section 7

Exceptional Learners

Chapter 15

Obstacles to Inclusion: One Early Childhood Inclusive Teacher's Perspective

Carrie D. Wysocki

Abstract

In spite of the attention given to the topic of including children and youth diagnosed with emotional and behavioral disorders in general education classrooms; there has been an absence of empirically sound research to guide policy and practice. With the passage of The Individuals with Disabilities Education Act (IDEA) there has been an increase of students with cognitive, social and emotional disorders included in general education classrooms. Significant debate continues to surround the issue of students with emotional and behavior disorders and other disabilities for placement in general education settings. This chapter will explore the experience of one such environment in which several students with emotional disturbances are included in a first grade classroom. The frustrated teacher expressed a perceived lack of knowledge in handling behaviors and persistent feelings of helplessness. She struggled with how to handle the behaviors of the students with emotional disturbances and questioned if their inclusion in the general education classroom was best for all. Although the outbursts and negative behaviors did not cease; it was observed with consistent approaches to addressing behavior, the teacher was successful at cultivating empathy among students and examples of positive behaviors and care were shown in student interactions.

Keywords: inclusion, emotional disturbances, special education, general education, empathy

1. Introduction

The murmuring voices in the classroom suddenly came to a halt with the outburst of a student as he shouted "I won't do it! Pick someone else! I'm going to kill you! I want to cut out your eyes out and kill you! You need to die!" [1, 2]. Upon hearing these phrases, one might have a variety of reactions, including shock as these phrases were uttered to a teacher. It may also surprise a casual observer to note that these phrases were coming from a first grade boy, with no medical or mental health diagnosis, in a general education classroom. Although the words used by the young student are disturbing; it is not an uncommon occurrence in public schools today for classrooms to have students that are considered "deviant, disruptive, and nonconforming" [3]. In fact, disrespectful and deviant behavior is anything but a recent issue in the history of education but is considered by many teachers to be on the rise in classrooms today. In the past few decades there has been an increased interest in the idea of inclusive education [4]. In spite of the extraordinary attention given to this topic, there has been a general absence of empirically sound research to guide policy and practice including children and youth diagnosed with emotional and behavioral disorders [1].

The ways in which educators have dealt with nonconforming students has changed over time. Students with emotional and behavioral challenges have been more apt to receive their education in specialized and non-integrated settings. The most significant alterations of the placement and education of students considered to have "deviant" or disruptive behaviors changed most significantly in the United States with the passage of The Individuals with Disabilities Education Act (IDEA), (Public Law 101-476; Public Law 105-17) passed in 1975 (as PL 94-142) amended 1997 and again in 2004. With this act, there has been increased attention to inclusive schooling, ruling every child is eligible to receive a free and appropriate education (FAPE) and to learn in the least restrictive environment (LRE) possible. Therefore, students with disruptive behaviors previously placed in alternative learning arrangements are now often mainstreamed or included into general education environments. This is considered the inclusion model of teaching, particularly if the disruptive child has special educational needs. The word inclusion has different meanings for various communities, but for the purposes of this chapter inclusion will encompass students educated in a heterogeneous, age-appropriate, child-focused school environment to prepare all students for full participation in a diverse and integrated society. A general education classroom is considered the program of education that children who are typically developing should receive, based on state standards.

True integration of students with emotional disabilities into general education classrooms is contingent upon attitudinal and social support [5]. Educators have known for decades that successful inclusion of students with disabilities, especially those with behavioral and emotional challenges, requires understanding and support from those with whom they share a classroom [1]. Teachers who engage in teaching inclusively are often resistant not because of the students with disabilities, but more about the valid concern of their preparedness to meet the demands of teaching multiple abilities in the same classroom [6]. The dominant factors inhibiting teachers to teach inclusively include attitudinal barriers and possessing the skills or knowledge to implement inclusive practices [7].

There are diverging philosophies guiding the educational expectations for students whose educational classification or stereotype is linked to their special education labels, particularly students considered with behavior disorders. This piece is an attempt to capture a snapshot of students with troubling behaviors in one inclusive classroom. Several months of observations revealed the frustrations of the inclusive teacher and the challenges presented to her in the attempt to educate several troubled students. The observer concluded that by creating a caring and empathetic classroom, the inclusive classroom may not eliminate the behaviors, however; inclusion can create positive learning experiences and promote student success despite the challenges.

2. History of educating troubled students

As stated, in American schools today, IDEA mandates that all students with disabilities have the legal right to be educated in the Least Restrictive Environment (LRE) and cannot be removed from a general education classroom simply because the school is not prepared to meet a student's needs [2]. Therefore, training for the education grade level team can be written into an Individual Education Plan (IEP) under support for school personnel [2]. Schools are required to provide a level of training under IDEA such as training in inclusive schooling, differentiation, modifying and adapting instruction, and collaboration. The law specifically guarantees that children with disabilities are entitled to the Least Restrictive Environment (LRE):

> *To the maximum extent appropriate, children with disabilities, including children in public or private institutions or other care facilities, are educated with children who are not disabled, and special classes, separate schooling, or other removal of children with disabilities from the regular educational environment occurs only when the nature or severity of the disability of a child is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily. Through the use of modifications, students can engage with content in different ways with different materials and supports than other students [2].*

Danforth and Smith in *Engaging Troubling Students,* reveal a great deal about the ways in which schools educate and have educated "troubled" students. The authors use the term "troubled" to describe students as behaving in ways that teachers and administrators find troubling. This behavior includes students who "resist, oppose school authority and norms in dramatic, loud and violent ways" [3]. Often the solution in the education of troubling students is to label them with an emotional disturbance and place them in a segregated classroom where their needs and issues can be specifically addressed. Before examining the snapshot of troubling students in a typical classroom, it is important to review a brief history of American education conceptualizing the problem behaviors of children in general education classrooms.

The construction of the disability category "emotional disturbance" (ED) became more widely known after World War II, and thus ED programs became a "central, consistent element within the framing of behavioral difficulties in American schools" [3]. Children identified with behavioral disorders are included in this category of disability [8]. IDEA provides a definition of emotional disturbance as a condition exhibiting characteristics that adversely affects a child's educational performance. According to Danforth and Smith, a study in 1980 revealed a "478% increase in the number of students labeled ED in American public schools in less than 5 years" [3]. The reason for this significant jump in the number of labeled students is due to a combination of factors such as "an acceptance of this excluded group into the public schools and the new diagnosis of ED" that were once considered nondisabled prior to the implementation of IDEA.

IDEA further puts forth that every child is eligible to receive FAPE and to learn in the least restrictive environment (LRE) possible. Even though IDEA does not specifically state students with disabilities be placed in an inclusive classroom, it does support the goal to create an educational system which provides equal access and opportunities for all students. Research shows there is a wealth of knowledge in the more than two decades of implementation that supports the inclusion of children with disabilities in education settings, including those with emotional disturbances [8, 9]. According to Baglieri and Shapiro, "students seen as exhibiting emotionally disturbed behaviors need to be included in the mainstream of education for three reasons: (1) to give them a chance to interact with youngsters who are not handicapped, (2) to provide constructive role models for behavior, and (3) to keep up academically" [8].

Often, the prevalent obstacle to including students with emotional disturbances in the inclusive classroom involves the negative teacher attitudes toward including students with significant behavior challenges. Studies regarding teacher attitudes "represent one of the largest bodies of research investigating the critical area of inclusion" [5, 10]. Teachers are often "confused, overwhelmed, and ill prepared to work effectively in inclusive classrooms and schools" due to inexperience and poor professional preparation in working with students with disabilities [3]. A review of the literature on teachers' attitudes toward working with students with ED reveals that general education teachers frequently report a resistance to full inclusion, often not a result of rejecting students, rather from feelings of a lack of competency [10]. Several studies have determined that more positive attitudes are reported following training and the most positive attitudes toward inclusion can be found in teachers who received more education for working with students with disabilities [11]. There is a correlation between teacher attitudes and their knowledge of disabilities. Negative attitudes might exist toward students with disabilities and inclusion because the teachers do not perceive that they have enough knowledge about this subject area [5, 11].

3. Case study of an inclusive classroom

One method to gain information on the value of an inclusive classroom for the emotionally disturbed or "troubling student" is the opportunity to observe it in action within an inclusive environment. A strength of utilizing a case study method involves the use of multiple sources and techniques in the data gathering process [12]. Through this field research method, my questions could be addressed through documents and artifacts, participant observation, impromptu conversations and interviews of the teacher in the inclusive classroom. After securing access to the elementary school, the principal recommended a primary classroom that included several students labeled as Emotionally Disturbed (ED) based on their special educational designation. The principal shared the teacher had expressed frustrations with the class on numerous occasions and the teacher welcomed the opportunity to have an outside perspective.

An inclusion model for educating students with special needs was adopted in a Midwest, PreK-5 elementary school. The previous special education arrangement in this particular building was a case by case placement that included a segregated multiple handicapped resource classroom. Students were mainstreamed, only included during specific time periods based on their individual skills, and it was determined by the special education teacher when the student was "developmentally ready" to attend their designated class or not. The inclusion model that was adopted involved the elimination of the traditional multiple handicapped, self-contained classroom and integrating all students with disabilities, intellectual and emotional, into their same age peer classrooms. As the new model for inclusion was accepted at this elementary, there were lingering fears and doubts from parents and teachers that it would be successful.

3.1 Case study approach

This project can be best described as an observational case study because: (1) the major data-gathering technique used was participant observation, supplemented with more in depth interviews; (2) the focus of the study was on a particular group; and (3) the focus of the study included the interactions of the students and the teacher-student relationships. In particular, I focused primarily on the group of people, the teacher and the students, who were typically present in the room each day [13]. Bogdan and Biklen believe that, "a good physical setting to study is one that the same people use in a recurring way" [13].

3.2 The first grade classroom

Over a span of 3 months in the spring, observations were made in the case study classroom. The first grade classroom at this inclusive elementary was the locale for the observations and interviews, which comprised of 26 students and one classroom teacher. The female teacher, Mrs. Bradwell[1], had 22 years of teaching experience. Over the course of the observations, several informal conversations and interviews were conducted. Mrs. Bradwell had no specific formal training or education in teaching students with disabilities or behavior challenges. The children she indicated as "troubling" included the following (see **Table 1**).

3.3 Observations

The initial first few weeks of data-gathering were primarily centered on observations. Rapport was established with the students and the classroom teacher and I was viewed as a support staff or learning teacher in the classroom. The students recognized my note taking and they are used to many preservice teachers coming in the environment based on a local university partnership. Observations notes were written either as they were happening or immediately following the interaction. Attempts were made to record direct quotes by participants and in the event that I did not capture the entirety of the direct quote, I summarized what I had heard. Detailed notes and records were kept throughout the 3 months, and for a period of 10 days the behaviors of the "troubling students" indicated by the teacher were recorded in detail to be analyzed.

3.4 Interviews

Throughout the 3 months of collecting data utilizing the observational methods, informal conversations with the teacher took place to engage on a deeper, more personal level. Notes were taken during these informal conversations and on two occasions we engaged in a formal interview process of audio recording my questions and the teacher responses. There was not a structured guide of interview questions for the interviews as I tried to maintain the fidelity of research methods by allowing the teacher to direct the content of the interview and side conversations. Detailed, descriptive questions are "inconsistent with the emergent nature of qualitative research in general and grounded theory methods in particular" [12]. The primary question asked to guide the inquiry focused on her feelings about the inclusive environment.

I encouraged the teacher to elaborate on topics and issues that she initiated and I followed up with more in-depth questions as I sought to more fully understand her

Joey	**Billy**
IEP for oppositional defiant disorder and other health impairment Brain damage, extreme violent outbursts, unpredictable	No IEP Defiant, hyperactive, refusal to participate and physically hurtful to others
Beth	**Sam**
IEP for emotional disturbances Defiant, irritable and depressed, resistant, combative, argumentative, home life reported as disrupted	IEP for learning disabilities Hyperactive, inability to focus, depressive, sensitive

Table 1.
Student descriptions.

[1] Teacher and student names are pseudonyms.

perspectives. The interviews and impromptu conversations allowed the teacher to share her experiences, observations, understandings, and stories in a private and safe environment. The in-depth interviews took place in her classroom at the end of the school day and allowed her the space and time to reflect upon her understandings and experiences. The loosely-structured interview protocol was reviewed and approved by the IRB. Following each interview, I transcribed the responses word for word.

3.5 Data analysis

When I began the analysis, I asked the following questions of the data: What is the main issue or problem? What idea keeps coming up? [14]. To answer my own questions, I wrote sentences or phrases that captured the overall story being told by the teacher. I used grounded theory methodology to analyze the case study, theories emerged from the data rather than being hypothesized prior to data [12]. Data collection, coding, and analysis were occurring simultaneously. The study's purpose was to develop practical theories in the area of the obstacles to an inclusive environment for children with emotional disturbances.

3.6 The findings

Mrs. Bradwell shared in her 22 years of teaching; the education of students with disabilities had changed in the last 15 years. She explained students with intellectual and emotional disabilities previously "were in house, it was in an MH room, not inclusion" [15]. She exclaimed she was "not prepared for things like autism, oppositional defiant disorder or roller coaster emotions, and my education at (university) did not prepare me for any of that. Before, when kids like that were included, it was only gym, special events, etc. but never in the classroom."

After the first few weeks of the school year, and the experience of the extreme behaviors of Joey, Mrs. Bradwell indicated she was provided a teacher support person 3 days a week to help manage and maintain the classroom. She was very frustrated as it seemed other teachers with more training in the areas of special education would have the inclusive classrooms of students with cognitive or learning disabilities. "I seem to get the kids that are more the emotional disturbed, like the ones from abusive homes, mother on drugs when she was pregnant, things like that." Mrs. Bradwell felt educating students with emotional disturbances was a challenge to her and the other typically developing students.

> *It is always a battle to get these kids to learn. I do not see inclusion as a great thing if they cannot control themselves and are not able to behave themselves so as to not cause disturbances in the classroom. Our feeling in this building is we do not want to send these emotionally disturbed kids to an ED classroom, because there they do not focus on academics. The problem is you have 25 other kids who pay the price.*

Regarding the view that students might possibly benefit from a separate educational setting, according to Danforth and Smith, segregated programs in the past have served as "dumping grounds" for students who failed to "fit the middle-class ideals of attitude, appearance, and behavioral style" [3]. Regardless, Mrs. Bradwell felt entirely inadequate for the demands of the students with emotional disturbances. Observations and interviews revealed the teacher used positive and loving statements regarding her students, but also overwhelmed with the dynamics of her classroom. In multiple conversations, she shared of the challenges with the students that caused her most concern (see **Table 1**). She stated: "you cannot control what comes out of their mouth, like I want to kill you, blow you up, and poke your eyes out, things of that sort. We get no training and I don't know what to do" [15]. She further revealed the teacher support provided 3 days a week was helpful, and she felt more competent at meeting the needs of the students with emotional disturbances only with aide support.

Mrs. Bradwell's insecurity at meeting the needs of students with emotional disturbances is not surprising as findings suggest "that although most of these students spend some time in general education classrooms, they are included in such classes less often than students with other disabilities and are likely to have teachers who feel unprepared to work with them" [16]. Because "society, schools and teachers set standards for acceptable behavior and expectations for children and adults" the challenges faced in educating students with emotional disturbances or behavior disorders are great, particularly when those behaviors are characterized by "impulsive, antisocial, hostile or aggressive actions directed toward others" [8].

4. The "troubling" students

When Mrs. Bradwell began the school year, she was immediately faced with outbursts from two different students and antisocial and hostile behaviors from two other students, described in **Table 1**. The needs of these four particular students in addition to the other 22 felt insurmountable to her. She immediately began a referral process for two of the students based on the combination of their academic and social needs. The significance in the referrals for Mrs. Bradwell was not only to obtain the necessary support services to the students, but the needed help she hoped to gain in the classroom. One of the students received an Individual Education Plan (IEP) for Attention Deficit Hyperactivity Disorder (ADHD) and the other student received an IEP for behavioral interventions which included a diagnosis of Oppositional Defiant Disorder (ODD), "a psychiatric disorder marked by aggressiveness and a tendency to purposefully bother and irritate others" [8]. The challenge in seeking and obtaining these diagnoses includes a differentiation between children, who demonstrate rational, purposeful, and communicative challenging behaviors and those with aggressive behaviors without a contextual/cultural rationale. However, the most common complaints of teachers about students considered troubling are "they are frequently off-task, not doing their assignments, and not sufficiently engaged in academic work and they do not get along well with their peers, interacting in negative or disrespectful ways" [3].

In the observations of the first grade classroom, the four students listed in **Table 1** exhibited many of these behaviors. Within the first hour of arriving, it was clear Joey and Billy were off task, would not begin their morning seat work even with various prompts, praise, or the possibilities of consequences. Mrs. Bradwell would continue to navigate throughout her morning routine and engage students, only to face resistance from students shortly into the lesson. This pattern of off-task, resistance, responding negatively or overtly to the teacher's requests was observed each day. During class story times, the students would be engaged at times, and on other occasions the personal space of other students was invaded by the troubling students; talking out and disengaged behaviors were repeatedly observed. **Table 2** indicates examples of the troubling behaviors for the four particular students during 10 days of observations.

There is difficulty in observing and appropriating what is considered an aspect of a behavior disorder or "troubling student" and that is a frustration many teachers and specialists discover, particularly in the diagnostic process. "What is disturbing to one person may be viewed as independent, humorous, appropriate or creative by another" [8]. While observing the four students considered "troubling," it was

Joey (IEP) • Two significant outbursts that involved threats of death • Refusal to complete morning work, all 10 days • Three acts of physically hitting another student • Four examples of running around the room and laughing at behavior
Beth (IEP) • All 10 days, head on desk refusal to work • Each day, several times a day argued with the teacher • Each day actively defied or refused to comply with the teacher's request • Blamed others for her misbehaviors • Angry and resentful
Billy • Three instances of refusing to complete work • Six examples of inappropriate behaviors at the story time area • Two recesses missed due to disrespect and incomplete work • Four instances of hostile defiance to authority
Sam (IEP) • Although revealed as a student of a troubling nature, Sam presented only on two occasions distraction and sensitivity

Table 2.
Student observations.

ironic some of the other members of the classroom were also engaged in behaviors that were deemed inappropriate, defying the teacher's requests or off task, yet they were not the focus of my observations. However, during the observations there was a consensus between myself and Mrs. Bradwell that the instances indicating which students were troubling were consistently regarding Joey, Billy and Beth. Although it is noteworthy there were several instances of resistant behavior among otherwise typically developing students in the classroom.

5. Teacher-student relationships

According to Danforth and Smith, "the most profound thing a teacher can do is create a relationship with a student that communicates deep acceptance and love to that student. That relationship is the cornerstone of good teaching" [3]. While there were many instances of nonconforming behaviors as indicated in **Table 1**, there were likewise a significant amount of positive and encouraging interactions of Mrs. Bradwell. Only on two occasions did she raise her voice, otherwise she would reassure, restate her expectations, and made the behavior expectations consistent and clear to her students. She did not use a reward system initially, but created a ticket system in the last few days of the observations due to the intensified end of school year student behavior issues and enthusiasm. The punishment system she typically used for her students was to take away a few minutes of their recess. Otherwise, Mrs. Bradwell did not use a prescribed management system in her classroom. Instead, she consistently used positive phrasing with all of her students in her lessons, in her daily transitions and student interactions. Some examples include*: Be kind; Make a good choice; I am looking for second grade behavior; In life sometimes we are asked to wait, so I am asking you all to be patient with others*; etc.

Although Mrs. Bradwell had clearly established some very positive student-teacher relationships, she felt discouraged by the relations with her troubling students. For example, with Joey and Billy, regardless of the trust, positive rapport and evidence of improvement in their overall behaviors; Mrs. Bradwell still felt defeated when they would act out. She seemed to feel the most sense of failure in her ability to connect with Beth. Joey had made significant gains in his ability to self-regulate his outbursts according to Mrs. Bradwell as compared to the beginning of the school year. However, the consistent anger and arguments from Beth were occurring continuously, causing Mrs. Bradwell frustration and feelings of helplessness in meeting Beth's needs. She felt she had exhausted all resources in connecting with Beth to help her socially and academically. Potentially a larger social issue was influencing the lack of progress, but one that was out of Mrs. Bradwell's control. Essentially, Mrs. Bradwell felt she had done all she could to establish a caring relationship with Beth and she felt it had failed.

Danforth and Smith reveal eight basic concepts that make up caring relationships such as time, being there, talking, sensitivity, etc. When discussing these ideas with Mrs. Bradwell, the frustration was even more apparent because a "caring relationship involves two people who must both participate" [3]. Her other expression of the hindrances with this particular student was her responsibility to meet all of her students' academic needs. The work of Nel Noddings describes caring as a relation, a connection or encounter between two human beings [17]. She emphasizes what constitutes a caring community in part, from cultivation of empathy, social concern and responsibility among children and more importantly how it does not conflict with goals of academic development.

Although, like Mrs. Bradwell, teachers who exhaustingly show care all day but do not feel like their students are really receiving that care know the frustration of a one-sided relationship. For teachers of resistant, depressed or troubling students, this can naturally be a problem. Often, Mrs. Bradwell was petitioning me "What is the solution? Do you have answers to share with me?" I would often share the challenge exists that relations do not merely consist of a list of approved behaviors that teachers should memorize and adopt. "Knowing how to be caring with one student is not necessarily ample preparation for creating such a relationship with another student" [3].

6. Inclusion is hard

Throughout the conversations and interview with Mrs. Bradwell, the sentiments she regularly revealed were feelings of failure and the overwhelming sense of an inability to connect with the troubled students. Often this feeling was translated into the idea that she "did not see inclusion as a great thing" [15]. It was important to consider that the limiting factors in the timing of the observations was that they were taking place at the end of the school year and students felt like they were done for the year and lost their motivation. Behavioral issues for a majority of students became a big problem and teachers had an incredible amount of paperwork to do at the end of the school year. Students often take advantage of the fact that their teachers are tired and preoccupied with all the forms and data they have to turn in. Nevertheless, in the conversations and observations, it would appear many of the successes and stories of promise were difficult for Mrs. Bradwell to discern, but were revealed in what she shared.

Joey had several outbursts in the time I was there to observe, but Mrs. Bradwell shared the context of how volatile they had been in the beginning of the year. Joey was clearly able to calm down with Mrs. Bradwell, an indicator of a trusting relationship. Even though Mrs. Bradwell recognized a caring relationship was seemingly established that involved nurturing, supportive elements; she felt that the cost for that developed relationship was the suffering of the typical students in the classroom. The students had to witness the behaviors of the nonconforming students.

> *I think if the parents truly knew how much disruption to the classroom on an average day, they would be outraged. I really do. My daughter, was in kindergarten with the little guy that I have now, and she would come home and share with my husband, who is also in education, what he would say, and the threats and the hitting, and my husband would say, enough is enough, I need to go in there and say something, as this is not safe! I would tell him, hold on, if it truly were not safe to have him in there, they would not have him in there. But at the same time, oh the distractions…now that we have done full inclusion.*

The persistent challenge for Mrs. Bradwell was recognizing the success of inclusion for all of her students outside of the troubling students. If the only way to measure success is academically, she concluded that her students did each make adequate yearly progress; but she wondered how much more progress might they have made if the troubling students were not present in the classroom. Mrs. Bradwell stated if the measurement was her level of stress in teaching an inclusive classroom, she could truly attest to the exhaustion, scattered emotions and an overwhelming sense of failure. However, the observations seemed to display a level of success that is difficult to quantify. According to Danforth and Smith, in examining ways therapists connect with people of emotional disturbances, researchers found a common element of approaches that worked best in therapy: "a respectful, valuing, and empathetic bond between therapist and client. An intentional and consistent focus by therapist and client on discussing and developing the relationship they share" [3].

The authors believe that "a similar bond- a pedagogical alliance- between teacher and student is similarly powerful when teaching students who struggle with social and emotional difficulties" [3]. They explain that no educational research base on this exists. On the other hand, most professionals would acknowledge that students need a wide variety of academic and behavioral programs, services, and supports to succeed, and considerable professional literature has described these interventions for students with high-incidence disabilities, including ED teachers with a strong repertoire of behavior-management skills to decrease inappropriate behaviors and increase prosocial behaviors. Thus, any conclusions on how creating a caring classroom can ultimately promote student engagement and participation within the inclusive classroom must come from the personal stories and narratives within the teacher reflections.

Even though Mrs. Bradwell was finding it challenging to enjoy the relationships with the students considered troubled and troubling, each of the conversations with her revealed her determination to learn how to better love her students. She expressed that her teaching has changed to "promote tolerance. I mean a lot of these kids have been with the kids since Kindergarten. They model what is shown to them by the teacher when it comes right down to it" [15]. She explained that she was often sharing with all of her students the necessity for patience and understanding. Mrs. Bradwell stated she would often explain that we all have differences in appearance, ways of communicating and how everyone relates to people, objects, and events differently from one another and some respond unusually or dramatically to things. Baglieri and Shapiro state when necessary, "these ways of responding should be addressed candidly in order to cultivate understanding and acceptance of difference" [8]. Building a sense of community among class members and relationships are vital to the helping task and imperative for moral development.

An example of how these conversations and explanations had made an impact was revealed 1 day in the behavior of a typical developing student, Chuck. He was the pleaser, always mindful of the other students in the classroom; Chuck had no behavior issues and was consistent with on task behaviors. Mrs. Bradwell shared at the start of the year during Joey's outbursts, Chuck would cover his ears and was clearly disturbed by what he was seeing and hearing. Mrs. Bradwell was very concerned of how these interactions and experiences were affecting Chuck academically and emotionally. Chuck continued to succeed academically and his reactions to the behavior outbursts of the other students over time diminished. On one such occasion while trying to help Joey, a mantra of threats ensued and Chuck was the first student by the visitor's to share what was happening, how everything would be alright and a first grade version of why Joey was behaving the way he was behaving. The empathy was evident and it would seem a social distance between Chuck and Joey had significantly diminished from the examples Mrs. Bradwell had shared in her interview.

As Mrs. Bradwell struggled to manage the students' overt behaviors, she did not utilize a classroom management plan or tool that may have aided in her success. Behavior-Management Strategies with clear rules and related consequences have been shown to assist teachers in their teaching. However, many general education teachers are reluctant to implement behavior-management systems suggested in the literature as being effective with students with emotional disturbances because "these systems appear to be too time intensive and dependent on consistent implementation [18]. Additionally, some behavior strategies are not considered necessary for the rest of the student population. For instance, a token economy system that relies on external rewards has been shown to be successful for students with emotional and behavioral challenges, for instance, students earn tokens for appropriate behaviors.

When a classroom management tool or behavior modification idea was shared with Mrs. Bradwell, she was resistant to adding an additional task in her day. She also explained that not all students need a reward for positive behaviors they are consistently displaying. As previously stated, there is a correlation between teacher attitudes and their knowledge of disabilities. This is particularly true of individuals with emotional disturbances. Students with frequent outbursts are too often viewed from the perspective of their deviant behavior and not as a result of their disability. Therefore, implementing a different behavior tool to assist the student is hindered by the assumption that the student should behave as the other students do. In contrast, students with physical limitations or visual impairments would not be denied the necessary assistance they require to access the inclusion classroom. A review of the literature suggests the need for effective instructional, behavioral, and self-management strategies for troubling students [18]. Fortunately, most instructional practices that are effective for students with emotional disturbances have a positive impact when used alongside their non-disabled peers.

7. Conclusion

Although the observations were just a single case study of troubling students in one inclusive classroom, the observations revealed first and foremost the frustrations of the inclusive teacher and the challenges presented to teachers by troubling students. Negotiating those challenges and the benefits of inclusion for Mrs. Bradwell was extremely difficult. Based on the observations and what Mrs. Bradwell shared of her classroom dynamics at the start of the year, there appeared to be a different outcome compared to the impressions of the observe, one that confirms the conclusions of Danforth and Smith [3, 19]. The observations revealed how creating a caring classroom can ultimately promote student engagement and participation within the inclusive classroom and that these interactions and relationships can have a profound impact on the emotional well-being and learning of all students, but especially the students with troubling behaviors.

The teacher interview and conversations demonstrated although nothing fully prepares a teacher to teach inclusively troubling students, an important aspect in her teaching was to recognize that each student is different and have varying educational needs. This of course applies universally to all students, troubling or not. The classroom teacher worked tirelessly to develop positive relationships with all of her students. Ultimately, it takes time, patience and persistence to meet the individual needs of each and every student in the classroom, regardless of their emotional, behavioral and educational needs. Then again, is not that true of good teaching regardless?

Acknowledgements

I would like to thank Dr. Margo Izzo of the Nisonger Center, Ohio State, for her support and encouragement in this research endeavor.

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Chapter 16

Relationships and Resources: Supporting Exceptional Learners from Birth through Primary School

Mary Heather Munger, Mary Murray and Alex Claussen

Abstract

Bringing a child into your family is an emotional experience. New parents are excited to begin a new chapter with their new little ones but also apprehensive about what the future may bring. The hopes, joys, and anxieties of parenthood are unparalleled. When a child has any kind of special need, those emotions can be more pronounced and all-encompassing as parents and caregivers struggle to adjust to the unknown. This chapter will outline common milestones of young children, challenges experienced by parents and caregivers of young children with exceptionalities, and strategies and resources designed to support families on their journeys. The information is designed to be presented in a way to help set families and their little ones up for success. The content provided in this chapter is built on the premise that knowledge is power, that all children can learn, and that parent-professional partnerships are central to the growth of all learners.

Keywords: resources, partnerships, typically developing, atypically developing, child development, resources, challenges

1. Introduction

> *"Help a parent, and you've already helped the child." Johana Scot [1]*

All parents anticipate with excitement the upcoming birth of their soon-to-be baby. They dream about who the child will look like, who he/she will act like, and if their new baby will be an engineer, a ballerina, an athlete, or a nurse. Many times, when the parents are told that their child has or will have a disability, the wind is let out of the sails that give life to these dreams. New parents are apprehensive about what the future may bring. The hopes, joys, and anxiety that come with each new day can be more pronounced when their child has special needs.

This chapter will outline typical and atypical social/emotional, language/communication, fine/gross motor, and cognitive/academic development and discuss the common challenges experienced by parents and caregivers of young children with exceptionalities as well as strategies and resources designed to support families on their journeys. Each section will describe transition points for a child with special needs and provide strategies on how to help families make informed decisions regarding major milestones within each time period. Resources will be provided to assist families and their child(ren) to reach their highest potential.

The content provided in this chapter is built on the premise that knowledge is power, that all children can learn, and that parent-professional partnerships are central to the growth of all learners.

2. Birth to age 3

"In the garden of humanity, every baby is a fresh new flower." Mridha [2]

Infants and toddlers are wonderful, miraculous, and exhausting. Each new day brings an odd mix of new discoveries and mind-numbing routines while attending to their every need. Caregivers have likely never been so amazed and exhausted in their lives. These new beings soak up every ounce of energy and love. Families are in awe of their new little ones and anxious about their development. Below, we outline typical and atypical developmental milestones for this period of time wherein exponential growth is the norm.

2.1 Social and emotional development

2.1.1 Typical

When a newborn comes home to a family, they typically require total care. Feeding, changing, and keeping them warm and dry consume the hours that make up each day. Children in this age span sleep a good portion of the day. They quiet down when they are picked up, turn toward voices, respond positively to touch, smile, recognize faces, and show pleasure when in a social situation [3]. Between 6 and 12 months, they display a few emotions, play peekaboo and simple games, comfort themselves, follow a few simple commands, and respond when they hear their name. Between 12 and 24 months, the typical child blossoms developmentally. The toddler will delight when they recognize him or herself in a picture and as they hug or kiss family members for greetings and goodbyes. One-year-olds will play alone for a few minutes and start saying no to many directions from caregivers [4, 5]. The 24- to 36-month-old toddler becomes more assertive and will let an adult know what he or she wants, which can be both humorous and tiring for the adult. He/she will watch other children play and will begin to join in and play near another child. This is known as "parallel play" [6]. Children this age prefer an ordered, more predictable routine, but they can adjust to change with minimum protest [7]. They want independence but need the security of their parents or caregiver, and they can become distressed if the caregiver becomes separated from them. During this age span, children begin to show empathy toward other children [7].

2.1.2 Atypical

When a baby or toddler has atypical social and emotional development, it is usually first noticed when the child does not smile or respond to their parent or caregiver. They may not imitate or show interest in adults or other children, which is unusual. Once they are toddlers, they may have extreme difficulty separating from their parents and waiting for a response or event to happen. They may not start interactions with others or respond to other children when they are spoken to. Children in this age span may show abnormal aggression or extreme passivity [8]. They may have rigidity about routines, and their sleep may be sporadic or interrupted. The social and emotional aspects of atypical development are very hard on parents. Taking care of a baby or toddler who may not be sleeping well and who may not respond to you or interact well with family or peers can be overwhelming. Parents who are tired and get little positive reinforcement from their child experience high levels of stress. Developmental milestones in these situations are no longer taken for granted but are earned through blood, sweat, and tears.

2.2 Language and communication skills

2.2.1 Typical

Besides smiling and interacting with a parent, typically developing infants between 0 and 6 months will start cooing and exhibiting differentiated cries. They will show excitement by waving their arms and legs, much to the delight of their caregivers. Between 6 and 12 months of age, the coos turn into playful babbles that may start to sound like words as they near the 1-year mark [9]. They will shout loudly to get attention, show affection, and start to understand cause and effect (e.g., if I cry, then something will happen). Children in this age span start to repeat a sequence of syllables and may say, “Momma” and/or “Dada” [6], which is so exciting for many adults who have dreamed what that moment would be like once they become parents. Somewhere between 12 and 24 months, the child begins to recognize names of familiar people, understands “No,” and tries to repeat words they have heard in conversation [10]. The “songs” they sing serve as wonderful entertainment and memory-building material. Young toddlers usually use between 10 and 20 different words by 18 months, and by the age of 2, they have a vocabulary of about 200 words. At this point, they can combine two words together. Many times, this two-word strand begins with “My ___! ” These children can generally point to body parts, follow one-step directions, and repeat words over and over [10]. Older toddlers (around three) have a vocabulary of about 450 words, can answer “where” questions, talk to peers and adults, match four colors, and understand “big” and “little.”

2.2.2 Atypical

From birth to age 3, atypical development may include limited facial expressions, not turning to sounds, not responding to their name, not using gestures, and/or lack of imitation. If the child between 12 and 18 months old has a vocabulary of less than 10 words, caregivers should seek professional assistance. A pediatrician is a good place to start. At 2, if the child does not have a vocabulary of 20–50 words and is not putting 2 words together, that is a concern. At 3, the child should have an interest in playing with other children and adults and use their language to communicate with others. At this point, they should have a vocabulary of about 100 words and should be stringing 2–3 words together (airplane in sky) [11].

2.3 Fine and gross motor skills

2.3.1 Typical

From birth to 6 months is a time where a baby will move their arms together and apart, bring their hands to their mouth, and possibly suck on a finger or fist. He or she may lift his or her head and shoulders off the floor when they are placed on his/her tummy. Between 6 and 12 months, the baby will sit up, start crawling and cruising around furniture, and start walking with hands held [12]. Typically developing 6-month olds are working on sitting up with support. Around this same time, babies are attempting to roll over. As they reach 18 months, the child should be walking independently, and by 2 they should be running fairly well. At this same time, they should be able to walk up and down stairs while holding someone's hand. They can also point to pictures in a book. These interactions help build a bond between the baby and the caregiver. One welcome relief that comes around this time is the child's ability to hold his or her own cup or drink with minimal spilling. They are also able to scribble with a crayon to create "pictures." Between 2 and 3, children this age should be able to copy or make straight lines and circles with a writing utensil and string beads on yarn or string [10]. Around this age, the child should also be able to pedal a tricycle. This can give caregivers some extra exercise as they chase after their busy toddler.

2.3.2 Atypical

Concerns are noted when a young infant (around 3 months) is not attempting to hold its own head up for short periods of time. Better head control appears between 3 and 4 months, so if that is not happening, seek the advice of a pediatrician. If babies around 6 months of age are not attempting to sit up with support or make any attempt to roll over, there may be an underlying cause. If he or she is not using pincer grasp around to pick up small objects around 18 months of age, or he or she does not point to things using his pointer finger, these would be additional warning signs. If a child past 18 months of age does not use both hands during play, if their movements are shaky or stiff, and if they cannot imitate a caregiver drawing a vertical line, or walk independently, there may be an issue with either gross or fine motor skills. Anytime that skills regress is another reason to seek an evaluation [10, 13].

2.4 Cognitive skills

2.4.1 Typical

Infant/toddler cognitive development changes very quickly. Between 0 and 6 months, an infant can recognize faces, which is a cause for cheering among caregivers. At 6 months, they start to enjoy playing games like pat-a-cake and pop-up toys. Around 8 months, fear and separation anxiety may begin [3]. As the 12-month mark approaches, babies can imitate gestures and facial expressions, which is great fun. Babies will also begin to show affection and enjoy picture books around age 1 [3]. Between 1 and 2 years of age, the child will begin to understand words and commands and may even respond to them, imitate adults' actions and words, begin to want to do things independently, and will start to respond with words when requested to complete a task. They can also understand that an object hidden under a blanket is still there even though they cannot see it. This is called object permanence [14]. Between the ages of 2 and 3, the child learns to do several things: name some objects in a book, group objects by category, stack rings in order of size, put together simple puzzles, tell others what he/she is doing, count to three, and play pretend. All of the different skills children acquire each year are amazing!

2.4.2 Atypical

Warning signs that a difficulty may exist for a child under a year are having problems tracking objects, not responding to sounds, having little interest in interactions with known adults, rigidity in routines, and fleeting eye contact with others. By 2 years, cause for concern would be if the child does not imitate other people, requires constant attention to stay with an activity, or does not understand common commands. By 3, the child should be interested in pretend play, know the function of common objects, no longer be mouthing toys, and play independently for short periods of time. If these events are not happening, caregivers should seek the advice of their pediatrician [10, 13].

2.5 Challenges and resources

One of the biggest challenges for parents of infants and toddlers with exceptionalities is getting a diagnosis. We know that a child with autism may have had up to eight wrong diagnoses before getting a correct autism diagnosis [15]. When a child is diagnosed or identified with a deficit, they are required to have an Individual Family Service Plan (IFSP). This plan is meant to identify services and supports for the child and their family. Services identified in the plan are provided at no cost to the family. Below are common considerations and challenges associated with this age span, suggested actions a caregiver can take to help address the concern, and resources caregivers can use to find more information (**Tables 1** and **2**):

Challenge	Action
Identifying the problem	Express concerns to pediatrician Get second and third opinions
Securing support/treatment/therapy for child	Connect with professional and parent organizations associated with your child's diagnosis (see Table 2)
Coping with emotional stress of having a child with a disability	Accept help from friends and family; establish a routine and build in time for your own interests. Join a parent support group and see a counselor if needed

Table 1.
Identifying and addressing diagnoses: challenges and actions.

Resources
Help Me Grow National Center: www.helpmegrow.national.org
Individual Family Service Plans: www.specialeducationguide.com
CDC's Milestone Tracker: check the app store appropriate for your device www.cdc.gov/ncbdd/actearly/milestone-app.html/milestones
International Resource: United Cerebral Palsy Association https://ucp.org/resource-guide/international-resources
Council for Exceptional Children Division of Early Childhood: www.dec-sped.org
Autism Society of America: www.autism-society.org
Issues Associated with Ages Zero to Three: www.zerotothree.org
Rights and Laws Associated with Special Education: www.wrightslaw.com
Center for Disease Control and Prevention (descriptions of milestones): https://www.cdc.gov/ncbddd/actearly/milestones/milestones-2mo.htm

Table 2.
Resources for infants and toddlers with special needs.

3. Preschool

> *"Children deserve to be loved and to know they are loved. They deserve to be cherished and to know they are valuable." Ramsey and Cruze [16]*

Preschoolers are silly, energetic, inquisitive, and tiring. They are still completely dependent on caregivers for food, hygiene, and other day-to-day needs. Many parents and caregivers opt to send their children to preschool between the ages the ages between 3 and 4 to capitalize on their sponge-like thirst for knowledge. When the child developing normally, this can be a time of great excitement and provide them with opportunities to socialize. Parents of children with disabilities have these same hopes, but they are often tempered with hesitation about difficulties that may lie ahead.

3.1 Social and emotional development

3.1.1 Typical

Typically developing preschoolers are able to express likes and dislikes and developing their own personalities. They are able to talk about emotions rather than just display them. However, even though they can put words to their feelings, they may still display emotions in an exaggerated way. They laugh hysterically when they are feeling silly and can have complete meltdowns if they are angry or frustrated. It is not until they are a little older that they have better control over their emotions. Preschoolers are impulsive and likely to take whatever they want and have total disregard for things they want nothing to do with. It is difficult for even typically developing preschoolers to fully understand the consequences and cause-and-effect relationships of their behavior, although this is the period of time when they learn this skill, as the adults in their lives guide them through making appropriate behavior choices. Preschoolers are able to display empathy and cooperation [17]. They are very creative in their free play and ability to pretend. They may have difficulty distinguishing what is real from what is imaginary. Socially, preschoolers love making new friends. They move from isolated play to choosing to play with others. It becomes easier for kids toward the end of this age span to separate from their parents for short periods of time and have fun playing at school or with caregivers while their parents are away.

3.1.2 Atypical

Once a child reaches 3 years of age, if they do not play pretend or make-believe or play with other children or with toys it is a cause for concern. If they do not have an interest in others (friends or adults), if their emotional responses seem "flat," or if they do not match the antecedent (e.g., in a funny situation, the child becomes angry), then a developmental evaluation is in order. It is normal for children of this age not to have complete control over their emotions, but mismatched reactions or a lack of reaction to emotional stimuli can be cause for concern [10, 13].

3.2 Language and communication skills

3.2.1 Typical

Typically developing preschoolers are fine-tuning their listening skills, which is the foundation for learning to read. They can follow simple verbal directions and repeat simple songs they have learned. Children from the ages 3 to 5 use most speech sounds correctly; they understand directional words such as "up," "around," and "behind"; and they use pronouns correctly. Rhyming is a very important skill acquired at this age. Preschoolers enjoy pretend reading and telling stories. Their propensity for talking sets the stage for their ability to read and write later on. They are able to articulate their wants and needs, and they are constantly adding new words to their vocabulary.

3.2.2 Atypical

If the 3-year-old drools regularly or has very unclear speech, then a speech evaluation is in order. At this age he/she should be speaking in clear sentences and should understand simple multistep directions. Be particularly concerned if the child does not make eye contact with his/her parents [18].

3.3 Fine and gross motor skills

3.3.1 Typical

The physical development of preschoolers is marked by increased coordination. Preschoolers can move both large and small muscle groups in meaningful and strategic ways. They can hop on one foot, kick a ball forward, and throw overhead. Their ability to hold writing instruments and aim small objects toward targets becomes more consistent and accurate between the ages of 3 and 5. Their hand-eye coordination also becomes more accurate [12].

3.3.2 Atypical

Developmental concerns should be noted if the child falls frequently while walking or does not run. Fine motor concerns should be explored if the child in this age range cannot eat independently using a spoon and cup or cannot hold a crayon [10, 13].

3.4 Cognitive and academic skills

3.4.1 Typical

Preschoolers are sponges when it comes to learning. One of the most exciting stages of development a caregiver will see during this time period is the child's ability to move from literal to representational or symbolic thinking. Somewhere between 3 and 4, children are able to use objects to represent other things and to pretend that something (like a horse or a fire truck) is present when it is not. Children at this age are able to begin categorizing objects, although they may only focus on one attribute of the object rather than take several attributes into consideration. Preschoolers are very egocentric, meaning that they see the world only through their own point of view [14]. The memory of a 3-year-old requires more recency than that of a 4-year-old.

3.4.2 Atypical

Atypical cognitive development in a preschooler would be if they cannot sort things by color, shape, or size, understand the concept of size such as which is smallest or largest, and do not know the primary colors red, yellow, and blue. As with all developmental ages, if a child ever loses skills they once had, it requires a trip to a physician to see if it is a concern [10, 13].

Challenge	Action
Identifying issue or concern Note: it may not be until children reach a school setting that parents and teachers recognize a delay or concern	Express concerns to pediatrician Get second and third opinions
Securing support/treatment/therapy/services for child	Connect with professional organizations associated with your child's diagnosis
Coping with emotional stress of having a child with a disability	Accept help from friends and family; establish a routine and build in time for your own interests and profession

Table 3.
Challenges and actions to identifying and treating diagnoses in preschool.

Resources
National Autism Association: http://nationalautismassociation.org/
The Council for Exceptional Children: https://www.cec.sped.org/
American Speech and Hearing Association: https://www.asha.org/
Interactive Autism Network: https://iancommunity.org/

Table 4.
Resources for preschool children with special needs.

3.5 Challenges and resources

Preschool lays the foundation for the remainder of a child's school journey. A positive start can set the stage for many happy and fulfilling experiences for everyone involved; a negative beginning can create a rocky road for all participants to travel on during future academic endeavors. When a child with a disability reaches 3 years of age, they will transition from an IFSP to an Individual Education Program (IEP) if they are eligible. This plan will identify goals and services for the child. All services are provided for the child free of charge. Below are common considerations and challenges associated with this age span, suggested actions a caregiver can take to help address the concern, and resources caregivers can use to find more information (**Tables 3** and **4**).

4. Primary school

> *"Parents with their words, attitudes, and actions possess the ability to bless or curse the identities of their children." Craig Hill [19]*

Five-year-old children are full of energy and enthusiasm. Typically developing children have a bubbling excitement for being "big" enough to go to "real" school. They have heard so much from their neighbors and siblings about what school days are like that many little ones are anxious to be a part of the official school-kid crowd. Dreams of bus rides, recess games, and eating in the cafeteria are only eclipsed by their parents' anxieties of how things will go. These anxieties can be exacerbated when special needs are present. Depending on the disability, the child's level of excitement can go from nonexistent to hyper-exaggerated. Students with intensive needs may not even be aware that a change is coming or have extreme difficulty adjusting to the change when it does. Those on the autism spectrum may perseverate with excitement or stress on different aspects of issues related to school. The parents of these children have the same range of emotions and stressors as they face the myriad of decisions to be made as they enroll their children in primary school.

4.1 Social and emotional development

4.1.1 Typical

Socially and emotionally, typically developing children entering primary school have an interest in other children. They can share and make friends and begin to take "ownership" of their friends. They pay attention to rules and want their opinions to be listened to. Kindergarteners like to sing, dance, and act [10]. In the upper grades of primary school, typically developing students behave in a more independent manner, they are eager to please, and they demonstrate an understanding of knowing right from wrong. They constantly seek attention and approval from adults. They like to please friends and be like their friends [10].

4.1.2 Atypical

Students with exceptionalities at this age vary greatly in their social and emotional development. Those with severe cognitive delays may have difficulty forming relationships due to a variety of factors, such as language delays or lack of social skills such as inviting others to play or being aware of comfortable zones of proximity when meeting others. Students with special needs at this age may not be as independent as their peers when it comes to social play. They may have difficulty with turn-taking and following rules, which can lead to arguments, ostracism, and bullying. Their attempts to make friends can often be awkward and cause them to be stressed or anxious about social situations. These difficulties are a source of much angst for parents. It can be heartbreaking to see your child bullied or left out by other children. Friendships are such an integral part of life; it is devastating to think that your child may not be able to form these important bonds with other people [10, 13].

4.2 Language and communication skills

4.2.1 Typical

Typically developing children in primary school can clearly use language as a tool to communicate their needs. They understand the role of letters in learning to read and grow from non-readers to fluent readers and writers within this time frame. Typically developing learners in primary school add new words to their vocabularies constantly, learning between 540 and 11,260 a year [4]. This vocabulary acquisition opens new worlds for them in books, in conversations, and through their own writing. Primary-aged students are able to connect their life experiences to the stories they hear and read, and they like to talk and write about stories. In this stage, they move from learning to read to learning from reading.

4.2.2 Atypical

Students with disabilities often experience language delays [20]. Depending on the severity, this can affect their ability to learn to read and write, as well as their effectiveness in communicating with others using speech and text. Disabilities involving receptive and expressive language skills can cause significant gaps in vocabulary acquisition. This causes a domino effect in their ability to understand new concepts or to discuss information and ideas in depth. Phonological awareness delays and deficiencies can affect a child's ability to manipulate isolated sounds in words, a key element of learning to read [21].

4.3 Fine and gross motor skills

4.3.1 Typical

Students entering kindergarten are usually fairly coordinated and spatially aware. As they grow throughout primary school, these skills are fine-tuned, and they develop the capacity to write neatly (utilizing fine motor skills) and participate in athletic endeavors (which utilize gross motor skills). Hand-eye coordination develops exponentially during this time frame. Children grow from barely being able to catch objects that are thrown to them to hitting balls with a bat during organized baseball and softball games.

4.3.2 Atypical

When a disability is present, this is yet another area that can be affected. Students may lack coordination and therefore have difficulty participating in play or physical education exercises. They may be non-ambulatory or need assistance with self-care tasks like brushing teeth, holding a writing tool, or typing. It is easy to see how lacking these skills can make a child stand out from their peers and cause both them and their parents a great deal of emotional distress. Along with the stress of not being able to perform these tasks at the same rate as their peers, children with atypical fine and gross motor development miss out on many of the benefits associated with physical play and learning through the repetitive action of tracing and writing with ease [10, 13].

4.4 Cognitive and academic skills

4.4.1 Typical

Typically developing primary school-aged children progress in their abilities to think logically and use reason. Early in this stage (around age 5), children are curious about everything. They constantly ask, "Why?" From kindergarten to third grade, their problem-solving skills improve. Memory and sequencing skills go from simple to complex as children move from mimicking simple directions to performing complicated tasks from multistep directions they hear or read. They add to their repertoire of ways to learn by moving beyond observation, imitation, and repetition to reading, discussing, and reasoning in order to gain new information and think about more complex ideas. They understand spatial and directional vocabulary and concepts of time and that numbers represent amounts. Children in primary school typically move from being non-readers to being able to read primary chapter books by grade three. They should be able to solve basic mathematical and logic problems as well as extract information from content area texts.

4.4.2 Atypical

The cognitive and academic development of students with disabilities varies in its progression. Students with moderate or intensive cognitive delays are likely to have difficulty retaining new information as well as applying information to new situations. Some students may have trouble accessing academic content due to physical barriers such as deafness or blindness. Students with autism may present exceptional skill in reciting information associated with a specific genre of information or topic of interest. For example, a child may be able to tell you everything there is to know about the solar system but may not be able to interact with their teachers or caregivers in depth like that about other topics. The primary-grade timeframe is also often the period of time when learning disabilities are identified. Students who are having difficulty with language-related issues may be at risk for reading difficulties. If a child has difficulty rhyming or manipulating sounds in words (e.g., "Take the /c/ off of cat and tell me what word you have"), intervention may be necessary. If the student has trouble with spelling or breaking down larger words, there may be a word-recognition learning disability present. In language comprehension, it may be that children (and parents) entered the school community thinking that everything was going to go smoothly, only to discover that learning does not come easily. Both of these situations bring various degrees of frustration and anxiety for both students and parents. If a child is not already identified, the process to assess, identify, and build the proper support network can be overwhelming. The relationships among all persons involved (the student, the caregiver, and the teachers) can become strained [10, 13].

4.5 Challenges and resources

All parents want their children to be in the best environment for learning in order to make this step a positive one. They wonder what kinds of options they have for schooling their exceptional child. What type of school to choose (private, public, full time, part time, etc.), what types of supplementary therapies and supports may be needed, and how to navigate the complicated process of securing those services through their child's school. If identification of a disability has taken place, or does take place during this time period, navigating that process can be trying. A child at this age will most likely be on an IEP and be receiving services through the school. Below are common considerations and challenges associated with this age span, suggested actions a caregiver can take to help address the concern, and resources caregivers can use to find more information (**Tables 5** and **6**).

4.6 Making connections

In each age range listed above, suggestions for how to help caregivers, family units, and the child with disabilities have been provided. Pulling these resources together and connecting agencies within the network and beyond can be a powerful strategy for maximizing support for all involved [22, 23]. Parents of children with disabilities interact with three primary categories of providers: medical, educational, and support services. When supporting units remain unconnected to any kind of network, they remain "bubbles" in the life of the family (see **Figure 1**). Each category of support is isolated and weak on its own. Within each of those bubbles, there can also be isolated components. For instance, the medical bubble could include doctors, mental health therapists, vision specialists, and home health workers. A family could be seeing multiple specialists who may not talk with each other and remain independent from one another. In the education bubble (e.g., teachers, therapists, tutors, principals), one could be seeing a general education and a special education teacher as well as a physical education, music, and art teacher. In the support services bubble (e.g., therapists, parent support groups, financial assistance and child care), a family could be connected with an occupational, physical, and speech therapist, parent support and/or disability-specific groups, as well as numerous social service agencies. It

Challenge	Action
Securing the proper types and amount of instruction and services	Meet with school team member first. Try to build a mutually respectful dialog about the situation and your child's needs. Speak with other parents who have been successful in securing services for their child. If you have difficulty working with the school, and you would like to secure the help of an advocate, you can find one in your state by searching here: http://www.yellowpagesforkids.com/
Supporting the student emotionally	Communicate with the mental health services and counseling department at the school. Pursue these services privately if need be
Coping with emotional stress of having a child with a disability	Accept help from friends and family; establish a routine and build in time for your own interests, and connect with professional organizations associated with your child's diagnosis
Difficulty learning to read	Formally state that you suspect a learning disability and that you would like the school to conduct an evaluation
Understanding the IEP process	Meet with the school's special education teacher or school psychologist. Find more information at www.understod.org

Table 5.
Navigating the process of choosing the best school for children with learning disabilities.

Resources
Understanding the Individualized Education Plan: www.understod.org
Ohio Center for Autism and Low Incidence: https://www.ocali.org
The National Center for Accessing the General Curriculum: https://ccrs.osepideasthatwork.org/resources/national-center-accessing-general-curriculum
National Center for Learning Disabilities: https://www.ncld.org/
Understood for Learning and Attention Issues: https://dyslexiaida.org/
International Dyslexia Association: https://dyslexiaida.org/

Table 6.
Resources for understanding action plans in schools.

is not unusual for these individuals to work on their own. They may not talk to each other and remain isolated, which can cause redundancy of service as well as unnecessary gaps in care. When the individual units and the components within the units are connected, they become a chain, much stronger and more effective in their support. **Figure 2** illustrates how connecting resources maximizes the strength of the overall network. When medical, education, and support services work together, the ultimate goal is to meet the needs of the individual with disabilities and their family.

Since it is not commonplace for agencies and/or providers to work together, a family with a child with a disability can supplant this phenomenon through organization and by keeping excellent notes. Starting a notebook with dividers for each area (education, medical, and support) of service can be very helpful. Every time a family sees a particular provider, they bring the notebook and update it. Verbally sharing the data or information in the notebook and providing copies to leave with the providers in order for them to get a full picture of what is happening help to streamline and strengthen a comprehensive support system. This can take place electronically or with paper notebooks. In the medical community, there are often medical portals where all of the medical information is shared within the medical system. This is generally not the case with the educational and support systems.

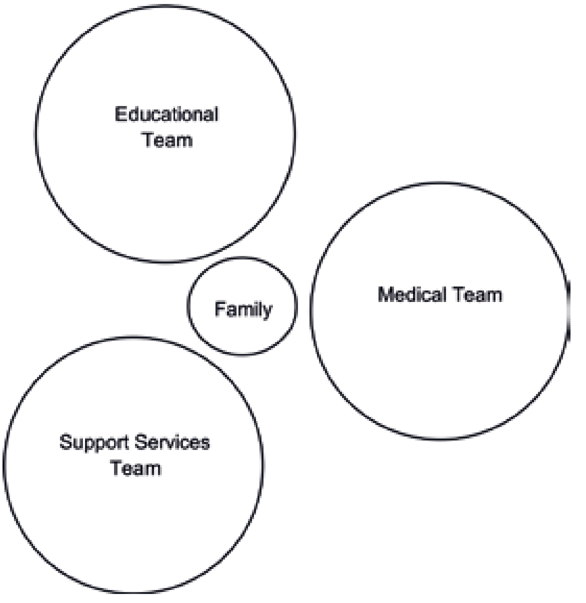

Figure 1.
Isolated services model.

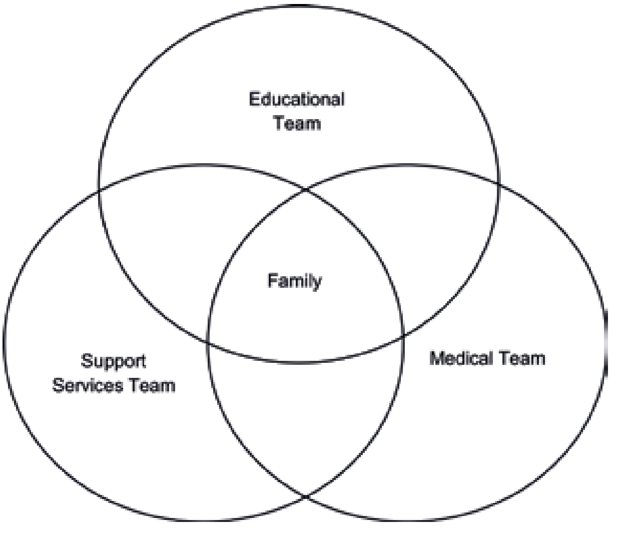

Figure 2.
Network chains model.

Providing a framework for all information to be shared benefits everyone involved. One of the greatest supports for families in navigating "systems" is parent-to-parent support. Pairing a parent up with someone who has gone through the system is very powerful and beneficial [22, 23].

The model illustrated below represents a typical approach to care for children with special needs and their families. Independent care units operate in isolation. Services are secured one by one, and professionals operate without knowledge of or interaction with the other agencies working with the families.

The model below illustrates a much more cohesive, efficient, and powerful approach to supporting children with special needs and their families. All service providers communicate with each other and coordinate services. This cross-pollination strengthens the support for the child, the family, and the service providers. It minimizes redundancy and makes progress monitoring more efficient.

5. Summary

Parents of children with disabilities travel a different (not better or worse) path than most parents. Many parents of typical children take development for granted. Parents of children with disabilities are forced to be keenly aware of every developmental milestone and can experience a somewhat different appreciation for each newly acquired skill. Although many disabilities may be invisible to the general public, the child, and the family are very aware of their existence.

Sometimes, parents have to navigate the three systems (medical, educational, and support services) on their own. Resources are often plentiful, but finding them can be a challenge. By networking with other parents, parents of children with disabilities can break down common barriers. Most parents find that they acquire a new set of friends (parents of children with disabilities) out of the necessity of finding resources for their child with exceptionalities [24]. Once parents are aware of typical and atypical development, they can identify potential concerns and how to start the process to obtain resources to get providers to work together to meet the needs of the whole child and their family. Traveling on this sometimes-difficult journey with information and knowledge of how to get help is a win for the family and an even bigger win for the child.

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Chapter 17

Promoting the Social Competence of Each and Every Child in Inclusive Early Childhood Classrooms

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Abstract

Social competence is part of a complex system that extends beyond the young child, necessitating prevention, assessment, and intervention. In this chapter, social competence in early childhood is examined considering existing research, developmental theory, and best practices and policies, many of which (on their own) address limited facets of a complex set of interactive competencies and outcomes. The potential and pitfalls of inclusive early childhood classroom structures relative to supporting interaction and social skill development are explored. Next, some of the most common social issues related to disabilities are described. These include deficits associated with specific developmental issues, such as emotional and behavioral issues autism, as well as others covered under the federal law (IDEA); universal practices for understanding and addressing student strengths and needs are shared. Finally, structures for addressing social interaction and supporting social competence in inclusive classrooms are presented. A conceptual model integrating professional preparation and the key components of inclusive preschool education for children with social competence needs is shared. These serve to illustrate practices and strategies which are supported by extant literature and acknowledge the dignity of children and their need for effective early childhood educational practices.

Keywords: preschool, inclusion, social skills, social competence, peer interaction

1. Introduction

Social competence is a term covering a variety of diverse internal factors and external behaviors that influence the likelihood and quality of social interaction. *Competence* implies an overall level of success in social interaction as it occurs in the contexts of daily life. The term has broad applications and encompasses many complex developmental factors, rendering most brief definitions simplistic. For example, the terms social skills and social competence are frequently been used interchangeably, but social competence has been conceptualized as a broader dimension comprised of not only social skills but also the neurological, temperamental, and environmental factors that both help and hinder social skill development and application [1, 2]. Social competence is experienced by the child but often judged by others: peers, teachers, and parents. The relationship between social competence and a variety of positive outcomes, such as success in school, has been well-documented. Social competence enables children to interact with peers in a variety of ways and contexts and to maintain positive relationships with peers and adults, both of which are critical for success in school and beyond. A significant amount of research into social competence in young children has identified negative consequences associated with social competence deficits.

In this chapter, the role of the early childhood educator in positively influencing the social competence of preschool children is explored. Specifically, the considerations, practices, and evidence bases for social competence teaching strategies and interventions in inclusive environments are emphasized. First, social competence is defined, and its importance to early childhood development is explored. Then, the impact of disabilities on social skills is touched upon. Universal considerations for preschool educators are presented, highlighting parallels between best early childhood education practices and those which form a foundation for proactively addressing social competence. Next, specific strategies and interventions to address social skills are shared. The chapter concludes with a model integrating these practices into a framework for addressing social competence in preschool that emphasizes strongly the role of the educator.

2. Importance of social competence in early childhood

In early childhood, play very often represents the context for the learning and expression of social behavior. A preschool-aged child's social competence among same-aged peers can be conceptualized according to what takes place as children interact—in other words, how children initiate, sustain, and maintain a level of positive interaction or cooperation—as well as how they resolve interpersonal conflicts. While such a conceptualization focuses on an important sequence of typical events in the preschool classroom, it is also an oversimplification of this complex construct. Each of these components might involve many discrete social skills as well as underlying reading of social cues and situations. *Social skills* include the discrete behaviors that make up or contribute to one's social competence, such as entering play, taking turns, making requests, etc.; many such skills are appropriate across a wide range of settings but must be understood and applied in context-specific ways. A given play context could also require a child to use social language, read of social cues, and demonstrate positive initiations and responses, as well as share, negotiate play roles, respond to aggression, and exchange ideas. In classroom contexts, social competence also includes behaving in accordance with classroom rules, displaying helping behaviors, and cooperating with adults during structured and semi-structured learning activities [3].

As a result, many early childhood programs consider social-emotional development and its associated skills as critical components of the preschool curriculum. Whether or not extensive planned opportunities to learn social skills are planned, in a high-quality preschool classroom, adults engage in play-based learning activities alongside preschoolers, so the social problem-solving which occurs during play is critical for children to reap the developmental benefits that early education provides. Developing social competence and demonstrating positive relationships before children reach kindergarten not only enable children to approach a healthy trajectory of social–emotional development (by providing children with friends *and* friendships as an additional learning context) but also enhance early adjustment and achievement in kindergarten and beyond [4].

What are these critical skills, and how do they operate and interact to produce social competence? First, it is critical to consider social competence within

Figure 1.
Model of internal and external influences on social competence in early childhood [1, 2].

the context of each child's broader ecological system. As illustrated in **Figure 1**, observed social competence (inevitably appraised by others) is the result of interaction between intra-child factors (such as brain development, temperament, self-regulation, and current developmental skills—including the impact of disability) and extra-child factors (caregiving, quality of learning environment and instruction, cultural and linguistic considerations). The interaction of these factors, as well as *how they are perceived by others*, is what determines longer-term outcomes in early childhood and beyond through the consequences of friendship vs. isolation, cooperative vs. independent play, rewards and acknowledgement from others vs. the use of punitive disciplinary practices, and access to vs. separation from the general education curriculum.

The importance of others' perceptions must not be underestimated, as these can create an environment of advantage or risk for children. For example, if a teacher is unfamiliar with the cultures of her students' families, she may at best fail to address a critical realm of assets and needs and at worst categorize behaviors or preferences that are normal for children as somehow "problematic." Likewise, if teachers are inexperienced in working with children with exceptionalities, they may be more likely to stereotype children or lower developmental expectations based upon their biases. The importance of perception can also be illustrated through social skills assessment (whether through systematic observation or norm- or curriculum-referenced checklists, all of which are frequently used in preschool). Teachers and caregivers may judge a child's social-emotional development or competence quite differently simply because of typical differences between the school and home environments. These differences can be more effectively explored and understood when teachers form positive, collaborative relationships with caregivers. In this case, the educator is more likely to better understand how a child's system of intra- and extra-child factors interact and make better instructional decisions.

Within this system, many specific social skills are learned and employed by the child. Examples of skills associated with later success in school include initiation/sustaining social interaction, in addition to getting along with others, following directions, emotional self-regulation, solving typical social problems in ways deemed appropriate by others, and persisting through social challenges [5]. Focusing on these areas as a teacher not only helps individual children improve and develop them but may also improve the social environment of the classroom as a whole, providing a more developmentally appropriate learning environment for all children.

2.1 Children with disabilities and unique learning needs

Helping young children to develop positive social skills and relationships is a critical responsibility for early childhood educators. This is particularly important for children with disabilities. At this point in time, however, the state of preschool in the United States paints a grim picture of the quality, appropriateness, and inclusiveness of classrooms in relation to children's social and behavioral challenges. With thousands of preschool children suspended or expelled each year (on average, 250 per day), preschool programs wield punitive disciplinary actions at a rate higher than at any other level of education—up to three times the rate of K-12 in pre-K and as high as 13 times the K-12 rate in child care for 3- to 4-year-olds [6]. A portion of the explanation for such disturbing statistics lies in a failure of the system of early childhood education (including preparation programs, administrators/policy makers) to fulfill its obligation to support teachers in playing an active role in understanding and influencing the complex system illustrated in **Figure 1**. A lack of cultural responsiveness or awareness of bias, insufficient focus on developing relationships with families and children, a lack of supportive services or interventions, and a low investment in professional development and increasing the status, licensure, and compensation of early childhood educators are all relevant issues.

In the end, the greatest influence on the success of young children in early childhood education is the educator himself/herself. The misinterpretation, rejection, and punishment of children with disabilities or developmental differences in the absence of inclusivity, supports, and developmentally appropriate interventions represent one of the key social justice issues of the field of early childhood education, particularly at a time when the majority of children under five do not have access to early childhood education programs to begin with. While these are clearly systemic issues affecting educators and not originally created by them, in many ways the teacher still holds the key to healthy, developmentally supportive, and inclusive classrooms.

For a variety of reasons, many children fail to adequately develop key social skills, thus lowering their overall competence and placing them at risk for punitive discipline and failure in school. In particular, children with disabilities experience peer rejection at a higher rate and are much more likely to miss out on highly impactful social experiences with peers. This may be a result of differences between their social and play skills and those of typical same-aged peers and will worsen with time in the absence of high-quality instruction and/or support. Examples of such differences that are observable from a very young age (some behaviors present by infancy) include lower rates of social initiation, positive social behavior, appropriate responses, a higher rate of more disruptive entry to play activities and problematic behavior, and poorer turn-taking skills [7]. As a result, young children with special needs experience a high rate of social rejection, i.e., social isolation and rejection of play initiations [8].

Differences and deficits in social competence in preschool-aged children are evident in children with many different types of needs (including autism, speech/language disorders, cognitive disabilities, and emotional and behavior issues, and developmental delay), as well as in children who placed at risk as a result of poverty, abuse, or engagement with child welfare agencies. Young children with disabilities tend to play with others less frequently and have fewer conversations than their typical peers; they may also lose social skills more quickly if teachers do not acknowledge these and encourage their consistent use [9]. As a result, such children are presented with fewer natural opportunities to develop and test out their social skills. For example, if it takes a particular child twice the number of peer interactions to learn an important skill (such as imitating and expanding on a peer's play), but she has only half the opportunities due to isolation from or rejection by peers or adults, serious consequences for her social development may result.

3. Foundational responsibilities of preschool educators

Ensuring that the preschool classroom provides effective, systematic, and developmentally appropriate instruction to support children's social competence requires collaborative planning, instruction that is informed by assessment, and targeted strategies that are implemented throughout the year. All of these dimensions of instruction must be provided in a high-quality learning environment that is inclusive of all children and supported by teaming and professional development.

3.1 Sustaining culture vs. acknowledging diversity

A first step in effectively addressing social competence involves reaffirming one's commitment to the inherent inclusiveness of the field of early childhood education. Developmentally appropriate practices, or DAP, as defined by the NAEYC place a high value on the developmental knowledge of teachers and their understanding of the milestones and key goals of the preschool years [10]. But instructional decision-making involves two other components which are intended to hold equal weight in determining the extent to which one's teaching practices are developmentally appropriate. First, educators must consider a child's individual interests, abilities, and developmental progress. Subsequent planning must take into account the inside out factors included in **Figure 1** at an individual level—in other words, planning for the interests of young children is not sufficient and is not considered developmentally appropriate practice unless the interests and needs of each and every child are considered and integrated. NAEYC's guidelines also stress that educators must consider what is culturally important to children and families, thus supporting their belief systems and practices. This does not mean that the classroom must mirror the home but rather that teachers (particularly when their backgrounds differ from those of the children they teach) examine the ways in which their backgrounds and biases influence their teaching aim to develop more empathetic, trusting relationships with children and families [11]. It is from these relationships that more meaningful antibias materials, activities, and teaching practices must be embedded, rather than through simply acknowledging diversity. This way preschool educators are more likely to begin the work of sustaining children's and families' culture rather than simply acknowledging it [12]. Culturally sustaining practices reject the notion that family culture can be subsumed or subordinated within a classroom or school culture and are actually reflected in NAEYC's DAPs which state the families should partner in curriculum planning and child assessment (see [10]). These guidelines are much more inclusive of diverse children and families than many educators may realize.

3.2 Acknowledging the effectiveness of inclusive models and commitment to the LRE

In one sense, the majority of programs serving preschool-aged children already have an inclusive structure. Head Start programs are required to serve a proportion of children with disabilities, just as they are children from households considered low income, and preschool programs funded by states must serve children aged 3–5 with disabilities in the least restrictive environment. Diversity is the everyday reality of the preschool classroom, and many of the practices that support successful inclusion also support not only children with disabilities but also those who require support to develop social competence in preschool. They include [13]:

- Responsive instructional practices, aligned with DAP's three principles, which respond to children's interests, motivation, and lives outside the classroom
- Proactive environmental and instructional accommodations which ensure the access to and understanding of the curriculum for children with widely varying strengths, needs, and approaches to learning
- Classroom communities that actively support cooperation through explicit and responsive teaching of skills with value beyond isolated classroom situations
- Classroom activities that involve heterogenous grouping, jointly planned and including the input of all key members of the early childhood program community

When children with identified disabilities are included in the preschool classroom, these four sets of practices provide a strong supportive context for better inclusiveness of the classroom as a whole and for addressing individual needs. The Individuals with Disabilities Education Act (IDEA) and its subsequent amendments mandate services for children aged 3–5 with disabilities within the least restrictive environment (LRE), which is defined as the educational environment as close to where nondisabled same-aged peers would be served as possible. In states where this results in a higher percentage of children with disabilities in general education classrooms for the majority of the time, the use of punitive disciplinary measures is lower. This means that collaboration to further the inclusive aims of IDEA through the classroom practices described above further provides a potentially direct remedy to the social justice issue of excessive suspension and expulsion of preschoolers.

4. Addressing social competence in inclusive classrooms

Instructional strategies for addressing social competence include embedding the teaching of social skills in each day's classroom routines and activities, as well as more explicit teaching of specific skills. Common social skills emphasized in early childhood curricula include those presented in **Table 1** below [14].

4.1 Embedded teaching

An initial step to addressing social competence in the preschool classroom includes identifying the skills that most children need to work on and ensuring that universal teaching strategies address these throughout the day. For children who require additional support or a greater number of opportunities to work on a particular skill, embedded teaching provides a framework for planning (e.g., [15]). Embedded teaching involves examining the daily routine and its varied learning activities and identifying wherein specific group or individualized outcomes may be addressed. In this sense, it combines accommodations for diverse children and targeted teaching strategies within a naturalistic approach that does not require significant individualized intervention or time away from the other priorities of teaching to accomplish. For instance, a teacher might intentionally model and teach skills such as requesting, questioning, commenting, and sharing while partnering with children in pretend play in the house area based upon the needs of particular children there and because that center provides a meaningful context within which to embed the teaching of those skills. In this sense, the teacher takes advantage of

Skill area	Social skills
Emotional understanding and empathy	Communicating emotions to others Expressing emotions in adaptive ways Recognizing that one's actions affect others Acknowledging and responding to others emotions
Initiation of play	Initiating social interactions Entering others' play Responding to the initiations or invitations of others Managing impulses through self-control
Maintaining social interaction	Turn-taking Engaging in parallel play Making attempts at cooperative play
Social problem-solving	Coping with the inevitability of limited resources (e.g., materials/ manipulatives) Communicating a social problem Cooperating in talking through a social problem Accepting and acting upon potential solutions to social problems Making choices that defuse or prevent conflict

Table 1.
Social skills emphasized in the preschool classroom.

these natural opportunities, acknowledges children who use these behaviors, and narrates intentionally to highlight their presence and importance. The teacher then may help younger peers who do not yet demonstrate those social skills to respond positively and to perhaps attempt the skills themselves with support. Everyday routines such as meals and snack times present another set of natural opportunities within which to embed the teaching of social skills such as greeting, conversational turn-taking, requesting and saying "thank you." Mealtimes also offer an opportunity to address and normalize children's varied cultural practices in relation to food.
In inclusive classrooms, teachers systematize the identification and use of these natural opportunities, while also identifying skills for which more explicit lessons or activities may be needed. Note that in embedded teaching, the center/routine/ activity may lend itself to certain forms of social interaction, but the teacher engages in active planning to both maximize the benefit of these opportunities and make room for additional ones. While this does require flexibility and in-the-moment responsiveness, it also requires that teachers (a) recognize key group and individual social-emotional needs, (b) understand that children in the naturally occurring and planned groups of the preschool day (as opposed to children who seem to be isolated or independent) will benefit from embedded teaching, (c) proactively plan across the daily routine, and (d) consider and select the best ways to deliver social supports within a variety of contexts. In this sense, it goes beyond intentional interaction because it is both targeted and preplanned.

4.2 Explicit teaching

Our understanding of the benefits of social competence and the risks associated with a lack of it is generally better understood than the use of supports and teaching strategies in the preschool classroom. While a variety of curricula, activities, assessment tools, and intervention strategies have been developed, none of them have an evidence base that encompasses the diversity of children, families, program models, or unique learning needs/disabilities preschool educators must navigate. Widely adopted early childhood curricula (such as The Creative Curriculum) and approaches (such as HighScope) include social-emotional goals, objectives, and/or indicators (i.e., specific skills) that can guide instruction in preschool classrooms. The explicit instruction of these skills takes many different forms. In The Creative Curriculum, teaching activities include what could be called embedded teaching focusing on social-emotional goals and objectives in children's play at various classroom centers. However, specific guidelines as to how to teach particular skills are lacking. In the HighScope approach, social and emotional indicators are assessed and planned for, and a hierarchy of strategies to support child-directed active learning is included. In addition, a specific model for intervening and supporting children to problem-solve through common conflicts is provided. It does, however, rely upon the existing skills of children to navigate its complex steps, which can take years to master.

Identifying high-leverage social skill instructional approaches within these approaches is challenging at best, as teaching strategies are typically employed within their curriculum frameworks. While evidence suggests that both of the approaches mentioned above demonstrate some effectiveness in improving overall developmental outcomes for young children, an evidence base for specific teaching strategies within those approaches is lacking. Nevertheless, certain commonalities across these approaches can be identified, representing a survey of common "best" practices. These include:

- *Direct instruction*. In classrooms where explicit teaching is used, teachers must (a) ensure that they address all of the types of critical early childhood social skills, including emotional understanding/empathy, initiation of play, maintaining interactions, and social problem-solving; (b) teach through the use of concrete and observable examples to which young children can relate; (c) integrate the skill across the curriculum, including making connections to literature wherever possible; (d) ensure that the skill is comprehensible and meaningful and involves behaviors that young children can successfully enact; (e) provide extensive opportunities for children to practice the skill in the context of natural activities within which the skills have a high likelihood of enhancing relationships and perceived competence; and(d) provide continuous support (through both feedback and encouragement) to children as they attempt these skills.

- *Social skill mini-lessons*. This involves teaching children specific social behaviors, such as taking turns or requesting toys from adults/peers, as children begin center-based activities or play. This instruction can occur at classroom centers (such as the block or art area) themselves or be delivered to the whole group prior to initiating such activities. Mini-lessons are often used to address situations that emerge throughout the week or during a unit in response to or to address anticipated issues that arise from, say, limited materials at a center or the entry of a new child to the classroom. Typically, teachers will use this type of approach to supplement more explicit instruction or as a substitute when time or other resources do not allow for a more systematic approach.

- *Behavioral supports*. Here, teachers utilize behavioral learning in order to increase the frequency of socially competent behavior, decrease problematic or aggressive behavior, and shape emerging social skills in context. Behavioral supports include prompting, contingent natural reinforcement, and redirection. These behavioral supports can be provided in conjunction with explicit instruction or be utilized in response to ongoing observation and classroom assessment. Behavioral prompts given to young children should be clear and concise, and wherever possible teachers should model desired social skills.

Contingent natural reinforcement can come in the form of narration combined with positive reinforcement (e.g., "Martie shared her crayons with you; Martie, you are sharing nicely with your friends"). Such reinforcement should be specific (as opposed to "good job" or "that is so nice"), clearly identifying the child's social skill. In this way, the reinforcement should evolve as the behavior evolves. Over time, these prompts can be faded or be replaced with more developmentally appropriate/specific ones. Redirection can also be used when children require more specific information about what to do or what social choices are available to them.

- *Monitoring with narration and problem-posing.* Here, teachers observe children as they interact, providing narration of both their play and of its social-emotional landscape, highlighting feelings, themes, and behaviors of which they would like children to increase their awareness. These are also valuable instances where teachers can infuse feelings vocabulary and pose ideas or problems for children to explore, e.g., "I wonder what might happen if you ask him to let you join." It is in contexts such as this that sets of strategies such as the HighScope problem-solving approach to conflict resolution would fit nicely, as this approach is designed to be implemented as children's play and interactions call for it—in other words, when conflicts occur.

In context, strategies such as these can effectively dovetail with the teaching of many other skills in the preschool classroom, and they can be particularly necessary in inclusive classrooms where the input, support, and prompting of the teacher may be necessary in order for interaction to occur (or occur successfully). Preschool educators should keep in mind that teacher-directed and structured activities to address social skills represent only one aspect of a healthy learning environment where positive relationships and a sense of community are developed. Explicit instruction of social skills works best in classrooms where children are offered a sufficient amount of freedom and choice and where activities and materials emphasize shared control between adults and children.

Where children with disabilities are present, a single approach certainly will not meet the needs of all children. Many children with disabilities benefit from basic classroom accommodations and seek out social interaction with peers, while other children may need more specialized, individualized social skill supports provided by their individualized education plan (IEP) teams, including special education professionals. Preschool educators must understand children as individuals rather than as members of a perceived disability category. By observing such children, learning their interests, preferences, and sources of motivation, as well as their experience/degree of success in social interaction and more informed decisions, can be made as to how children with disabilities will respond to existing practices and whether more targeted social skills interventions may be necessary. But it is always better for such interventions to be delivered within positive nurturing relationships with skilled and understanding adults who appreciate that social competence is part of a complex ecological system rather than simply a characteristic of children to be simplistically judged by others.

5. Interventions to address social skills

In diverse preschool classrooms, play-based learning and social relationships form an important piece of the foundation of social development and influence later academic achievement. At the same time, the consequences of disabilities in early childhood and/or insufficient or inappropriate social behavior destabilize that foundation. Over time, these differences and deficits predict negative outcomes such as emotional and behavior problems, disciplinary action, and school dropout. In other words, the social and behavioral challenges faced by many children with disabilities worsen over time in the absence of intervention. In this sense, social competence interventions may be viewed as essential forms of both intervention and prevention.

Interventions of various types are available to improve social skills in early childhood, including increasing the frequency and quality of specific skills and enhancing social pragmatic skills (which include both the verbal and nonverbal behaviors associated with interactive and cooperative play). What remains to determine is whether these interventions produce effects across contexts that are long-lasting and that make an impact on meaningful social behaviors and social competence rather than simply increasing the instance of isolated skills. Studies examining these factors are greatly needed, as well as ones that include the perspectives of peers and caregivers within a more context-specific model of social competence.

Social skill interventions generally fall into one of four categories: systematic arrangement of the classroom environment, behavioral strategies, instructional approaches, and combined approaches (which utilize elements of two or more of the above). These interventions share many features with the universal instructional strategies discussed earlier in this chapter. What distinguishes interventions from such strategies is a set of practices that includes (a) predetermined decisions about the frequency, intensity, and duration of the intervention; (b) a matching of the intervention to identified individual or group needs; (c) the use of assessment tools to establish skill performance levels and track progress; (d) goals identified either from individual children's IEPs or by analyzing data on current levels of performance. Interventions ideally also have an evidence base supporting their use; however, preschool teachers frequently do not have either the resources or the preparation necessary to access and evaluate such evidence. Interventions may also be embedded into multitiered systems of support (discussed later in this chapter).

Systematic arrangement of the classroom environment, sometimes referred to as environmental arrangements [16] or structured play, is a means of more effectively facilitating social interaction (e.g., altering the size, arrangement, or materials at a center to perhaps facilitate more cooperative play). Such strategies are the lowest intensity form of social competence intervention, and virtually no evidence base exists in the literature verify their effectiveness. However, environmental arrangement is an important consideration for educators as they design more direct and intensive interventions.

Behavioral strategies again use cues, prompts, and positive reinforcement to increase interactive social and play behaviors. As part of a systematic intervention strategy, they can be effective in increasing the social behavior of children with autism spectrum disorder. They can involve peers and occur across contexts, allowing for greater generalization. An example of a behavioral intervention might involve peers in increasing opportunities for target children's interactive play. Peers are positively reinforced for following through on-stated plans for social play that include choosing target children as playmates. A key consideration in behavioral strategies is that they are usually focused on specific behaviors, while the context of social competence is quite complex. Careful monitoring is essential to ensure that behavioral strategies are part of a systematic approach that increases desired behaviors, decreases undesirable ones, and addresses competence as a whole. As an example, an intervention that focuses on initiations may be successful in getting children to interact, but without focusing on the complexities of maintaining positive interactions, such interventions, can lead to increased conflict among children without consistent adult monitoring and attention to additional social competence dimensions.

Instructional approaches include any intervention involving the direct instruction of children in specific skills such as sharing, helping others, and initiating social interaction (e.g., [17, 18]). These preschool social competence interventions have the strongest evidence base for children with special needs and involve teacher-led social skill activities followed by supported play. In other words, using a variety of strategies, teachers help children to learn and master the skills, including offering support during the times when children have natural opportunities to use them. In some cases, teachers may directly teach social behaviors (such as greetings or requests for toys) and then follow up during play. For example, at circle time, a teacher and children sing a new song about inviting others to play. She then follows the children into the learning centers, watches and listens as some children try this new behavior, and supports children who are playing alone, but seem ready to learn to invite a friend to join them. Some children might respond to a prompt; others might need the teacher to model what to say and do. Such adult-mediated instructionally-based social competence interventions can have a significant positive effect on the social competence of young children with special needs when offered in naturalistic settings. Given that instructional approaches are the most widely studied and that these may be integrated into existing classroom activities across a wide variety of settings, the potential for their utility in inclusive classrooms is great.

The use of social skill interventions with preschool-aged children is well supported in published research, with a variety of programs showing a positive impact on specific skills in both specialized and inclusive settings. Some of the positive outcomes include increased social language and play initiations, and decreased maladaptive behavior, and increased overall competence as observed by adults. But while published research appears to indicate that these interventions have a generally positive relationship with various social skills and other behaviors associated with social competence, many questions regarding their impact on overall competence remain unanswered. The impact of social competence interventions has been found to vary across variables such as gender, age groups, risk factors, and disabilities. There are no consistent guidelines regarding intervention length and intensity, type of interventionist, treatment integrity, and presence of follow-up. Few of these variables have been explored sufficiently.

What remains to debate is whether these interventions produce effects *across contexts that are long-lasting and that make an impact on meaningful forms of social behavior and relationships*. Studies examining these factors are greatly needed, as well as ones that include the perspectives of peers and caregivers within a more comprehensive and culturally situated model of competence. Generalization and maintenance are also areas of missed opportunity and have not been sufficiently addressed in this body of research, as most social skill intervention studies do not follow children over time, across settings, or view competence multidimensionally as opposed to assessing specific behaviors or short-term adult perceptions.

6. Integrative models for promoting preschool social competence

Social competence can be integrated into multitiered systems of support [19] that (a) organize common approaches as classroom-wide (universal), naturalistic (targeted), and explicit (intensive) [20]. Considering available interventions through this three-tiered lens is an essential step in aligning practice with the federal law. Some include social skill curricula as a universal intervention at the first of three tiers of support. Other approaches such as the Pyramid Model [21, 22], which is now in use in 29 of the United States, offer a comprehensive model including coaching and professional development effectiveness in both increasing social skills and addressing behaviors that interfere with preschool children's learning and relationships. The Pyramid Model emphasizes professional development in evidence-based practices, as well as nurturing relationships and a healthy, developmentally appropriate classroom environment as the foundation of preschoolers' social-emotional development. This implementation of social-emotional supports and interventions represents the top levels of the pyramid, which was designed to complement the tiers of response-to-intervention models while adapting them to address the realities and needs of the field of early childhood education (including children under age three). Such models not only hold great promise in terms of positively influencing the social competence of children but also create networks of support, resources, professional development, and data that will continue to bear fruit as they are even more widely implemented.

Figure 2 is designed to place such models into context, as they address only part of a broader realm of need in the early childhood field. First and foremost, increasing the amount and depth of teacher preparation in this area is critical. Innovation in teacher education has moved from the university classroom to field-based preparation embedded in mutually beneficial partnerships with early childhood education programs, and it is in these field-based apprenticeships that the awareness, relationships, and practices to address preschool social competence must be learned and developed [23]. The merging of professional preparation and development

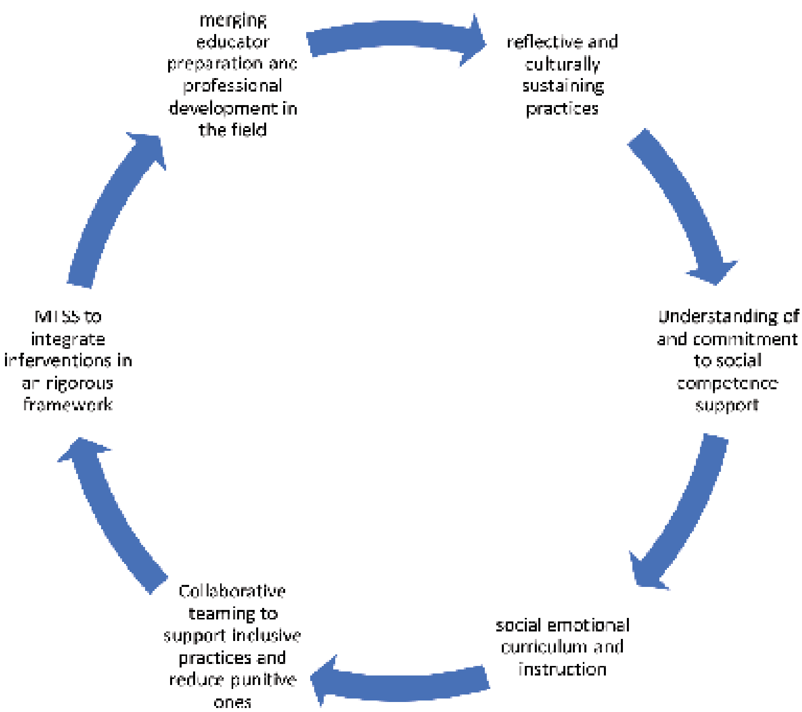

Figure 2.
Interrelated factors promoting preschool social competence.

provides an essential opportunity to learn, practice, and reflect critically upon practices as they are designed and implemented with diverse children. In this sense, the obligation of culturally sustaining teaching practice becomes the everyday work of the teacher candidate (rather than an abstract notion to be faced upon entry to the field), with support from faculty and practicing teachers.

Through supported reflective practice and experience with children and families, preschool teachers can grow to understand the complexity of social-emotional development and all of the factors influencing social competence, as well as the role of the educator and the early childhood program in teaching and intervening to influence positive outcomes. Through empowering teachers to understand and work within this complex system, successful inclusion and an inclusive philosophy are born. At this point, a critical lens on discipline and punishment of young children widens, and comprehensive-tiered systems and the interventions therein may flourish. In this sense, all key players in the preparation, support, and everyday work of preschool educators have a role in promoting social competence for each and every child.

7. Conclusions

Children who have positive relationships with peers in inclusive classrooms become accustomed to play with children of varying ability levels and may carry their inclusive experiences and perspectives as they move forward into K-12 education, which represents a meaningful, long-lasting impact on our field and the children and families served within in.

Preschool provides key opportunities to understand and influence the social competence system on which many aspects of future development are based. Teachers in inclusive classrooms can strengthen this foundation by engaging in culturally sustaining practice, directly teaching a variety of social skills in accordance with or alongside the preschool curriculum, utilizing inclusive practices and interventions to avoid or defuse punitive practices, and by engaging in collaborative and tiered systems of professional development, support, and intervention.

Without sufficient preparation, professional development, and the integration of intervention efforts in collaborative systems of teacher, child, and family support, preschool educators are not likely to meet the social competence needs of all children in inclusive classrooms. Teacher preparation must more strongly emphasize these teaching and intervention skills, so that preschool educators feel confident prompting, supporting, and further developing children's social behaviors so that inclusion programs can be successful. Teacher preparation programs can accomplish this in several ways. First, by emphasizing meaningful community partnerships, programs can better align the aims of field-based teacher preparation (see, [23]) with those of early childhood programs—in other words, by focusing teacher candidates' time in classrooms on making a positive, measurable impact on the development (including social behavior) of children. Next, through supported practice under constant faculty supervision, candidates can successfully succeed at teaching and intervention practices that are particularly challenging to enact in practice (including addressing challenging behavior and improving social competence across people and settings). Finally, by aligning these preparation activities with professional development offered within mutually beneficial partnerships, preparation programs and early childhood education programs create a shared culture of trust and growth.

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Chapter 18

Including Children with Visual Impairments in the Early Childhood Classroom

Danene K. Fast

Abstract

The practice of inclusive education—or inclusion—within general education classrooms is becoming more prevalent within early childhood settings. To successfully deliver classroom curriculums, promote learner growth, and meet the goals of all students served within inclusive settings, teachers must have a basic understanding of the unique learning needs of all students, including those with visual impairments. Because students learn best when the teachers who educate them first understand their needs, this chapter is designed as a basic starting point for early childhood educators who have limited to no background in working with students who have visual impairments. The goal of this chapter is to give early childhood educators a basic understanding of visual impairments, questions to ask when serving children with vision loss, and to show how accessibility can be approached in a way that is meaningful to students with visual impairments.

Keywords: visual impairments, blindness, inclusion, early childhood education, accessibility

1. Introduction

An inclusive educational classroom refers to a learning environment where the academic, physical, and social needs of all learners, including those with disabilities, are addressed within one comprehensive setting [1, 2]. The practice of inclusive education—or inclusion—within general education classrooms is becoming more prevalent within early childhood settings [3–5]. With this increase in practice, early childhood educators routinely encounter and teach students who have a range of special needs within regular classroom settings; however, parents of children served within these inclusive settings report that quality of inclusion can vary greatly among schools and individual service providers within school settings [1]. Due to the fact that the United States exemplifies one of the most comprehensive systems of special education in the world [6], highlights of this system and associated laws are noted throughout this chapter as an example for all readers who are interested in special education services.

The Individuals with Disabilities Education Act (IDEA) highlights that children in the United States of America must have access to equal opportunities within public education settings. Children with disabilities are entitled to the same educational experiences as their peers without disabilities [7]. While this is the law in the

United States, the practice of inclusion is expanding to more countries throughout the world [5, 8]. This expansion of services is due, in part, to documented benefits of inclusive classrooms where students with disabilities are making greater gains in academic skills and behavioral characteristics than same-age peers who receive services in special schools. In addition, court cases—such as the Hendrick Hudson School District v. Rowley U.S. Supreme Court landmark decision in 1982—followed by the 2004 amendments to the IDEA, the merger of special education and general education is viewed as benefitting all children in the classroom [9, 10].

To successfully deliver classroom curriculums, promote learner growth, and meet the goals of all students served within early childhood settings, teachers must have a basic understanding of the unique learning needs of all students, including those with disabilities. Early childhood educators who have received training in special education topics are generally more positive about inclusion than those who enter the teaching field with a limited knowledge of special education [5, 11]. Research indicates that the provision of basic special education knowledge and training to early childhood educators improves attitudes toward students with special needs, a better awareness of inclusion, personal expectations, and improved outcomes for students with disabilities who are served within these settings [5, 12–14]. Students learn best when the teachers who educate them first understand their needs and, then, provide instruction in a way that meets these needs.

Visual impairment is one specific category within special education identified under the IDEA. Within inclusive settings, early childhood educators may encounter students with a variety of different visual impairments. This chapter is written from the perspective and experiences of a dually certified elementary educator and teacher of students with visual impairments (TVI), as well as a certified orientation and mobility specialist (COMS) with over 20 years of experience in the field of education. It is designed to be a basic starting point for early childhood educators who have limited to no background in working with students who have visual impairments so they can acquire a basic understanding of visual impairments, questions to ask related to serving children with vision loss in their classroom settings, and how to approach teaching in a way that is meaningful to these students. While it is not designed to be a *comprehensive guide* to meeting all the needs of students with visual impairments placed within inclusive early childhood settings, this chapter is designed to provide *foundational information* for general educators who are expected to work with children who have vision impairments within inclusive education settings.

This chapter is divided into four sections. It begins with a basic overview of visual impairments and the specialized needs of students with visual impairments, continues with the educational implications of visual impairment on learning, and addresses the use of a team approach in meeting the unique needs of learners with visual impairments. The chapter concludes with a section that addresses "take-away tips" for early childhood educators—including practical strategies that can be used when working with students who have visual impairments in their inclusive classrooms.

2. A basic overview of the specialized needs of students with visual impairments

2.1 Background

Visual impairment is categorized as a "low incidence disability" within the field of special education in the United States. The federal definition of the term "low incidence disability" includes (a) a visual or hearing impairment, or simultaneous visual and hearing impairments; (b) a significant cognitive impairment; or (c) any impairment for which a small number of personnel with highly specialized skills and knowledge are needed in order for children with that impairment to receive early intervention services or a free appropriate public education [6]. None of the disabilities listed under the category of low-incidence, including students with visual impairments, generally exceeds 1% of the school-aged population at any given time [15]. This means that early childhood educators who work within inclusive settings may only encounter students with visual impairments on a limited basis throughout their careers. Due to this fact, these educators may have minimal to no experience in delivering services that meet the unique needs of students with visual impairments within the early childhood classroom.

In the United States, students with visual impairments have been included in general education classrooms since before the 1975 implementation of P.L. 94-142, the Education for All Handicapped Children Act, now known as IDEA. While data from the National Longitudinal Transition Study (NLTS) reports that students with visual impairments spent, on average, 86.8% of their day in general education classrooms, academic success has not been guaranteed, with as many as 49.9% of these students reported as having failed at least one course in general education [16, 17]. Educators who are specifically trained to work with students who have visual impairments have long argued that the *physical inclusion* of students with visual impairments in general education classrooms *is insufficient* for academic success [16, 18]. Rather, these specialists emphasize that the specialized needs of students with visual impairments, including the need to participate fully in the general education curriculum with *sufficient accommodations*, must be met if academic success is to be achieved [16, 19, 20]. In order to accomplish this goal, early childhood educators who serve these children within inclusive settings must recognize the needs of students with visual impairments to ensure these *sufficient accommodations* are provided for student accessibility and, ultimately, success in the classroom.

2.2 What constitutes a visual impairment?

One misconception among general educators regarding students with visual impairments is that "legally blind" means a complete loss of sight. This is not true. Under the IDEA, "visual impairment – including blindness," is defined as, "an impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" [7].

Teachers who are not familiar with visual impairment—including blindness, may believe that students with vision loss placed in their classroom settings have *no usable vision*. Early childhood educators need to recognize that a majority of students who are diagnosed with a visual impairment have some degree of usable vision. According to information from the World Health Organization (WHO), an estimated 253 million people live with vision impairment: 36 million are blind while 217 million have moderate to severe vision impairment [21]. This means that while some students may have "no light perception," meaning that they see only darkness, many have vision that is useful for a variety of tasks, including reading print, identifying faces, recognizing color, and traveling independently, without specialized training. When working with students identified as having a visual impairment, remember that their ability to use vision for classroom activity will vary. While some may have no usable vision, "blind" does not always mean a complete loss of sight.

Regardless of their diagnosis, students who have vision loss will also have variations that exist among the causes of visual impairment, severity, and the manner in which it affects how the individual can see. Students with visual impairments may see things differently from one another, even when they share the same eye condition. Different types of vision loss may include a reduced acuity—or clarity—that cannot be corrected with glasses, a field loss—or "blind spots" with a student's field of view, muscle control problems (lazy eye), or problems with perception—for example, a student may see educational materials, but cannot describe or comprehend what is being seen.

2.3 Recognizing visual impairments in the early childhood classroom

When a child with a visual impairment is assigned to an inclusive classroom setting, the classroom teacher should always ask about the child's degree of vision loss. Teachers who do not recognize that there are varying degrees of visual impairments may wrongly assume that learning environments need not be visually stimulating; this is especially true in early childhood settings where pictures, color, sight words, and learning centers are used within everyday learning tasks. In settings where the majority of students rely on visual cues, teachers must explore alternative ways to meet the educational needs of their learners with visual impairments, including those with no vision and partial sight. Knowing the degree of a child's vision loss can assist in determining, selecting, and using specialized accommodations needed within the educational setting.

In addition to recognizing the individualized degree of vision loss that is present when a child who is identified with a visual impairment is assigned to an inclusive classroom, early childhood educators must also be cognizant of the warning signs of visual impairment in children who are not specifically identified as having a visual impairment prior to attending a formal learning environment. Because the early childhood setting is one of the first formal learning experiences for young children, it is often within this setting that visual impairments are first identified. Because so much of classroom learning occurs through a visual model, it is important for early childhood educators to recognize when a visual impairment may be present. If visual impairments are overlooked, delays in learning can occur for children who require accommodations.

Signs of eye trouble in children may include physical characteristics, behaviors, verbal communications, or trauma to the face or eyes. Physical characteristics may include eyes that are red, inflamed, watery, or off-center. Behaviors may include rubbing, shutting—or covering—one eye for tasks that require vision, tilting of the head when viewing materials, leaning forward to see better, tripping over objects, excessive blinking, or extreme sensitivity to light. Verbal cues may include statements such as, "I can't see that," "I see two of that," (double vision) or complaints of dizziness, headache or nausea [22]. Any of these symptoms, including classroom emergencies where the eye may be affected, should be reported to school health services, administration, and the child's parents and/or guardians so that follow-up assessment can be determined.

3. Educational implications of visual impairments on learning

3.1 Planning for the needs of students with visual impairments

Planning for the needs of a child with a visual impairment within an inclusive classroom setting may be seen as a challenge, especially if it is the first time that a general education teacher encounters a student who has vision loss. With adequate background knowledge, support, and recognition of the unique needs of these learners, teachers can appropriately plan to meet the needs of students with visual impairments.

Once general education teachers recognize that there are different variations of visual impairment, the next step in planning is to understand the *educational implications* of visual impairments upon learning. The development of students with visual impairments can be affected by many factors. These include, but are not limited to the type and severity of the vision loss, the age of onset of the visual impairment, the amount of intervention received within educational and home settings, use of residual vision, personality, availability of equipment and resources, presence of other disabilities, acceptance, and family involvement. While students with vision loss can accomplish many of the same activities as children who are sighted, these outlying factors can affect education in various ways, causing students who are visually impaired to learn in a variety of different manners. Some students will require only minimal accommodations while others will require extensive accommodations and different tools for learning. These accommodations should be (a) developed and discussed by a team that includes parents, teachers, related service staff, and administrators. While this can be completed in a variety of different ways throughout the world, within the United States this is completed through the use of an Individual Family Service Plan (IFSP) or Individualized Education Plan (IEP). Because these forms are used within a highly consistent, regulated system within the United States [6], the IFSP and IEP are highlighted in this chapter with the understanding that these same forms may not be used consistently throughout the world. Countries other than the United States may have policies and/or forms unique to their individual laws. In the event that there is not uniformity within other areas, the US forms highlighted within this chapter may serve as an example for teachers in countries where progressive special education is still developing.

An Individual Family Service Plan (IFSP) is a legal document designed to focus on the needs of the family of a child with special needs, including visual impairment; this document is used for children from birth to the age of three. Within the IFSP, children are served through early intervention teams, usually in the home or a center-based setting.

An Individualized Education Plan (IEP) is legal document designed to focus on the education program of a child with special needs, including visual impairment, within school settings. Within the IEP, children ages 3–21 are served within local school programs by the personnel hired within these educational programs. Early childhood educators may encounter both IFSPs and IEPs when serving young children within educational settings; IFSPs will be particularly prevalent at meetings where children are transitioning from early intervention to pre-school settings. The content found within these documents is set by federal law; however, the actual documents used to outline these plans may vary from state-to-state. If they are not included within initial planning meetings, general education teachers who serve children with visual impairments may request to be a part of this team to gain a better understanding of needs, expectations, and accommodations needed to meet educational goals.

3.2 Addressing educational implications of visual impairment

Lack of visual input compromises the ability to see a whole picture or concept as a starting point to learning [23–25]. Learners who can see are able to capture the "whole" of an object through a sense of vision while learners with visual impairments must use their senses to learn from "part to whole." For example, a student who has vision can look at a book, video, picture, or a display at a zoo to understand the concept, size, shape and magnitude of an elephant; the child learns about the "whole" animal at one time. A child with a vision loss cannot see the books, videos, pictures, or displays that provide a "whole" view of the elephant; this child will learn about the animal in a step-by-step process. A typical learning sequence may include learning about the texture of an elephant's skin, the diameter of his legs or trunk, the weight of the animal, and the environment in which the animal lives; once these "parts" are learned, the "parts" are put together to form a "whole" picture.

Students with visual impairments must *learn through experiences—learn by doing*—in order to master a skill. Using the hands as a tool to gather information is needed for children who are learning without the use of sight as their primary sense. Allowing children to explore objects so that they can experience and learn details that are invisible without the use of touch is essential for learning. Allowing children to smell, feel, and move objects using all of their senses, in addition to exploring with their hands, provides multiple inputs for learning. When completing lessons, provide actual objects for the student to touch, hear, smell, and explore. An actual piece of fruit that can be peeled, smelled, and tasted is a much richer experience than looking at a photo or touching a model.

In addition to "part to whole" learning, students with visual impairments sometimes have *fewer natural learning experiences* because they are not able to observe everyday objects and interactions, especially ones that are non-verbal. Areas of learning that can be particularly affected include concept development, interpersonal communication, life skills, and academic development. In accessing the early childhood curriculum and age-appropriate milestones of development, students with visual impairments should be encouraged to complete skills that are beneficial to the growth of positive self-image, appropriate dress, self-care skills, good interpersonal communication, appropriate behaviors, increased independence, and productive community experiences. These skill sets can begin in early childhood with simple, everyday tasks such as tooth brushing, hair combing, dressing, organizing a personal space, and eating.

Classroom teachers should resist urges to treat students with visual impairments differently than their same-aged peers. Encourage self-sufficiency and decision making from an early age. As an early childhood educator, it is easy to want to do things for a child who has a visual impairment, especially if a teacher notes that the child has a slower pace than peers who do not have a vision loss. Children with visual impairments learn best through experience—do not be afraid to give them *extra time to learn and explore*. Remember that a final product is not always as important as the learning process. Early childhood educators should allow students to experience natural learning experiences and classroom exploration that provides students with multiple opportunities for independence and success [26].

3.3 Creating an accessible learning environment

Because students with visual impairments cannot use their sight as a primary learning medium, they tend to rely on their senses of touch, hearing, smell, taste, movement, and residual vision to gather information from their learning environments. To address this way of learning, early childhood educators must create environments that are engaging and accessible using all senses so that those with visual impairments can learn. Because children are naturally curious, use of universal design in creating leaning environments is beneficial. Use of color, clear-large print sight words, Braille labels, multiple textures, tactile markings, stickers, object cues, and a variety of materials that can be touched are all ways of encouraging students to explore with all of their senses to learn within the classroom setting. Teachers should recognize that alternate teaching materials for students with visual impairments may not always be needed for classroom activities. Many items, such as crayons, blocks, toys, finger paints, putty, musical instruments, recreational equipment, or sensory table items, are universal tools that can be used by all students. A learning environment that is well planned is not just beneficial for students with vision loss, but for all learners who are participating in the classroom setting.

In addition to using a variety of materials for exploration, there are a variety of factors that can also be considered when planning a learning environment. Proper lighting should be considered, especially for children who have low vision or light sensitivity. Natural lighting diffused throughout a classroom—such as light from windows or overhead lights that point toward the ceiling versus fluorescent lights that point toward the classroom floor—is best for students with light sensitivity. Sound within classrooms can be modified to ensure all students can distinguish work time from free time or play time; use of an FM system or sound reduction boards to eliminate unwanted noise can benefit all students.

Use of contrast in creating classroom materials can assist all students in distinguishing picture cues and identifying classroom activities. Texture—or tactile additions, such as outlining a picture with school glue and allowing it to dry or placing a screen behind coloring pages—can assist children with no usable vision to access activities that are traditionally concepts that require vision. Finally, once a classroom setting is established, teachers should resist urges to move furniture. Keeping furniture pieces and specific learning areas in their original locations will assist children who have visual impairments with their classroom orientation, movement, and location of desired spaces within an environment. If the furniture is moved, be sure to notify children with visual impairments of changes, allowing them time to explore and become comfortable with their surroundings. This is another example where students with visual impairments will obtain information in a manner that is "part-to-whole," as peers with vision will immediately see changes to a "whole" classroom layout, while a student with vision loss will learn the layout in a "step-by-step" manner.

3.4 The expanded core curriculum

In addition to learning age-appropriate milestones and subjects established within general education curriculums, students with visual impairments also have unique needs that expand beyond those of other students. Because students with vision loss are *unable to observe the nonverbal behaviors and actions of others*, classroom teachers must recognize that the manner in which incidental skills are learned is impacted by vision loss. In order to teach these incidental skills to students with visual impairments, an *expanded core curriculum (ECC) for students with visual impairments* has been designed to go beyond the core components of math, reading, writing, and science to address essential areas and experiences that are unique to persons with vision loss [26]. The ECC is a curriculum that addresses functional outcomes for students with visual impairments, including nine (9) skill sets that address (a) compensatory (or access) skills, (b) social interaction skills, (c) recreational and leisure skills, (d) orientation and mobility (O&M) skills, (e) independent living skills, (f) assistive technology skills, (g) career education skills, (h) sensory skills, and (i) self-determination skills.

Although children who are visually impaired have little or no opportunity to learn ECC skills by visual observation alone, they have the opportunity to acquire these skills through sequential, systematic instruction by a *knowledgeable person* [27]. In addressing specific skills identified within the ECC, a team approach to learning is imperative. While early childhood educators are able to understand the basic implications of vision loss on learning and accommodate the basic needs of learners through universal designs and inclusive classrooms, these same teachers need to know they are not alone in determining what is best for students with vision loss.

There are educational *specialists who are specifically trained to work directly with students who have visual impairments*. In addition to working directly with students, these specialists also work with teachers, administrators, and families, to create individualized plans designed to meet the unique needs of students with vision loss. Early childhood educators who have children with visual impairments placed within their classroom settings can request the services of a teacher of students with visual impairments (TVI) and an orientation and mobility (O&M) specialist to assist with accessibility, technology, and ECC skill sets that go beyond typical classroom protocols.

4. A team approach for meeting the needs of learners with visual impairments

Because children with visual impairments fall into a category of "low-incidence disabilities," early childhood educators who work within inclusive settings may only encounter students with visual impairments on a limited basis throughout their careers. In addition to the challenge of having minimal to no experience in delivering services that meet the unique needs of these students, early childhood educators may also not recognize that there are disability-specific specialists who are trained to work directly with these students.

In order to effectively serve students with visual impairments within inclusive settings, early childhood educators must recognize and understand that learners with visual impairments have unique needs. Even the youngest of students with visual impairments access information using a range of tools, including enlarged print, Braille, technology, screen-reading applications, audio output, and close-circuit televisions (CCTV). The tools being used by learners with visual impairments will vary based on age, individual capabilities, learning characteristics, and the extent of vision loss. Adaptations are determined by team decisions, after an assessment is completed by a certified teacher of students with visual impairments (TVI) and/or orientation and mobility (O&M) specialist.

Due to the complexities of vision loss that go beyond a typical classroom learning environment, early childhood educators who have students with visual impairments in their classroom settings can—and should—request services from professionals who are specialized in visual impairments and trained to work with children who have vision loss. Often times, these specialists are hired on an itinerant basis, meaning that they will come to the classroom setting and work with children who require their services on an as-needed basis as determined by the educational team. By working collaboratively with educational and mobility specialists to assist with assessment, planning, teaching, and implementation of strategies to address the expanded core curriculum (ECC)—including Braille, technology, and orientation and mobility (O&M) within inclusive settings, children with visual impairments who receive specialized services will receive a broad range of educational services to meet their unique needs.

4.1 Specialists serving low incidence populations

According to federal mandates, states are required to provide all students with a free, appropriate public education (FAPE). Critical shortages of special education teachers represent a serious challenge to achieving this goal for students with disabilities [28]. In providing services to students with low-incidence disabilities, the availability of qualified special education teachers is limited; this is especially true when a direct focus is placed on the education of students who are blind or visually impaired. Regardless of this shortage, students with visual impairments are entitled to the services of these professionals to facilitate learning goals within educational settings. Early childhood educators, as well as the parents of children with visual impairments who are placed within their classrooms, have a right to request the services of a teacher of students with visual impairments (TVI) and an orientation and mobility (O&M) specialist as an appropriate accommodation.

A *teacher of students with visual impairments* (TVI) is a licensed teacher trained to provide disability-specific needs of children with visual impairments, including needs that go beyond those of a special education curriculum for high incidence populations. University programs that train teachers of students with visual impairments (TVI) include courses that cover a variety of tools and skills specific to the needs of students with visual impairments. These include teaching and using assistive technology, writing reports, assessing students with visual impairments through formal assessments, determining accommodations, teaching and using Braille for both literacy and mathematics, and addressing the expanded core curriculum (ECC), with the exception of orientation and mobility (O&M) training. These specialized services provided by TVIs are essential components of educational programs for all students who are visually impaired [29].

The area of orientation and mobility (O&M) is an important component of success within school and community settings, particularly for students with vision loss [30, 31]. Orientation and mobility (O&M), or the ability to move about in the home and community, is a specialized training designed to facilitate the ability of persons with visual impairments to perform independent travel skills [30]. Orientation and mobility (O&M) training can begin within early intervention to address early body movements, identification of sound sources—including voices, turning toward sounds, and first movements with scooting, crawling, and, eventually, walking. It is a skill set that continues through adulthood, when adults train to become independent within every day, community settings.

Orientation and mobility (O&M) services enable individuals to acquire knowledge and skill sets needed to travel safely and independently [32–37], resulting in better accessibility to public domains and enhanced quality of life. *Orientation and mobility (O&M) specialists* are university-trained and certified to teach these skill sets to students—and adults—with visual impairments. Orientation and mobility (O&M) specialists are not the same as an occupational therapist (OT); these should not be confused when establishing services for children with visual impairments, as occupational therapists (OT) are not certified to provide O&M training for individuals with visual impairments.

Early childhood teachers who are working with students who have visual impairments in the inclusive classroom can assist with orientation and mobility (O&M) skills by remembering some basic interactive tips. When interacting with a student who has a vision loss, always remember to introduce yourself. While a student with visual impairments may know you, that student may not immediately recognize your voice. When talking with a student who has a vision loss, do not direct your conversation to someone else and use a normal conversational voice. Always ask before rushing to assist a student with a visual impairment. Finally, when leaving a student who is blind, be sure to tell the student that you are leaving. As a classroom teacher, the interactions that you have with students who are visually impaired will be watched and imitated by other students in the class. Always remember to provide a good example, so that others can learn from your modeling.

4.2 Collaboration for success within the early childhood classroom

The addition of a teacher of students with visual impairments (TVI) and an orientation and mobility (O&M) specialist to the educational team of students with visual impairments can be imperative to success. These professionals address unique learning needs, such as Braille, technology, orientation and mobility (O&M), and other areas of the expanded core curriculum that are not addressed within teacher training programs designed for early childhood educators. While early childhood educators can provide access to standard curriculum materials, unique learning needs—including Braille, technology, orientation and mobility (O&M), and other areas of the expanded core curriculum (ECC) must be addressed by knowledgeable professionals training in these specific disciplines [26].

Once these professionals are part of a student's educational planning team, early childhood educators should work cooperatively with them, as well as the school administration, student families, and other related service providers to provide educational experiences that are effective and enjoyable. As the use of specialized curriculum, equipment, materials, and individualized instruction becomes incorporated into the inclusive classroom setting, the early childhood educator should regularly collaborate with the teacher of students with visual impairments (TVI) and the orientation and mobility (O&M) specialist to become familiar with these additions to the classroom setting. Because itinerant staff often travel between school buildings, there will be times when the classroom teacher is a student's only point of contact. Returning to ideas presented at the beginning of this chapter, early childhood educators who work with students with visual impairments in inclusive settings should be familiar with the adaptations and accommodations used by these students to ensure student success, as they may be the only point of contact available to the student at a given point in time.

5. Final considerations and "take-away tips"

As role models to students, early childhood educators who have students with visual impairments in their classroom settings are responsible for ensuring that these children are welcomed and given the opportunity to form social relationships within the school community. Early childhood educators must have an awareness of the unique needs of these students, especially in areas where there is not a teacher of students with visual impairments (TVI) or an orientation and mobility (O&M) specialist assigned to the student.

When working with students who have visual impairments, be challenged to take risks that encourage the growth of these students. Do not simply plan to eliminate parts of a curriculum that may be challenging for a child with a visual impairment, but find meaningful ways to make it accessible. Be aware of situations where a child may have limited exposure so that examples or explanations can be provided to expand learning concepts. Do not be afraid to ask what the child sees. Having a concrete understanding of a child's perspective may assist teachers with expanding upon this knowledge.

Ensure that all children in the inclusive classroom setting feel safe. Use peer interactions to develop positive self-esteem and have high expectations for all students, including those with visual impairments. Remember that students with vision loss will sometimes miss non-verbal cues that are provided within classroom settings. Emphasize listening skills for all students, avoid using non-verbal expressions—such as shoulder shrugs, head nodding, or facial expressions—to manage classroom behaviors. Simple sound cues—such as a tap on a student's desk—or a gentle touch can quietly ensure that a child with a visual impairment is being included in a discussion.

Provide students with appropriate materials to maximize learning and have a variety of learning resources on-hand to quickly adapt and/or explain concepts to

DOI: http://dx.doi.org/10.5772/intechopen.80928

a child with vision loss. Early childhood educators should regularly consult with parents and specialists to identify ways to support student learning. Remember that disability-specific skills, such as orientation and mobility (O&M) or Braille, will be addressed by a specialist; however, familiarity with these concepts are important to understand all aspects of the child participating in the early childhood classroom setting.

Finally, when in doubt of how to handle a particular situation, never be afraid to reach out and ask questions. Communication and collaboration with other professionals who have had similar experiences is one of the biggest resources for educators who are working with children with visual impairments for the first time. Remember that all students—regardless of background, income, disability, diversity, or visual impairment—have the same rights within the classroom setting. Provide them with daily opportunities to develop their goals, dreams, and aspirations, keeping in mind that all kids—regardless of their variations—are more alike than different.

Acknowledgements

I would like to express my appreciation to Dr. Tiffany Wild for her encouragement and support in developing this chapter.

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Edited by Donna Farland-Smith

This book will serve as a resource for students, researchers, and practitioners in the area of early childhood education. The 18 chapters are divided and organized into the major areas relevant to early childhood education: early childhood development, play, science, mathematics, technology, literacy, and exceptional learners. Each chapter contains an overview of background information pertinent to the chapter and a synopsis of research or a new research study. The information contained in this book provides a foundation for past and/or present research and suggests future research studies.

Published in London, UK

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ISBN 978-1-83962-142-0
9 781839 621420