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# Technology in Learning

*Edited by Micheal van Wyk*

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# Meet the editor

Micheal van Wyk is a Full Professor of Economics Education, an NRF-rated researcher, and chair of the Department of Curriculum and Instruction, School for Teacher Education, College of Education, University of South Africa (UNISA). He is a qualified professional teacher, teaching both in primary and secondary schools. He has more than 18 years of teaching, research, and supervision experience at higher education institutions. He has published eighty-nine journal articles as well as numerous conference proceedings, book chapters, and books. He has supervised many doctoral and master's degree students. Dr. van Wyk is a flipped instructional designer researcher in open-distance e-learning (ODeL) research. He is the recipient of the 2013 Chancellor Award for Excellence in Research, UNISA, and the 2018 Scholarship of Teaching and Learning (SoTL) for his groundbreaking research on the e-portfolio as an alternative assessment approach in teacher education in the College of Education, UNISA. One of his recent articles entitled, "Students' Perceptions of the Flipped Classroom Pedagogy in an Open Distance e-Learning University," was voted the best scholarly publication by *Ubiquitous Learning: An International Journal* and was consequently awarded the 2020 International Award for Excellence for Research by the Common Ground Research Network, University of Chicago, USA. In 2023, he received the Chancellor's Award for Excellence in Research from UNISA. Dr. van Wyk currently serves on journal editorial boards and vetting panels. He is the associate editor for *Heliyon: Education*. As a highly-rated scientist, esteemed scholar, and motivational speaker, Dr. van Wyk received the 2022 Medal of Honor from the Education Association of South Africa for his contribution to teacher education. He serves as a mentor for the Open and Distance Learning (ODL), the Commonwealth of Learning (COL) project entitled the "ODL Practitioner Research Training and Mentorship Initiative." His research interests include flipped pedagogy, technology-integrated teaching and learning strategies, social media tools for the classroom, e-portfolios, Afrocentric-Indigenous pedagogy and research methodology, cooperative learning, and economics education.

# Contents

# Preface

*Technology in Learning* brings together theory and practice in one single text. It examines the basic rudiments of technology and how they are integrated into teaching and learning. It provides case studies and critical reflection exercises to facilitate novice researchers' understanding of how to apply technology-integrated teaching and learning tools in practice. This book represents a novel approach to integrating technology into teaching and learning in that it addresses basic technology integration as well as blended spaces.

Section 1, "Theorization of Technology in Teaching and Learning", includes four chapters.

Chapter 1, "The Role of Modern Technologies in Improving the Quality of Education", focuses on the role of modern technologies in improving the quality of education. It explains various forms and patterns of e-learning that have emerged, including blended learning, which has become the focus of attention for many universities. Blended education focuses on providing learning in interactive, flexible, and interesting ways and helps to create suitable learning environments for students.

Chapter 2, "Influence of Information Technologies on the Quality of Study Programs in Higher Education", explores how modern information technology influences the quality of study programs at higher education institutions. It highlights the importance of technology in study programs and explains how such technology is accepted by students and teaching staff. Furthermore, it discusses challenges faced when applying such technologies, what ideas students support, and what teaching staff is needed to successfully utilize new technologies in higher education.

Chapter 3, "Virtual Reality and Creativity: Lessons Learned from a Luminaire Design Project", examines the use of virtual reality (VR) in design education, which studies have shown leads to greater creativity in students. However, some studies show only a partial impact of VR on student creativity. The Luminaire Design Project used video data analysis (VDA), whereby the authors examined a half-hour excerpt of a recorded VR learning experience from a previous study on interior design students. The chapter explains the impacts of VR on students' creativity via observing and interpreting one participant's interaction with VR and the context of the virtual environment.

Chapter 4, "Holistic Thinking in the Implementation of Digital Learning Activities, with Due Regard to Implementation of a Learning Management System and Digital Learning Course: A Field Report", describes seven steps for developing a digital learning (DL) approach. It provides tips from fieldwork that address the different areas of a company, such as learning strategy, roles, and responsibilities.

The second section of the book "Case Studies Using Technology-Integrated Learning in Context" provides case studies showcasing the application of technology-integrated learning in context.

Chapter 5, "Ludus Reading and RoboKind™ Robots Increase Early Literacy Rates", examines a new model for impacting reading instruction by combining Ludus Reading and RoboKind Robots on first-grade students' phonics skills and attitudes toward reading. Ludus Reading phonics instruction involves explicit and systematic lessons with underpinnings in play-based, technology, and multisensory techniques. In this case study, the RoboKind Robots were programmed to act as teaching assistants and help the teacher during the Ludus Reading phonics lesson.

Chapter 6, "Using Information and Communication Technology and Developing the Creative Abilities of Social Work Students", employs a descriptive-analytical approach to investigate students' creative competence. This chapter reports the impact of using information and communication technology (ICT) on developing the creative abilities of social work students, such as high readiness to use ICT. It suggests that reliance on ICT improves academic and personal performance.

Chapter 7, "The Influence of Social Media Networking Platforms on Promoting EFL Learners' Lexical Competence Repertoire: An Exploratory Study", reports that language learning is significantly influenced by social media. The growth of social media has become an international phenomenon. The chapter concludes that using social media platforms serves the educational and instructional settings for both teachers and learners. Social media supports and increases student learning performance.

Chapter 8, "Perspective Chapter: The Relationship of Technology and Creativity in Childhood Period", discusses creativity as a phenomenon that can be utilized in the conscious use of technology. It explains the importance of support in using creativity for enhancing the abilities of children. In supporting creativity, the use of technology is important, and teachers can use this phenomenon in their lessons.

Chapter 9, "Developing Creativity via LEGO and AI Robotics", reports on a longitudinal study that investigated the impacts of robotics programs on developing creativity among elementary school students. The introduction of LEGO robotics intervention proved significantly effective in developing creative thinking skills of fluency, flexibility, and elaboration of learners.

Chapter 10, "Digital Platforms in Teaching Arabic Dialects", gives an overview of Moodle as a digital platform. Moodle teaches didactic material in Arabic. The use of teaching platforms and accessible online materials is a response to the increasing demand for distance training courses. The chapter explains the need for innovation in the methodological, technical, and strategical approaches to language teaching.

Readers can use this book as a practical manual that explains the theoretical underpinnings of technology and its implications for practice. It is recommended to read through the book in order, focusing on the learning objectives formulated at the

beginning of each chapter. Try to get a feeling about the different sections regarding research philosophies, research designs, different types of methods, and other important issues in this book. If you are involved in a research project, try to revisit some of the topics if needed for further clarity. Each chapter provides specific self-assessment activities to further your understanding of the content of each chapter. If additional information is needed, consult the list of further readings and concepts at the end of each chapter.

I hope that readers will find this book a valuable resource whether working on research or engaging in scholarly pursuits.

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Section 1

# Theorization of Technology in Teaching and Learning

Chapter 1

# The Role of Modern Technologies in Improving the Quality of Education

*Abbood Abbas Abbood, Ansam Qassim Gadhban and Mayyadah Hasan Rhaif AL-Sahlanee*

## Abstract

The past era between 2019 and 2022 witnessed a development in technologies as a result of the use of scientific platforms and the creation of virtual interactive lectures, as universities began to develop scientific platforms as well as conduct virtual workshops and seminars, and once the matter of coexistence with the virus became necessary, a term called blended education appeared, which is a mixture of between the environment of e-learning and the environment of in-person education, and this form of education is considered one of the arts that universities resort to in completing the education process. As it became possible to attend the lecture from anywhere, this is a good thing that creates more freedom in the possibility of attending the interactive lesson or watching the recorded lecture later. Also, the teacher can take the test for his students in a way that does not require his attendance. Blended education is a method of self-education, as the student can access educational resources without the need to go to the university, so it is necessary to pay attention to developing modern technologies, improving the Internet service, and harnessing it for the benefit of the educational process to the fullest.

**Keywords:** education, traditional education, E-learning, blended learning, modern technologies

## 1. Introduction

The years of the third millennium are witnessing a vast knowledge and technological revolution characterized by rapid development through many local, regional, and global changes, and contributed to defining the features and characteristics of the education field. These changes forced educational institutions to respond and push them to adopt modern methods and strategies, and to be able to face and keep pace with these changes, with the intention of providing the best in this field. At the same time, education in the era of the knowledge revolution faces various challenges because of the enormous achievements in the field of information and communication technology, which made the world a small village in light of globalization and scientific and economic openness, and this in turn reflects in the development of education, which does not stop because there are convictions that the real renaissance in

any country can only come with a real education renaissance. Quality education leads to a worthwhile investment and a great renaissance, so governments began to think about changing educational systems and shifting to e-learning blended learning as the main and only source of information e-learning, in which the role of the teaching is a supervisor, guide, facilitator, assistant, and complement to education, employed by modern teaching strategies that rely on the Internet. The era of the Internet is the focus in the development of school curricula and decisions, and this new assignment represents the primary role teaching must play. Thus, studying blended learning and identifying its methods, components, and foundations based on them, and how to design educational situations for it have become an important and necessary matter for the teaching to be qualified to deal with it. Academic achievement is also one of the important aspects of the mental activity conducted by the student, which has a clear impact on academic excellence. Proceeding from these data, it is necessary for those concerned to give this subject sufficient attention by identifying the needs of students in adapting to their personal requirements and in accordance with the needs of society [1–3].

Various forms and patterns of e-learning have emerged, including blended learning, which has become the focus of attention for many universities. Blended education focuses on providing learning in an interactive, flexible, and a variety of interesting ways and helps to create suitable learning environments for students. Blended learning is based on the integration of learning experiences in a classroom face-to-face lesson and learning experiences through networks and the Internet; thus, it allows active independent learning, develops personal relationships, and encourages students to exchange ideas, information, and experiences. However, blended education has shown its importance in meeting the educational needs of institutions, where the combination of traditional classrooms and e-learning for web-based training or synchronous and asynchronous presentation *via* the Internet leads to improving the quality of education and increasing expertise and experiences [1, 3].

Modern learning has many advantages as follows:

- Increasing the effectiveness of education: Blended education helps to increase the effectiveness of education through improving education outcomes.

- Diversity of means of knowledge it employs various education and cognitive means for the learner to choose from them what suits his/her abilities and skills: It helps students to acquire more knowledge and raise the quality of the educational process.

- Achieving active learning for students: It depends on enriching the activities and focusing on the role of the active interactive learner through integrating individual and cooperative activities and projects instead of the learner receiving information.

- Achieving interaction during education helps enable students to have the opportunity to deal with teaching and their colleagues face-to-face through electronic and traditional means of interaction, which helps to strengthen human and social relations and attitudes of learners during education.

- Teaching flexibility provides flexibility to the individual needs and learning styles of students at all levels.

- Mastering practical skills helps in providing scientific topics and skills that are difficult to teach completely electronically, especially practical skills.

- Providing practice and training in the educational environment gives the possibility of training in the study environment, practical training and actual practice of skills, and appropriate reinforcement for performance to achieve educational goals.

- Achieving satisfaction with education students can communicate with Internet programs to consolidate information, increase achievement, and follow up on actual training, which will increase the effectiveness of the teaching process and increase student satisfaction toward learning.

- The credibility of evaluation achieves a great deal of credibility in the education assessment system, and blended education needs modern learning and teaching strategies. Among these strategies, the learner-centered learning strategy is one of the strategies that help accelerate learning and discover knowledge faster, student-centered teaching strategies.

Considering the developments of the current era, and in response to the huge changes in the requirements of the labor market, which reflect in the teaching processes and strategies in higher education, it has become necessary to move from traditional teaching methods to methods that suit students' minds and conscience and meet their needs while achieving efficiency and effectiveness in performance and achieving targeted learning outcomes, which aims in general to move from teaching students about knowledge to training them to search for it and transforming the student for a future of information into a product. This process takes place considering the momentous change in students' thinking methods and the multiplicity of their learning styles and their exposure to multiple stimuli that distract their attention. The most prominent one is modern communication technology devices and applications. It has become necessary to search for teaching strategies that help to arouse the attention of students to enable them to participate in the teaching situation and immerse them in thinking about what they learn, which results in the assimilation of information and its use in solving problems [1].

The education based on the traditional role of teaching being a carrier of information and knowledge is no longer appropriate for the era of teaching innovations that require the participation and communication of the learner interactively and positively in obtaining information from its various sources to develop. Using skills in modern educational means and techniques is represented by the emergence of e-learning, digital curriculum, distance learning, smart classrooms, and others. The preparation of the teaching considering this technical development in education is one of the most important challenges facing the institutions of his preparation, in terms of developing his preparation programs in the faculties. To enable him to use the latest contemporary technological means and to perform his roles entrusted to him that require his knowledge of the learning skills represented in the use of tools Electronic Communication. Several studies have emphasized the need to train student-teaching on the skills of using technical means in education and developing interaction and electronic communication skills before and during service using (the Internet and its applications—electronic courses, various applied programs—searching in educational websites—using e-learning management systems). The

mechanisms of its use in education create and provide an interactive learning environment in the study. If these skills and competencies are among the most important requirements for the teaching in general to perform his roles and tasks, then the teaching and educational technology specialist has them as one of the necessary skills that he must master, because it is at the core of his work, as he is the reference in this field and the missing thing is not given to him, especially since there are studies and researches indicating the lack of these skills among learners in general. The emergence of modern educational strategies based on combining the advantages of e-learning and the advantages of traditional education under the name of blended education with the aim of achieving an elevated level of communication and electronic communication between information sources and students is explained. The blended learning patterns are as follows: integration of e-learning and traditional education with a combination of self-learning and cooperative learning programs. Integration of synchronous e-learning programs and asynchronous e-learning programs is the most used type one that links e-learning with traditional education. There are many models for this common type of blended education that combines e-learning and traditional education, but despite this multiplicity, the difference in starting one before the other or synchronizing between them has not been accurately determined so far, especially since one of these models may be negative for the results of some students. Sometimes the opposite happens, and what does not affect the collection aspect becomes effective in the performance aspect, which calls for the need to conduct such a study [4, 5].

## 2. Traditional education concepts (in-person education concepts)

Traditional education is an active style of learning. Students learn quickly in the classroom. One-to-one interaction with teaching and students helps them to actively learn the given lessons. This is the most prominent advantage of traditional education. Active student and teaching participation students actively participate in classroom activities. They help other students study relevant lessons. They ask questions from teaching if they have any misunderstandings in the study. Active participation is necessary to gain a clear understanding of the theories discussed in the classroom. There is effective communication between teaching and students. This is very necessary to increase the level of confidence of the students. Effective communication makes students well connected and teaching also feels efficient after getting feedback from students. Regular leisure activities make the students better and get some relief from the stress of studying. They enjoy these fun activities. These activities are useful in addition to studies. The best part about traditional education is that it is scheduled and implemented correctly and regularly. Timetable and duration of lectures or classes are all scheduled. This helps in the quality of education and makes students disciplined and civilized.

Students engage with different people during their study experience. One of the benefits of studying at an on-campus university is creating meaningful relationships that are likely to last for years. The entire study or college experience relates to the need to be part of the many individual and group projects that require you to connect with your peers. Various activities that take place in university, schools, gatherings to study for exams, and sharing study notes are some of the ways in which personal relationships can be maintained. While keeping these relationships on campus is quite easy, doing it online will be problematic. If a student is considering a particular major such as nursing, agriculture, biology, music, medical, theater, or others, then online

classes cannot be beneficial in these areas. But some impractical online classes can be easy to take, and studies cannot be done in labs, clinical practice, or without a traditional class. The university officials organize courses in this traditional way so that all students can attend. Attending classes means joining the class on time. In this way, the students will learn their own routine, which will inevitably make the students disciplined and committed, because they practice punctuality throughout their years and acquire habits for all their lives. There are some university experiences that you will not get anywhere else. Field trips, university activities, and various clubs, of which you can be a part, are just some for those experiences. From each of these activities, you will receive life lessons that will be useful in the future.

Overall, interacting with teaching and colleagues online will not take more effort, although communication through emails and social media may make communication easier for both parties and save time and effort than visits or interviews.

Not all majors are available while one can study many different subjects online, some of them cannot be modified according to the format across the course. All those majors that require firsthand training or the use of any equipment fall into this category. To study these specific majors, you may have to attend their classes on campus. Therefore, it will be a restricted time and obligated to go and return at a certain time, which is against the nature of some people. More Responsibility Leads to Constraint: Flexibility is what makes online learning unique and convenient for students. However, this flexibility can be more comfortable, and while attending classes is on your own schedule, it is your responsibility to organize everything else in between and manage your time, constraint, and inability to engage in other activities.

Attendance or traditional education is education based on giving education lessons in the present with the participation of the teaching and the learner, and it is the pattern used and the method used in education in all countries of the world for many centuries.

Due to the rapid spread of the Corona pandemic around the world, many countries have taken precautionary and preventive measures to limit its repercussions, including closing educational and university institutions, and replacing education with education through electronic platforms and various social media.

The process of teaching online in emergency situations is a temporary means necessitated by the circumstances to transform the educational process from the traditional system to an e-learning system using technology and employing it in teaching students during crises. Of quality and does not consider the educational foundations of presentation, reporting, empowerment, communication, and evaluation.

There is no doubt that in-person education is the most appropriate and useful method of education for acquiring knowledge, strengthening the knowledge supply, and developing capabilities through direct communication and instantaneous interaction between the teaching and students in a single temporal and spatial framework.

The face-to-face meeting of the teaching with his students in the classroom at the university is a direct means of communication in transferring information and knowledge from teaching to the learner, and testing and evaluating them formally and morally, where teaching can meet, discuss, ask, and evaluate, and thus can evaluate and guide them in a better way.

The transformation process for remote e-teaching, while it contributes to finding alternatives to teaching and learning in the time of the pandemic, will not be in any way a permanent alternative and a suitable and successful option, as there is no inevitable attendance of education in its traditional, customary form, with the use of modern technology and platforms. It supports and supports in-person education, as it enhances the learning process within the traditional classroom.

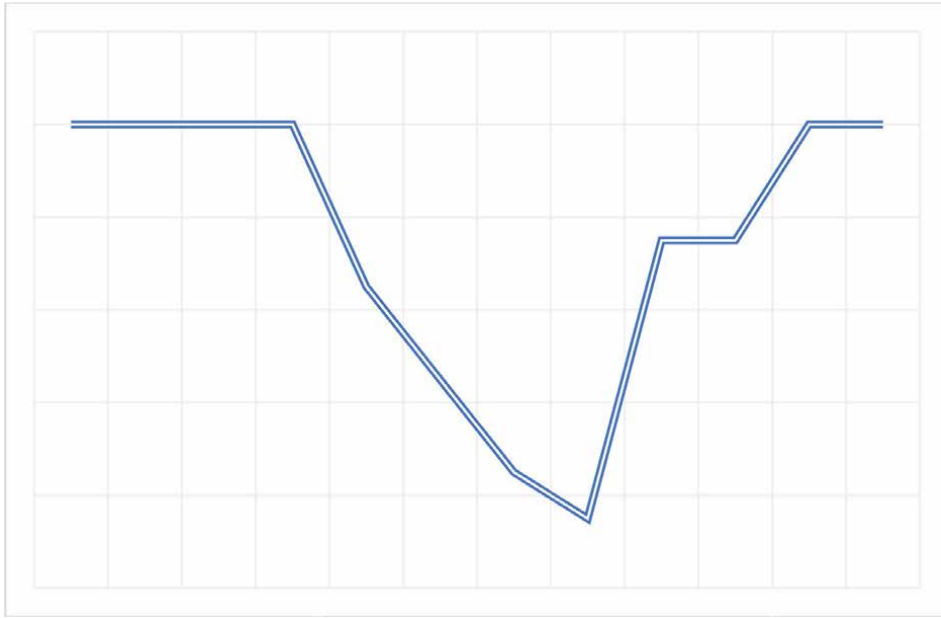

**Figure 1.**
*The quality of In-person education in the previous and coming years in universities.*

**Figure 1** shows the quality of traditional education in previous years and the decline in quality indicators coinciding with the Corona pandemic and the return and improvement of these indicators in the post-pandemic period.

## 3. E-learning concepts

The use of computers in the field of education is still in its infancy, but it is growing every day and has started to take numerous forms, from the use of computers in education to the use of the Internet in education, and finally, the notion of e-learning has emerged, which depends on technology [2]. E-learning programs are becoming more important because of their capacity to address the issue of the knowledge explosion, which is brought on by the enormous amount of intellectual output in the various scientific and human fields and the inability of traditional education programs to comprehensively encompass the objective aspects of various disciplines, due to the difficulty of Modernization and inf. This attempts to emphasize the idea of e-learning and the motivations behind our focus on it, as well as to highlight the barriers that stand in the way of the development or use of this area of education [3].

E-learning Definition Modern educational methods and tools have emerged because of technological advancements, which rely on the application of technological innovations to improve educational effectiveness and efficiency. Examples include the use of computers and their accessories, electronic displays, satellite channels, satellites, the Internet, and electronic libraries to make learning accessible to everyone, for those who want it, and in a location that works for them [6].

E-learning can be defined as a method of delivering educational content with fixed and moving visual elements as well as audio and visual effects. E-learning has several definitions, including that it is an interactive system for distance education

that is provided to the learner on demand and is based on an integrated electronic digital environment aimed at educating people over distance, and this definition reflects the specifics of e-learning that affect educational communication processes, course development, teaching strategies, and assessment, as well as any related to them. It also includes organizing exams, providing guidance and direction, managing, or evaluating resources and processes. The elements have contributed and continue to contribute to the adoption and spread of this system in numerous nations worldwide [7, 8].

An additional definition of e-learning was given as "the use of technology and technological means in education and harnessing them to learn the student individually and collectively and making it the focus of the lecture, starting with the techniques used for presentation inside the classroom from multimedia and electronic devices and ending with deviating from the physical components of education: such as the smart school and virtual classes that are During which the interaction between the members of the educational process via the Internet and interactive video technologies" [9, 10].

E-learning takes place in three different environments, namely direct network learning, blended network learning, and supportive network learning. The scope of the educational process is through a range of means, including computers, the Internet, and electronic programs prepared either by specialists in the field of education Ministry or by companies. It is one of the educational means that rely on electronic means, to make knowledge available to those who spread outside the classroom, and it is one of the forms of distance study, and it is also a method of education using modern communication mechanisms, computers, networks, and multimedia, to deliver information to the recipient as soon as possible and at the lowest cost [8, 11].

After the emergence of e-learning and the spread of its various applications and the acceleration of its growth and development day by day, and the attempts of specialists and those interested to find a comprehensive definition of the concept of e-learning, each of them formulated a definition of this concept from a different angle, which made an agreement on a unified definition of e-learning exceedingly difficult. Several definitions of e-learning have been presented, some of which are overlapping, and others are not overlapping [8, 12].

Through closed electronic networks within the group, shared between universities, or on the Internet, e-learning enables the learner to interact with the material to be learned with the least amount of effort and the greatest amount of benefit, while also enjoying the feature of flexibility in time and place. Although it has been identified with contemporary communication technologies embodied in electronic computers and networks, the notion of e-learning extends to cover many communication technologies that rely on electronic components in their creation, such as radio, video, and television [13].

Even if it is 24 E-Learning and Virtual Education Describing it by means of electronic communication, in addition to the fact that the concept is also linked to computers and networks together, which makes us refer to the initial use of computers in education, which was represented in two directions.

- The first trend: is to use the computer to help in education.

- The second trend: is computer-based education, whereby the computer and its programs are the other party in the education process as a substitute for teaching [14].

E-learning can be defined as an interactive system for distance education that is provided to the learner according to demand and depends on an integrated digital electronic environment aimed at building courses and delivering them through electronic networks, guidance, and direction, organizing exams, managing, or evaluating resources and processes. E-learning is one of the most important technological applications in the field of education and its methods so it can be said that it represents the new model that works to change the complete form of traditional education in the educational institution to be concerned with global cooperative education, continuing education, continuing training, and training of professionals in all the education and scientific fields [15].

Due to its many benefits and advantages, including its ability to help with the knowledge explosion problem and the growing demand for education, as well as its ability to help with lecture overcrowding when used in a distance education method, as well as its ability to increase opportunities for admission to education, e-learning has spread so quickly that some have predicted that it will be the best and most widely used method for education and training in the near future [16, 17]. E-learning works to raise students' achievement in various subjects, by providing many exercises in which the learner interacts with educational software and the presence of feedback [4].

For educational purposes, this great rush to use technology led to the emergence of modern trends in the education field, most notably the study of the impact of e-learning on the teaching and learning processes. Digital technology has contributed to changing the features of the educational system with its various elements. For example, digital information technology has contributed to changing the role of the faculty member and the teaching from a mere transmitter of information to playing the role of facilitator, explainer, guide, trainer, evaluator, and constructive leader [16]. Digital technology has also contributed to changing the role of the learner from just a recipient of knowledge to the role of the investigator, researcher, and discoverer. The adoption of e-learning in most universities as a supportive educational method has become urgent, as was mentioned in the report, which was titled "The Pursuit of the Goal" of online education in the United States and others, which concluded that the demand for e-learning has doubled during the last 5 years students and faculty members agreed that this may come through the capabilities provided by e-learning and distance education that meet their needs and remove the obstacles that may be caused by traditional forms of education such as distance, lack of time, transportation costs, conflicts of appointments, childcare, or others.

E-learning has two types: synchronous e-learning and asynchronous e-learning: Synchronous e-learning refers to live online lessons, synchronous online lessons, or virtual lessons in the classroom. Synchronous e-learning is used in online conference systems, webinars, or other such applications such as Zoom, Free Conference call, Meet, WebEx.

Asynchronous e-learning is a self-paced step where students access lesson materials on a computer, or on the Internet, at the appropriate speed for students and then choose what they want to learn and set a learning history with students. Asynchronous e-learning software includes lecture content, videos, pre-recorded visual or text elements, and other interactive elements such as Classroom, Edmodo, Moodle, YouTube, Telegram, WhatsApp, Viber [18].

**Figure 2** shows that the quality of e-learning in previous years was low and quality indicators increased in conjunction with the Corona pandemic, and the return of these indicators decreases somewhat after the pandemic.

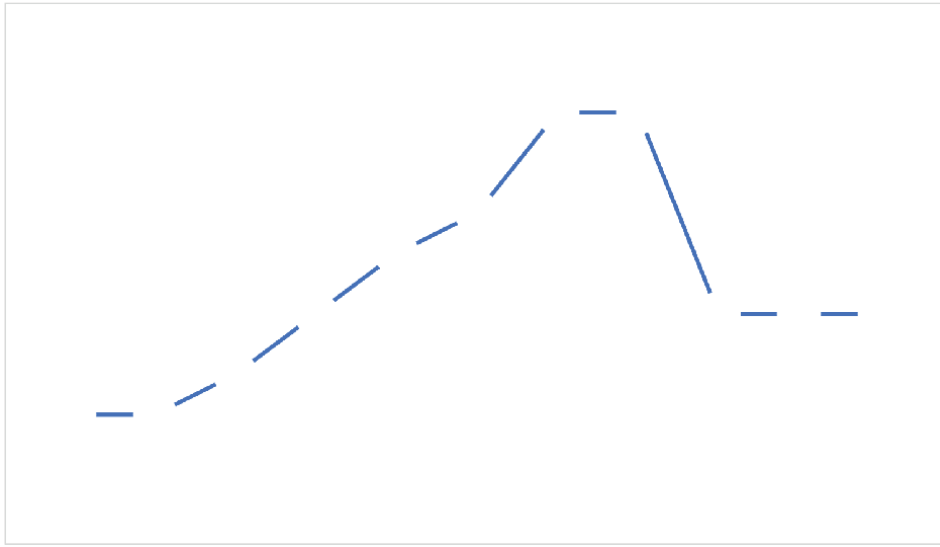

**Figure 2.**
*The quality of E-learning in the previous and coming years in universities.*

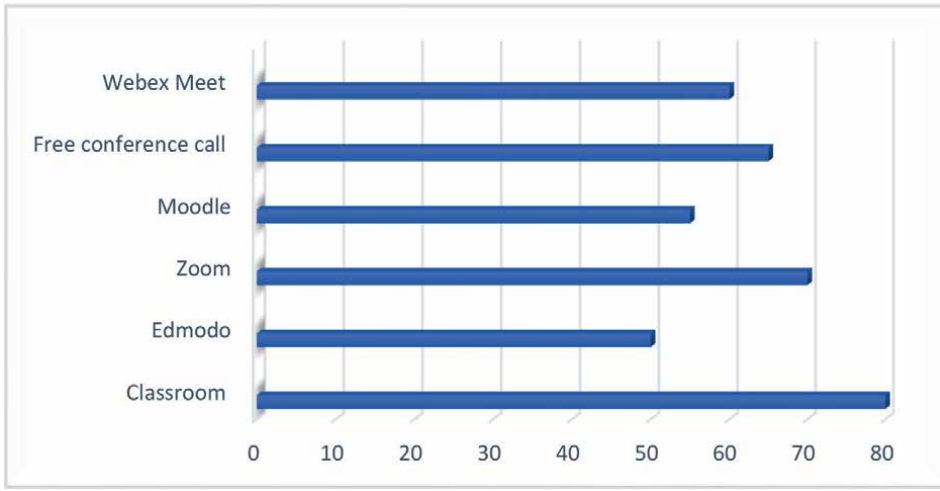


**Figure 3.**
*Most used applications in e-learning.*

**Figure 3** refers to electronic communication platforms, where we note the most used platforms are Google Classroom for asynchronous e-learning. As for the most used platform in synchronous interactive lectures, it is the Zoom platform, and the educational platform least used is the Edmodo platform.

## 4. The difference between traditional education and E-learning

Urban or traditional learning relies on the presence of learners or students daily or at predetermined periods during the grade as a venue to absorb science, whereas

e-learning aims to deliver education through the methods of communication. The instructional material in traditional education is frequently printed in writing, while e-learning offers educational material in the form of books, documents, electronic papers, websites, and diverse electronic sources as auditory or visible. E-learning relies on synchronous and asynchronous learning because traditional classrooms in urban settings cannot accommodate students who happen to be in class at the same time as the teacher and vice versa [19, 20]. Costs of distance learning are frequently lower than those of traditional learning. The teacher's position in this education was distinct from that of the corporation and the only information source, as well as from that of the supervisor's purpose, and the student's prompt aids in overcoming all barriers and challenges that stand in the way of the arrival of the scientific article. Along with its many other sources of information, including the Internet, this education also relies on self-learning, which encourages more productive involvement of student. More adaptability makes it easier to update and change training or instructional materials offering both the same education and the options for admittance to children who compete for scarce places in urban schools. Additionally, it aids in the quick detection of outcomes and errors and the immediate assessment of pupils' skill levels. Without having to abandon their jobs or roles, learners can learn, train, and qualify. It has the flexibility to ask the teachers the questions he wants whenever and wherever he wants [17, 20].

Due to the close relationships and the educational setting, these young people overcome their shyness and introversion and approach the lecturers with questions. They participate in answering questions with their classmates and offer their responses, which are then reviewed as to whether they are correct or incorrect. This unique interaction as well as the many ways people express themselves—from words to actions, signs, and feelings—makes presence education crucial. It allows the teacher to deliver to the class any messages he chooses that are simple for the students to understand and retain [21].

E-learning is thus a contemporary revolution in teaching methods. In this pattern of education, educational lessons are exhibited for students through the Internet in the form of educational images and files, and other ways. The nature of e-learning depends on how information and instructional materials are delivered electronically or by default. The use of electronic media enables communication, information gathering, skill acquisition, and engagement between the learner and the school as well as between the teacher and the university. This pattern can be referred to as a default education and readiness because it does not require learning to take place in a classroom or other venue for instruction [9].

## 5. Blended learning concepts

One method of modern education is the combination of traditional education and e-learning in a learning environment. Online learning, traditional classroom instruction, and solitary study are all combined to create blended learning, which is effective. Its popularity has increased in the recent years because of the remarkable expansion of online learning as well as other causes. Some people could view blended learning as a compromise or as an alternative to online learning. Improving the learner experience is unquestionably a wonderful method to use the blended learning model. Blended learning has benefits and drawbacks in terms of both staff training and student education.

By viewing the curriculum online, students can access the resources without limitations and in accordance with the timetable, which makes blended learning more convenient. By incorporating technology into classroom instruction, teachers are free to reach more students through blended learning, which gives each student the opportunity to receive individualized instruction that suits their specific requirements [4, 5].

Blended education aims to develop the cognitive and performance aspect of students, and to achieve democracy in education, in addition to supporting students with modern technological tools that raise their creativity, and in blended learning nomenclature there may be many names for blended education, which fall under one goal, which is distance education, and among these names are the following:

- Blended learning.
- Mixed learning.
- Hybrid learning.
- Blended learning history

Blended education has been known for about a hundred and twenty years, specifically at the beginning of the year 1900 to 1910. During these 10 years, the use of mass media and communication aimed at educational education began, and these means were represented in holograms, films, slides, graph tables, and others. Many other means [22].

Blended learning is traditional education in the presence of the teacher and the learner together face to face, with indirect education, which is through communication only through the Internet. Self-education is also mixed with direct traditional education, as there is no authority over the learner except himself. The process of integrating education is also known as planned and unplanned education, which is web-based education. It also mixes customized education, that is, prepared according to the student's need, with the provision of ready-made contents, which are closer to the educational specialization. Education is also mixed with practice, if it contains many scientific exercises in addition to the basic teaching foundations known, from direct education [23].

The built-in approach is based on the integration of learning face to face and learning online. This means that the student has his lessons from the teacher directly and has some at home. This makes a learning environment with modern developments and does not lose the features of direct interaction between the teacher and student, particularly in practical colleges such as medicine, agriculture, and others. This also provides pupils in the basic educational stages an opportunity to collect academic in the case of their absence from the school for disease, travel, or epidemics. Here, we must point out that distance learning materials may be complementary to learning in the classroom. But it may not be available in the lesson hours in the classroom. The article in the school, which tells the era of ancient state in the Pharaonic Egypt, is complemented with a documentary and graphics for the construction of pyramids. This makes history here is not an article, but an interactive material that students interact with the viewing article. This requires qualitative change in learning environment in schools and universities to suit the limited capacities provided by this pattern of learning. The learner here is active generating ideas and obtaining knowledge in an

individual and collective way. Distance learning is an opportunity over the Internet to think all students and data from home. The course allows for the semester for discussions and applied activities, which raises the knowledge capabilities of learners. Of the data of this type of education: The participation of ideas over the course of serious discussions about the lesson develops the ability of mind to generate ideas. This requires exercises on ways of thinking and devising solutions and obtains new generations other than those who are used to education in the Arab world to provide them with a mention and conservation only without realizing the mind. This is also a sense of responsibility since the teacher will not be a source of information as much as it will be evidence of building ideas. This is pushing new generations toward sailing in the knowledge space and gaining self-learning capabilities. Create concepts: The creation of a structure or identifier of any topic in mind is the best knowledge exercise for learners, and this helps build maps of concepts, from here to build maps of concepts through unlimited digital learning tools, such as images and graphics. This makes a fun learning process and helps the student on indulgence, particularly if he is asked to implement an explanation for his material according to his understanding. Creative presentations: This type of creative capacity education undertakes any students who have opportunities to build stories and short videos and guidance, about education. This is what develops students' expression skills and helps them make their ideas in the field of work after graduating. Cooperative Education Strategy: Individual competitions in education in the Arab world have generally been disaster in creating individual trends through competition in the classroom, while cooperative learning strategies have proven effective in developing a student's responsibility, and gaining collective action skills, and logical and analytical thinking, through which teachers can ensure the participation of all learners in the learning process. Project-based learning: The draft-based education combines project-based learning advantages in traditional learning environments and learning through the Internet environment. In this type of education, students learn basic concepts through online sources, and they are taking their practical skills by engaging in collective projects in a face-to-face learning environment. Education is increasing from the teacher's ability to analyze and review the work of the students and to provide them rapidly, giving the ability to adapt its teaching methods and feedback to each student and improve its efficiency in time management [24].

Blended learning is more than just a virtual lesson that is added to lessons in the classroom. He reformulated education overall but was flexible and practical so that the student becomes active educators. Flexible education is based on the use of time for learning with methods that suit students, and their individual preparedness, and the speed of each student in reading and analysis and enabling him to use modern technologies, so it is based on the design of flex grade or sometimes called design-oriented design to face. Most of the activities are made in a quota. To complete some of them in the form of activities or duties are executed outside the grade, whether at home or anywhere else. Inverted grade design is opposite to the flexible school grade structure. When students read about the lesson at home, they answer questions, and are formed and seek related to visual and audible sources. Blended learning makes it possible to continue learning much faster. By combining face-to-face training with e-learning, the learner becomes active in his training process. This method allows him to validate what he has learned during his lessons. This facilitates the control of the education process. People who do this type of training choose how quickly they learn. When a learning point is not understood, it can be revised as many times as desired until it is incorporated into on-the-spot learning. Conclusion Blended learning is a

combination of face-to-face teaching and learning with online teaching and learning. Examples of blended learning include problem-based, project-based, and original learning tasks. Any university program can be in the form of blended education, as its models will include empowerment, improvement, development, and training [5].

We notice from **Figure 4** the quality of blended education between the past and the future, where it is expected that the quality of blended education in the coming years will be better than it is now.

**Figure 4.**
*The quality of blended education in the previous and coming years.*

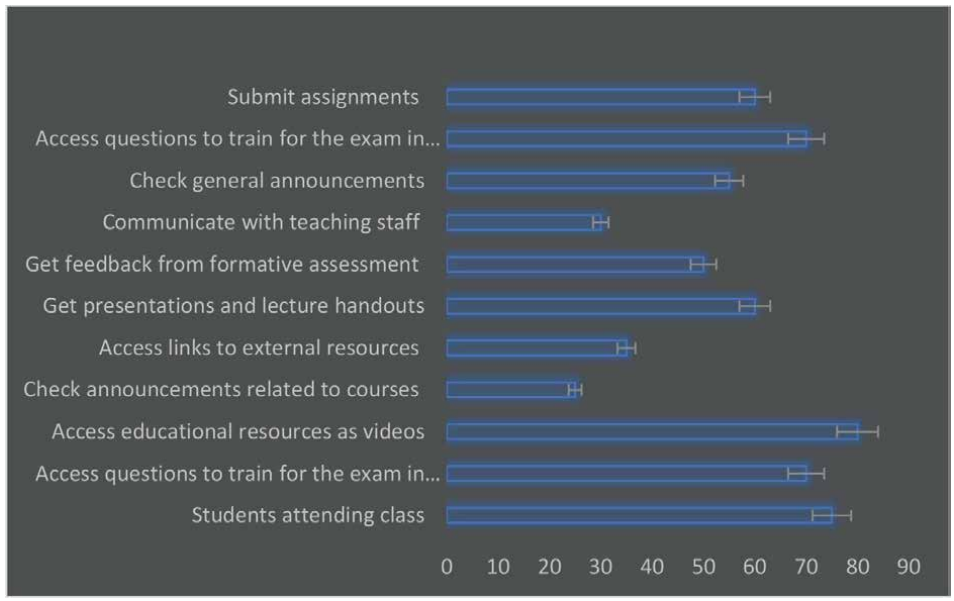


**Figure 5.**
*Use of blended education in universities.*

The use of blended education in universities has forms, and as shown in **Figure 5**, where we note that the best use is the presence of the student in the class, and it is side by side providing him with a video lecture.

## 6. Conclusion

The aim of writing this chapter is to study the impact of blended education on the quality of higher education and the role of modern technologies in improving the quality of education, as blended education is what educational institutions in the entire world go to, especially Iraq. By comparing traditional education with e-learning, we noticed that each of them has benefits and harms, but the integration between them overcomes the difficulties and improves the performance of the teacher and student alike.

It was also noted that the development of modern technologies and educational platforms increases the improvement of the scientific level by creating an interactive atmosphere. As a result, educational institutions seek to build their own platforms for the sustainability of e-learning and the integration between it and traditional education.

## Conflict of interest

The authors declare no conflict of interest.

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Chapter 2

# Influence of Information Technologies on the Quality of Study Programs in Higher Education

*Krunoslav Škrlec and Marijan Čančarević*

**Abstract**

The chapter is to explore how modern information technology influences the quality of study programs at higher education institutions. The objective of this chapter is to determine how such technology is implemented in the study programs and how such changes are accepted by students and teaching staff. Besides the primary objective, the chapter also aims to explore what challenges arise when applying such technologies, what ideas students support, and what teaching staff. An analysis of these ideas will attempt to make recommendations on how to reap the benefits of new technologies in the best possible way for all participants in higher education.

**Keywords:** information technology, communication, education, study programs, higher education

## 1. Introduction

Educational reform in the Republic of Croatia is currently at the top of the priorities of the entire society, with the aim of how to connect this reform with the needs of the economy. The need for change in education system is evident, but the challenge lies in what to implement and how to go about it. One such challenge is information technology, or information communication technology (ICT). Although the speed of change in this area has been known for a long time and has been suggested by experts for years, it has nevertheless caused various challenges in the both economy and the education systems. Such a challenge is presented in this chapter through the analysis of the impact of information and communication technology on the following process participants:

1. The impact of technology on students,

2. Impact of technology on teaching staff and.

3. The influence of technology on the overall quality of the study program.

By analyzing these segments of the educational process, we will try to point out main issues of the modern education system and try to give guidelines on how to make it easier for teachers and students to use modern information and communication tools to enhance the quality of education for all participants in that process, with the aim of adapting as easily as possible to the needs and challenges of the economy as a whole.

### 1.1 Topic and objectives of the research

The topic of research in this chapter is the impact of information and communication technology on the system of higher education through the analysis of three segments of that system. It pertains primarily to students, namely, their attitude toward such technology and the need to use it in both teaching and solving of tasks set before them. The research is also directed toward the teaching staff and their attitude toward the use of such technology, but also concerning the relation to requirements toward students regarding the extent and manner they should utilize such technology.

In accordance with this research, the main aim is to determine how the interactive use of information and communication technology by students and teaching staff affects the overall quality of study programs and the educational system as a whole.

### 1.2 Research methodology

Methods [1] that were used in the research are the questionnaire method, which aims to investigate in what way and to what extent students or teachers use information and communication technology during lectures, and how much in the process of solving tasks. In doing so, emphasis is placed on research in terms of teachers' attitudes toward the use of such technology in the teaching process and the use of technology in the process of solving tasks. Likewise, we desire to investigate the level of proficiency regarding the use of technology by both teachers and students.

A case study method of selected tasks will be used, in which the degree of use of such technology by all research participants will be analyzed, as well as use of e-learning tools and methods of statistical data processing. Lastly, the method of presenting the obtained results using tables and diagrams will be used with the aim of understanding the effect of information and communication technology on the quality of the teaching process.

### 1.3 Research participants and research limitations

The participants in the research are teachers ($n = 40$) and students ($N = 90$) at higher education institutions dealing with social (economics) and biotechnological sciences (agriculture). Therefore, students and teachers in other scientific fields were not included in the research, which is the main limitation of the work.

## 2. Information and communication technology in education

Nowadays, modern education at all levels is unthinkable without information and communication technology [2, 3]. Although we have been aware of this fact for a long time, we get the impression that this technology has surprised us with its speed of "penetration" into all segments of society, including education.

The impact of ICT on education can be observed through many parameters. In this chapter, the analysis is focused on the use of technology in the process of maintaining the curriculum, and solving tasks and remote work for both teaching staff and students.

### 2.1 Information and communication technology and teachers

The use of information and communication technology by teachers can be observed through several aspects. One interesting aspect is the degree of utilization of the classroom in which the "classroom of the future" is located, as the authors of the research [4] call it, in which they state that such a classroom is used by teachers in the highest percentage (39%) in a time unit of only 1 hour per month.

The research in this chapter is directed toward the use of ICT by teachers [5], relating to use of such technology in terms of the degree of utilization in the teaching program, its use in the creation of tasks, and distance learning. It is precisely on these three aspects that the research of this work is focused, with the aim of detecting problems that arise and measures that could help in overcoming these sorts of modern challenges.

### 2.2 Information and communication technology and students

An indispensable segment of information and communication technology research in education is students and their attitude toward such technology. It is interesting to analyze previous research related to this contemporary challenge.

By reviewing the literature and empirical research within past 10 years, it is evident that such technology was used for the purpose of developing intercultural competence [6, 7]. In other words, information and communication technology served as a bridge between new cultures and people. Likewise, the areas of research went in the direction of analyzing the advantages and disadvantages of written communication using the new IC technology.

An interesting analysis of research [8] on the use of tools by students is that it indicates that the most interesting tool in the use of information and communication technology is the use of mobile phones (45%), while the Internet usage is somewhat smaller (37%). The analysis of previous research shows that students are very interested in new technologies [9]; however, the challenge for the education system is how to use this interest in the best possible way.

### 2.3 Distance learning

Nowadays, the use of information and communication technology in education is most often associated with the concept of distance learning. It is difficult to determine the exact beginning of this concept, but with the rapid development of ICT there is the possibility, and daresay the need, for distance learning better known as e-learning. E-learning can be defined [10] as support for learning through the application of network technology, where network technology means Internet technology, and we can also expand this definition with the term information and communication technology.

For the implementation of e-learning in classes, some implementation prerequisites are necessary in terms of availability of computer equipment, access to the Internet, information literacy, and IT literacy. However, no matter how we approach

previously stated points, e-learning concept faces great challenges. E-learning [11] is not just about uploading the course study material, but it is also a way of thinking, transferring, assessing, and evaluating knowledge. Distance learning has its advantages and disadvantages.

The main advantage [12] of such learning compared to classical learning is its availability 24 hours a day, 7 days a week, regardless of the geographical area in which you are located. The system not only enables greater availability of learning materials, but also the access to teachers and quick feedback. It allows for independent learning, as well as communication and collaborative learning. E-learning systems have a high level of security when entering into the system and its use is allowed only to authorized users with a username and a password. It is possible to manage users within the system by assigning roles and groupings. The system offers a large number of tools for content storage, communication, and knowledge assessment. On the other hand, the main disadvantage of such learning is that teachers are generally not skilled users of new technologies and do not have enough self-confidence. They approach new technologies with fear, which is an additional impediment when it comes to their implementation. Until now, teachers had the main role in teaching. However, with the advent of e-learning, their role changes, and they become moderators who direct students toward independent creation of knowledge; that is, they move from the traditional to the constructivist way of teaching.

## 3. Research results

The research was conducted on first-, second-, and third-year students attending graduate professional studies as well as students from specialized graduate professional studies. Professors who teach at the aforementioned universities are also included in the research.

The time period to which the research refers is a period going back 3 years, that is, from 2017 to 2019, where the results obtained through the survey and the analysis of the case study were presented.

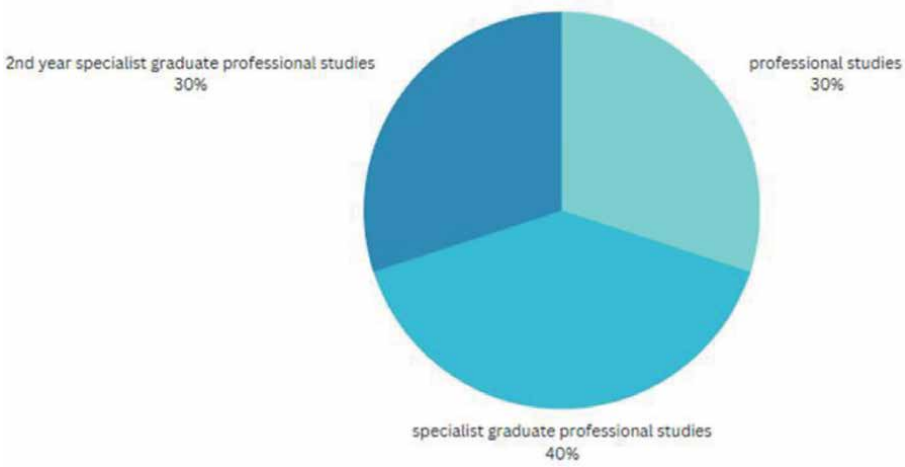


**Figure 1.**
*Presentation of the structure of surveyed students.*

**Figure 1** shows the structure of surveyed students by years of study in professional studies and students from specialized graduate professional studies.

### 3.1 The impact of information and communication technology on students

The first part of the research refers to information and communication technology and its utilization by students. The research is structured by years of study with the aim of being able to analyze the results to see the trend of growth or decline when it comes to impact of such technology on the target group.

**Figure 2** displays the results of the first-year students' survey that show how much the students of the said year believe that IC technology is needed in the process of teaching by a higher education institution, and how important they consider such technology to achieve learning outcomes that would aid them in the labor market.

**Figure 3** shows the results of the second-year students' survey, which also show us how much importance students of the said year consider ICT to be in the classroom learning process.

Subsequently, **Figure 4** shows results of research into the impact of ICT on students in the final year of professional studies, and as expected, there is a great increase in awareness of the importance of using information and communication technology in the teaching process with the aim of mastering such technology, which has proven to be an integral part of the teaching process.

At the end of the analysis of the results related to the ruse of ICT in the classroom setting, **Figure 5** presents the results of the research among students of specialist vocational studies. These results are particularly important, because they pertain mainly to students who are studying part-time, that is, students who are already on the labor market, so it is logical to conclude that they possess the best knowledge regarding the importance of applying new technologies in the economy, which ultimately indicates the importance of using ICT in teaching at selected studies.

**Figure 6** shows the answers of all the examined professional studies students concerning the need to use information and communication technology when solving problem tasks or experiments. On the other hand, the results of the examined

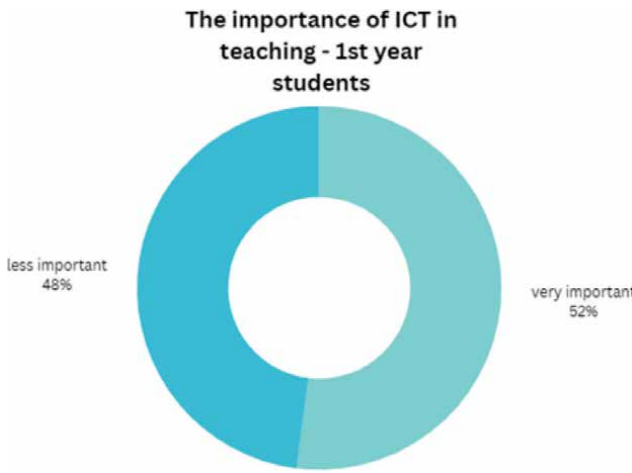


**Figure 2.**
*Presentation of first-year students' results.*

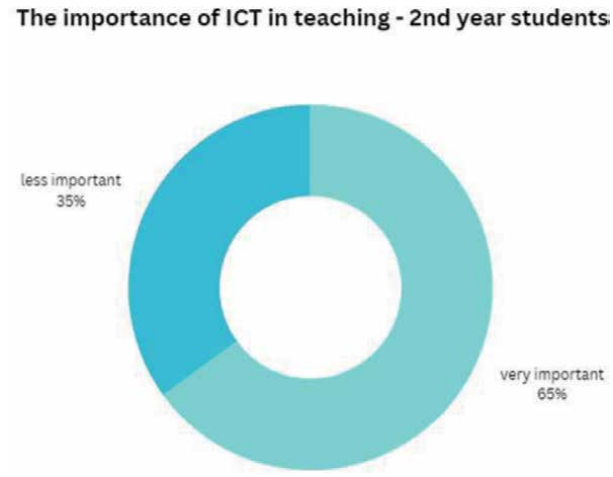


**Figure 3.**
*Presentation of the results of the second-year students' survey.*

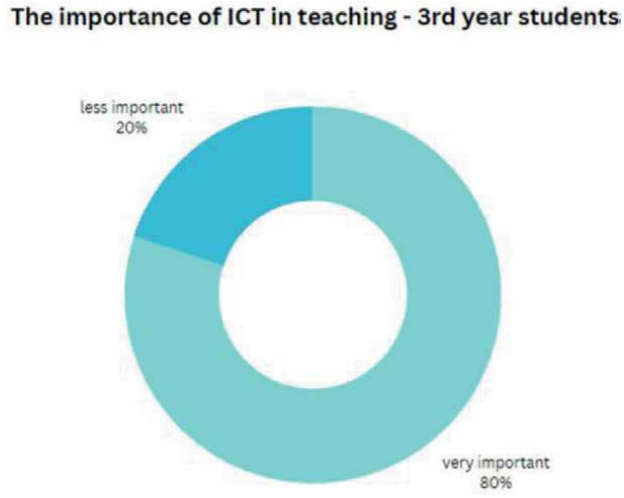


**Figure 4.**
*Presentation of the results of the third-year students' survey.*

students of specialist graduate professional studies are not shown graphically, because the answer is 100% in favor of the necessity of using ICT in solving any problem task or experiment, both for students studying the economic group of subjects and for students studying subjects in the field of agriculture.

### 3.2 The impact of information and communication technology on teachers

The research related to teachers is divided into two parts. The first part of the research results refers to the results of a survey of students who evaluated the level of ICT use skills by the teaching staff. The second part of the research refers to a case study on the use of a distance learning system and the analysis of results that evaluate teaching staff in the application of ICT during teaching and solving of the set problem solving tasks (possibly experiments) by the students.

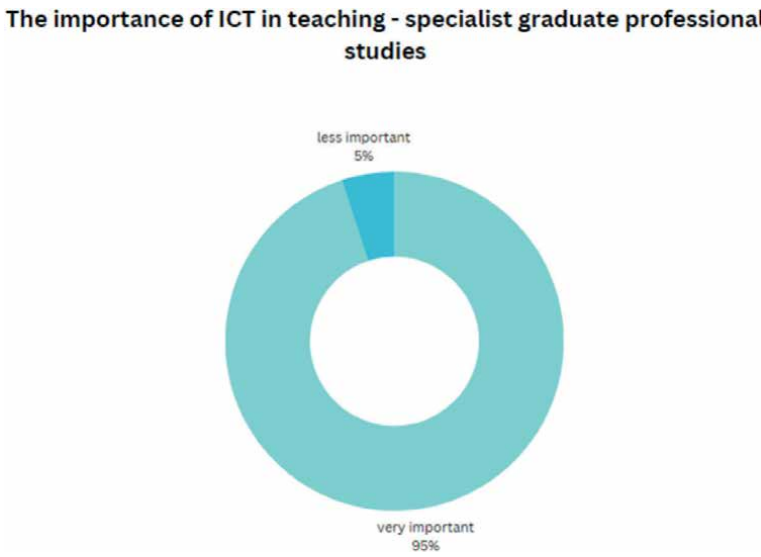


**Figure 5.**
*Presentation of the results of students' answers—specialist graduate professional studies.*

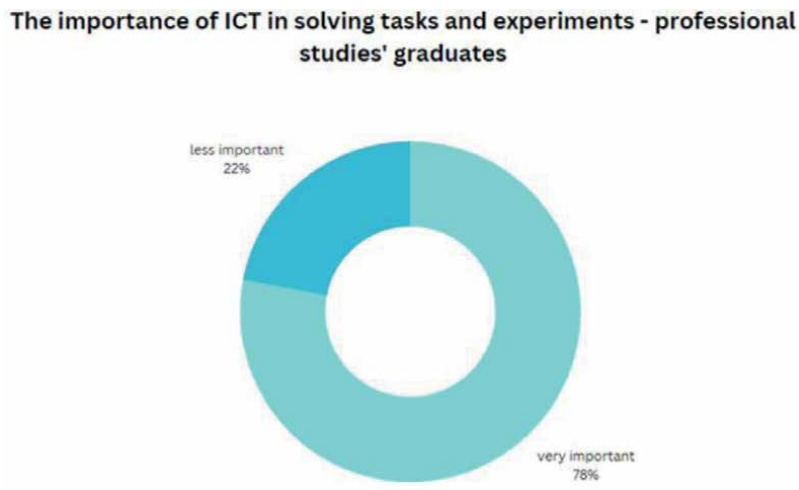


**Figure 6.**
*Presentation of the results of students' answers—the need for ICT in solving tasks and experiments.*

### *3.2.1 Assessment of teacher competence in the use of information communication technology*

The results are presented cumulatively, that is, jointly by students of professional studies and students of specialized graduate professional studies.

Research results, **Figure** 7, indicate students' belief that only 10% of the teaching staff have advanced skills when it comes to the use of information and communication technology tools. On the other hand, the results indicate a large number of teaching staff who are not at an advanced level.

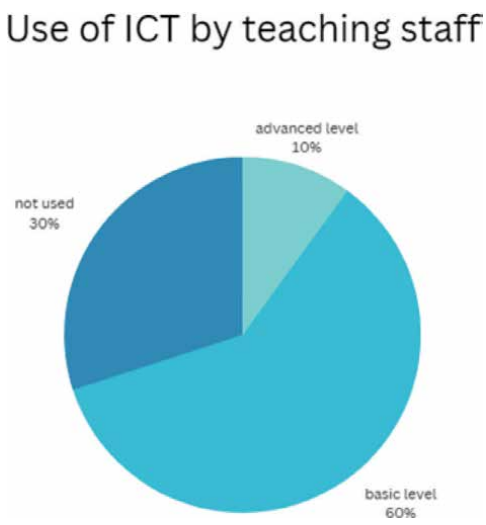


**Figure 7.**
*Presentation of students' answers—use of ICT in problem solving tasks by the teaching staff.*

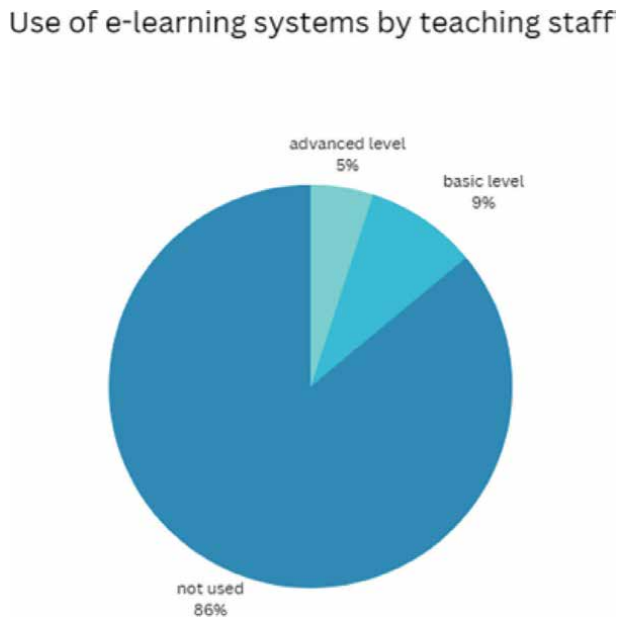


**Figure 8.**
*Use of e-learning systems by teaching staff.*

### *3.2.2 Evaluation of distance learning system use by teaching staff*

The results on the use of distance learning system by the teaching staff are presented here. The results were obtained through the case study analysis method on the use of Merlin e-learning system.

From the results of research, **Figure 8**, on the use of advanced systems related to information and communication technology that serve as a support for the teaching

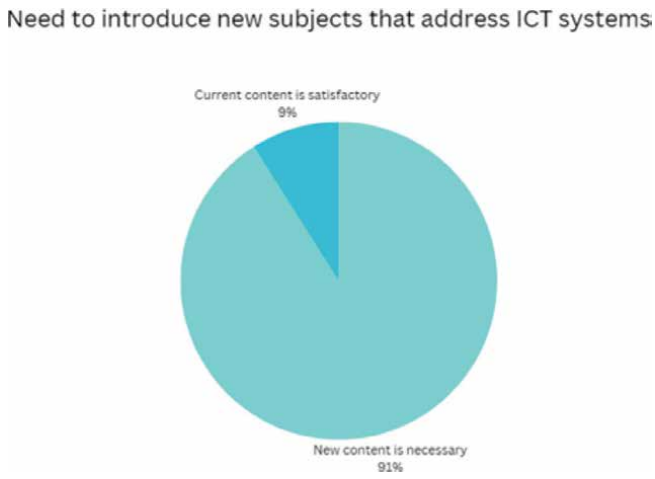


**Figure 9.**
*Need for additional modules that address ICT systems.*

process nowadays, it is clear that the level of use of such system(s) is low, which is certainly not a satisfactory assessment of the competence of teaching staff.

### 3.3 The impact of information and communication technology on the overall quality of the study program

The influence of information and communication technology on the overall quality of the study program is clearly visible from the stated and presented results of research among both students and teaching staff. However, perhaps the best insight into the challenge of modern study programs and the guidelines that must be followed in their development is provided by the result of the last survey question, which refers to the need to use such technology in the teaching process through the representation of modules that study such technology.

**Figure 9** clearly outlines students' belief that due to needs of the market, it is necessary to introduce new contents that addresses both the theoretical level and the practical application of new information and communication technologies, thereby raising the quality of studies and the competitive ability of graduates on the labor market.

## 4. Conclusion

Many important conclusions can be drawn from the research results. First of all, one can see the correlation of the positive growth of students' awareness on the importance of information and communication technology as they approach the end of their studies. This is especially evident among students of specialist studies who have already entered the labor market. The research results related to the teaching staff are particularly symptomatic, which clearly show the need for further training of all participants in the teaching process for the simple reason that the labor market in a developing economy demands it, whether we like it or not.

Finally, it is important to emphasize the need for continuous education of both students and teaching staff. In addition, it is important to pay attention to investments in that particular sector. Modern technology is expensive due to large use of expertise

and know-how, so if we want to be a knowledge-based society, determination on its own is not enough.

## Additional information

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Chapter 3

# Virtual Reality and Creativity: Lessons Learned from a Luminaire Design Project

*Hoa Vo and Peter Huesemann-Odom*

## Abstract

Current research in design education showed that experiencing virtual reality (VR) in learning led to higher creativity in students. However, some studies showed only a partial impact of VR on student creativity. Using video data analysis (VDA), the authors examined a half-an-hour excerpt of the recorded VR learning experience from a previous study on interior design students ($n = 13$). The authors sought an explanation for the partial impacts of VR on students' creativity via observing and interpreting one participant's (a) interaction with VR and (b) the context of the virtual environment. VDA analysis results indicated that the implemented VR technology was intuitive for a fundamental learner yet required time and practice to gain advanced skills. Exploration time was also necessary for students to fully demonstrate the novel, resolution, and style aspects of creativity in their works. The implication is that the partial impact of VR on creativity found in the previous study might be due to the constraints of time and expertise of students (i.e., learn and explore), not VR technology per se. Educators and institutions wishing to include VR in their curricula should allow students ample time and access to VR applications and headsets to practice and sharpen their expertise.

**Keywords:** virtual reality, creativity, creativity assessment, digital learning, education

## 1. Introduction

Creativity is the top desirable competency across industries in the Fourth Industrial Revolution or Industry 4.0 [1, 2]. Bermúdez and Juárez [3] developed a competency model for Industry 4.0 with four key dimensions: information and communication, management, organizational learning, and environment. Creativity makes up 44% of the last dimension, environment, together with research and transdisciplinary. Chaka [4] also analyzed 64 journal articles from eminent databases, such as Scopus and Web of Science, on Industry 4.0's desirable competencies and found notable discussions about "creativity" in 30 of them (47%). The all-time-high importance of creativity, thus, leads to the robust discussion of how educators across disciplines can facilitate their students to become more creative in Industry 4.0. According to Cropley [5], fast-moving and revolutionary technologies are at the core

of Industry 4.0. Hence, creativity education needs a technology-focused component to help students manage and tolerate complex and uncertain problems of the new industrial revolution and be able to communicate critical and practical responses. Although integrating technology into education appears to be straightforward, there is more to discuss. First, which Industry 4.0 technologies are beneficial to creativity? Second, how should the impact of said technologies on creativity be evaluated?

The first industrial revolution, or Industry 1.0, represented the mechanized and steam-powered production of increased functionality and quantity of products. Consecutively, Industry 2.0 introduced the mass production of standardized and interchangeable parts of products. Industry 3.0 then represented automated and digitized production, providing multiple iterations of products that meet various needs on the market. Industry 4.0, lastly, individualizes products for an ever-changing market using computer simulations and communication networks [6]. Technologies of Industry 4.0 cover augmented reality (AR), virtual reality (VR), digital three-dimensional (3-D) modeling and prototyping (e.g., additive manufacturing), robotics, and the Internet of Things (IoT), to name a few [2]. Among those, VR has become more important in education, especially for design disciplines, due to its affordability and accessibility [7, 8]. Remarkably, current literature shows that integrating VR into design education benefited students' creativity by reducing the cognitive load to process or improving the precision of their designs [9–12]. Therefore, design educators should focus on these technologies to prepare students for Industry 4.0.

Interestingly, empirical evidence on how Industry 4.0 technologies impacted creativity was partial. For example, Rojas et al. (2015) assessed the creativity of participants ($n = 38$) designing bottles in VR. They only found a significant increase ($p = .013$) in design newness (i.e., novelty), not in design function (i.e., resolution) and appearance (i.e., style) [13]. While comparing student designs in VR and the two-dimensional application window, Jin and Lee (2019) found a wide variety of ideas in the former but more efficient ideas in the latter [14]. In other words, Industry 4.0 seems to elevate certain aspects of creativity but not all. Similarly, the authors examined the creativity of students ($n = 13$) designing a custom luminaire in VR and showed improvements only in novelty ($p = .05$) and style ($p = .02$), each from one of two independent judges [15]. These results showed that only certain aspects of students' creativity increased with the use of VR, which led to a research question:

*"What might explain the partial impacts of VR on students' creativity?"*

The authors dissected this question using Video Data Analysis (VDA) [16] of student experiences with VR in the same nine-week luminaire design project. This article presented the VDA analysis results of a recording excerpt of student experiences and discussed lessons learned from integrating Industry 4.0 technologies, especially VR, to design education, with an example from an interior classroom. The authors collected and analyzed data with approval (H22142) from their University's Institutional Review Board (IRB).

## 2. Literature review

In this section, the authors presented a brief history of VR and prominent creativity measurements to set the stage for the methodological decisions of this study. Through the first subsection, the authors walked the audience through the current

state of VR applications in design education. In most cases, research showed VR as an effective pedagogical tool, which resulted in multiple positive learning outcomes (e.g., creativity). In the second subsection, the authors discussed different components of creativity and how to measure each in its entity. Together, these subsections justified the importance of VR in design education and emphasized the need to measure corresponding learning outcomes accurately. After all, creativity is a complex phenomenon that is hard to comprehend, especially in light of new technology such as VR.

### 2.1 Virtual reality

From the mid-1960s to the late-1980s, virtual reality (VR) flourished thanks to the rapid development in computer displays and related technologies [17]. Ivan Sutherland introduced the concept of VR in 1965 with the ambition to make a computer-generated simulation of the physical world that "looks real, sounds real, feels real," and "responds" to human interactions [18]. Said ambition formed four critical components of VR: (1) a virtual environment; (2) immersion; (3) sensory feedback; and (4) interactivity [19, 20]. A virtual environment refers to the representation of objects with shared attributes to their equivalences in the physical world. Immersion means the sense of presence or the like-real feeling of being in a virtual environment. Sensory feedback indicates the audiovisual and haptic perceptions relative to one's physical position in a virtual environment. Interactivity represents the ability to manipulate and interact with a virtual environment and objects within it. For those critical components to work, VR media and systems are needed. Media are the virtual worlds created with computer graphics. For example, Gravity Sketch (GS) is a digital modeling application to collaborate and develop 3-D objects in a virtual environment [21]. Systems are equipment that allows one to immerse, receive sensory feedback, and interact with VR media. Examples range from a single device, like the head-mounted display (HMD), to a whole room with complex virtual visualization systems. Ivan Sutherland and his colleagues at the University of Utah created the first HMD in 1970, which heralded advancements such as BOOM (i.e., a small box containing two monitors) in 1989 and CAVE Automatic Virtual Environment (i.e., a room with stereoscopic images projected on the walls) in 1992 [18, 19].

VR becomes more accessible via web browsers and head-mounted displays (HMD) or headsets in the form of 360-degree captured photos or computer-generated simulations of real-life environments, including physical characteristics of shapes, colors, lighting, and so on [22, 23]. There are "tethered" and "stand-alone" HMDs that refer to headsets that generate and visualize VR graphics with or without connecting to external processing units (or computers), respectively [8, 24]. "Stand-alone" HMDs, moreover, are attractive to science and design educators due to their user-friendliness and cost-effectiveness [25, 26]. Said growths, thus, make VR an integral part of employees' workflow and students' learning, in industry and academia [27]. Current literature in design education even showed that VR pedagogical applications improved students' comprehension of their designs' real-world manifestation and user experience. Lou [11] examined two graphic design courses ($n = 30$, each) using VR or presentation teaching approaches. With VR teaching, 77.7% of students mastered course content compared to presentation teaching, with 40% of students. Moreover, 83.3% of students increased in creativity and imagination with VR teaching. With presentation teaching, the number was 34%. In VR course, 73.3% reported better information retention. Only 45% of students said the same in the presentation course. Also, according to Obeid and Demirkan (2020), Gravity Sketch (a VR design

application) enhanced attention and confidence in interior design students ($n = 42, p = .0001, p = .045$, respectively).

### 2.2 Creativity measurement

Creativity is a complex phenomenon to operationalize and measure. Hence, the wealth of knowledge in creativity research presents multiple creativity concepts, leading to various measurements. According to Corazza et al. (2021), the core aspects of creativity are originality and effectiveness [28]. These two aspects, however, are context-embedded or have their meanings changed depending on the corresponding disciplines [28, 29]. Lu and Kaiser (2021), for instance, described creativity in mathematical problem-solving as fluency (i.e., number), flexibility (i.e., variety), and originality (i.e., newness) [30]. This perspective reflected the works of Torrance (1966) and Leikin (2013), with the aspect of effectiveness translated into the number and variety of solutions that are relevant to solve the problems [31, 32]. Creativity in design disciplines, however, features the combination of originality (i.e., newness) and effectiveness (i.e., function or the value of serving a specific purpose) [33, 34]. Current creativity research in design literature also introduces a third aspect: style (i.e., appearance, attractiveness, sentiment) [35, 36]. This third aspect contributes to the sentimental values that occur when observing a design and, thus, is highly relevant to creativity in design disciplines [36]. The authors of this chapter, thus, defined creativity in the interior design discipline through three aspects: originality, effectiveness, and style.

With this conceptual skeleton, the authors adopted the Creative Product Semantic Scale (CPSS) [35], which measures creativity through three components: (a) novelty or newness, (b) resolution or functional value, and (c) style or appearance. Under each component, there are three sub-components with multiple 7-Likert semantic scales. There are 55 semantic scales in total. A study using the CPSS to measure the creativity of three chairs with a Norwegian sample ($n = 128$) showed sufficient internal consistency between criteria in each dimension (.78 to .85) [37]. Exploratory factor analysis also showed that the three components accounted for 74.9%, 77%, and 79.3% variance in the creativity of the chairs, respectively. A subsequent study with an American sample ($n = 185$) displayed the same results. The internal consistency ranged from .69 to .86, and confirmatory factor analysis was high (.91 to .94) [38]. However, rating 55 semantic items are time-consuming [39]. Hence, multiple researchers adopted a simpler CPSS of 15 items with five semantic scales per component [40, 41]. Wei et al. (2015), for instance, used said 15-item CPSS to assess students' creativity in an interior design project and found a satisfactory internal consistency for items in each dimension ($\alpha > .72$) [40]. Interestingly, a study on VR and creativity used only two components of novelty and resolution from CPSS. These two components indicated an adequate internal consistency (.62) and explained 72.6% variance in the creativity of participants ($n = 81$) [10]. Overall, CPSS is a conceptual- and statistical-reliable measurement of creativity.

## 3. Method

This study extended a previous study [15] on the learning experience of interior design juniors ($n = 13$) creating a custom luminaire with VR at a southeastern

university. The purpose was to seek insights on the partial evidence of VR impacts on creativity from the said study. The custom luminaire project lasted 9 weeks and required students to design an original and functional light fixture with an operable lamp for indoor use. The course instructor (i.e., the first author) partnered with Gravity Sketch (GS) to gain students access to Co-Creation, a collaborative VR modeling application. As students had minimal experience with VR, Meta Quest 2 headsets were chosen to run GS Co-Creation due to their user-friendly and intuitive nature. Students hand sketched 10 ideas of the custom luminaire, then revised three viable options in Co-Creation, refined one best option in Computer-Aided Drawing (CAD) software packages, and 3-D printed it as a scale model (see **Figure 1**). Two internal facilities supported students with VR headsets and 3-D printers (including supplies). Using the 15-item version of CPSS [40], two judges independently rated 10 sketches, three revisions, and one best option for every student. Averages of (a) novelty, (b) resolution, and (c) style ratings from the two judges determined each student's creativity. Paired t-tests for CPSS averages between 10 sketches, three revisions, and one best option indicated improvements in novelty ($p = .05$) from the first judge's ratings and in style ($p = .02$) from the second judge's ratings [15].

The authors adopted the qualitative approach of using Video Data Analysis (VDA) to examine a half-an-hour excerpt of the recorded learning experience of a student in Co-Creation via the Meta Quest 2 headset. VDA is the science of interpreting human movements, views, spatial usage, interactions, glances and gestures, facial expressions, and body postures to understand their social behaviors [16]. Based on that premise, the authors hypothesized that how students navigated and designed in GS Co-Creation might explain the partial impact of VR on their creativity. However, the authors collected no facial or verbal information as participants wore VR headsets in a formal classroom. Only their head movements (as shown via their changing views in the virtual environment) and hand gestures (as demonstrated via their controllers and pulled-up menus) were available for analysis. With such data, the author focused on the two metrics of VDA: (a) interaction and (b) context [16, 42]. Interaction elucidated how students used basic commands, manipulated digital models, and navigated

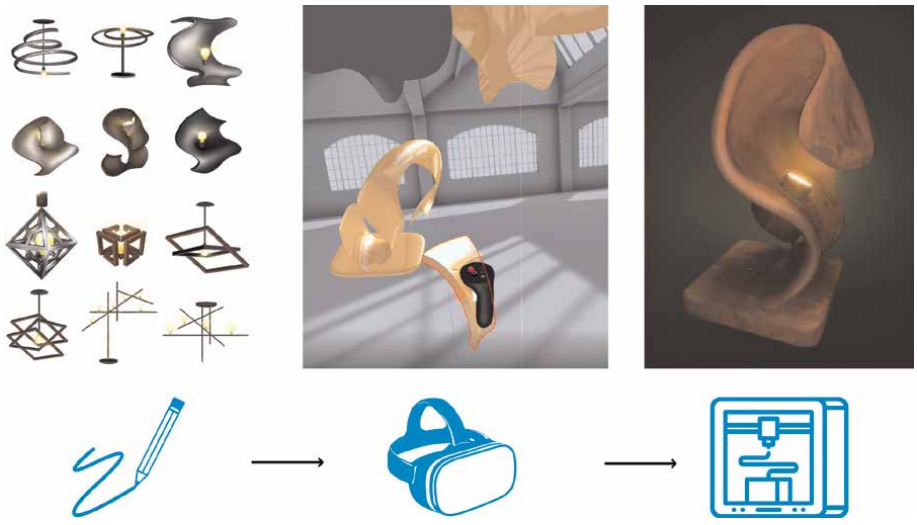

**Figure 1.**
*The design process in the nine-week custom luminaire project.*

GS Co-Creation's virtual environment. Context described the virtual environment's dimensions, such as space and lighting properties. The observation checklist for (a) interaction included which controller(s) the participant used, what menu/command the participant pulled up from the controller(s), what geometries the participant created with the controllers, where the participant stayed, and where they looked at in the virtual environment of GS Co-Creation. Regarding (b) context, the observation checklist contained the tangible elements such as the lower horizontal surface (i.e., floor), the vertical surfaces (i.e., walls), the upper horizontal surface (i.e., ceiling), and the intangible element of lighting in the GS Co-Creation virtual space. Also, the authors chose an excerpt from a participant who had minimal VR experience in the third week of the project. The authors expected to observe prominent details related to the VR learning curve as the participant was a new learner and only exposed to GS at this project stage.

## 4. Results

The authors used two metrics to analyze a half-hour recording excerpt of a student sketching in GS Co-Creation (during the third week of the project): (a) context and (b) interaction. **Figure 2** depicts the GS Co-Creation interface, which contains the shared virtual environment, two controllers with GS command buttons, 2-D reference photos, and 3-D models. At 00:19:00, the video went dark, indicating a problem with Wi-Fi casting. The video resumed at 00:21:33, demonstrating that the student knew how to use the headset, although slowly.

### 4.1 Context

Regarding (a) context, the shared virtual environment was a warehouse-style structure with rectangular windows on the walls and skylights on the roof. The surfaces were pale gray, including the floor, the walls, and the ceiling, which was an angled roof. No indications of a specific location were available since the windows only showed white surroundings. Although those features were static, the light intensity changed depending on where the student was moving in the environment. The command menus appeared as rectangular tabs with small icons showing the different modeling options, such as creating surfaces, strokes, primitive forms, and other functions (e.g., getting 2-D reference images, saving, and exporting sketches). For each modeling option, there are sub-commands to change colors, materials, and even reflections.

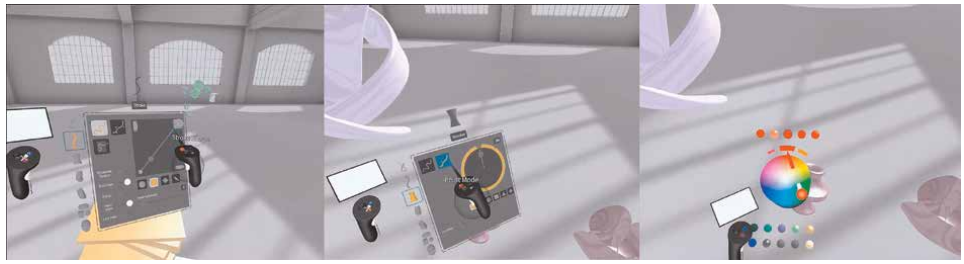

**Figure 2.**
*GS Co-Creation interface screenshots from the VDA excerpt.*

### 4.2 Interaction

In terms of (b) interaction, the student used the controllers to create and place geometric shapes (i.e., pink cubes) on top of each other. The student changed their position in the virtual environment and overlooked the composition of the pink cubes from above then started to delete all the pink cubes. Their classmates occupied the shared environment, creating different shapes in various colors as well. The student created a new shape, a white rectangular box bordered with a thin black line, moved on to the color wheel command (see **Figure 2**), and selected several colors (first pink, then a light yellow). The student looked around (as if investigating the environment), reselected a darker shade of light yellow, and used the controllers to create a square column. Looking over the column, they placed another rectangular geometry on top of the column. Said process was repeated by reselecting the color and browsing the color wheel. The student created additional forms in orange for the column but then deleted them all.

They then restarted by creating three orange rectangular shapes and laid them on top of a light-yellow column. After that, the student continued adding another rectangular shape at a 90° angle to the pile of columns and constructed two rectangular shapes on top. They moved to another corner of the room and created four more rectangular shapes stacked on top of each other. The student then made up-and-down gestures with the controller but did not create other shapes with these movements. Instead, they opened the menu toolbox. After selecting the stroke tool, the student drew two parallel yellow-colored strokes independently above the earlier created geometric shapes. Erasing these strokes, they created a curved line with the right controller moving to the left, creating a curved line. The student once again erased those stroke lines, then drew their name with the strokes yet deleted them completely again. The stroke drawing continued as the student formed multiple arches over the top of the stacked rectangular shapes. As the student moved around, they hovered the right controller across the geometric shapes, which made them turn red (i.e., indicating the ability to select object using the controller).

The student opened the menu again and activated the primitive object tool. During the next minutes, they repeated creating and erasing the geometric objects. Afterward, the student drew several spirals on both sides of the stacked rectangular shapes from top to the bottom, but then again erased them. Next, they drew a circle followed by nonspecific circular lines to form a structure on top of the stacked rectangular shapes. The student then used both controllers to grab and bring the group of geometric shapes closer to their view. They looked up to the ceiling and down to the floor of the environment, activated the menu, and selected paint color tool. The paint color tool offered multiple options in tone, shade, and reflectivity. The student made multiple selections over again. They also moved the controller back and forth to assign such options of tone, shade, and reflectivity to the surrounding geometric shapes. After that, the student turned 360° and opened the menu again to continue modeling with the revolve tool. They started with a moderate thickness and the star profile, then assigned a reflective material to the newly created shape. While making a variety of star-like shapes with this tool, the student also stretched and distorted those into different angles. They also spent time playing with different variations of the star-like shapes and continuously changed their choices of tone, shade, and reflectivity.

After a while, the student activated the stroke menu and selected a color by pulling and pushing the color wheel to choose a blush color. They also pick a material for the stroke by pointing to the reflectivity options below the color wheel. The student started creating undefined circular shapes with the stroke tool in rapid movements. After

**Figure 3.**
*Examples of VR sketches in GS Co-Creation from the VDA excerpt.*

completing the sketch (see **Figure 3**), the student teleported around it and appeared to be thinking about revisions with their controllers hovering over the sketch several times. The student again decided to delete the sketched strokes and then opened the menu again to select the primitive object tool. They started with a cube in light yellow and enlarged the object by pulling both controllers apart. The student added two additional cubes and then erased them all. Repeating with another cube, the student placed two more cubes on top of each other. They kept going back and forth to the menu with the primitive object tool to create more cubes one on top of another. The student then pulled one of the cubes to another direction and changed its height, width, and depth.

The student created a new column next to the four cubes and kept placing additional cubes and rectangular shapes on the column and deleted all of them together. Next, the student explored the surface tool on the menu with the bridge curve option. A curve appeared between the controllers, which got bigger and smaller as the student moved the controller toward or pulled them away from one another. The student then paused for a moment and activated the revolve tool again with a six-sided shape. They first drew a flat hexagon border, moved the form with both controllers around the four cubes, and changed its size. While this tool was still activated, the student erased the smallest cube on the top and moved the hexagon shape to the left side of the pilled cubes. They also pulled the form in different directions and changed its size, trying to make it more prominent. These movements created several tower-like structures (see **Figure 3**). During these creations, the student moved back and forth, closer and away from the sketches. Suddenly the student looked up to the ceiling of the environment and shortly to the floor. Then the screen turned black.

After about 2:30 minutes, the student came back to the environment looking at the sketches created earlier, still having the hexagon tool activated. The student was now inside a hexagon ring, pulling it toward different directions. They then drew another smaller hexagon shape inside the hexagon ring and deleted the giant hexagon ring and tower-like structures. The student activated the hexagon tool and flipped the left controller back and forth to change the axes of the hexagons (see **Figure 3**). After a while, the student erased all other cubes while keeping the hexagons. After changing its size several times, the student activated the color wheel again and made the hexagons light blue. The student continued to experiment with its height and the excerpt ended with the student finishing the hexagons in the virtual environment.

## 5. Discussion

Based on the VDA analysis of the excerpt from the learning experience designing with VR in a nine-week custom luminaire design, the authors noticed two prominent

observations. First, the student displayed proficiency in using Co-Creation, yet focusing on a limited number of tools. Second, the student constantly drew and then deleted the sketches. The excerpt was recorded in the third week when students transferred their three most potential 2-D sketches into GS Co-Creation to develop 3-D models. As a result, both observations were legit and shed some light on the partial impact of VR on student creativity. The first observation indicated that the student could navigate the virtual environment and retrieve and use the menu tools of GS Co-Creation. During the whole excerpt, the student was fluent in both controllers, creating, moving, or scaling geometric shapes. Nevertheless, the student limited the variety of geometric shapes to cubes, strokes, and multi-side profiles (i.e., hexagons and stars). These shapes are primitive or revolved (i.e., a profile moving along a central axis), showcasing an articulate yet fundamental VR modeling skill. This is comprehensible. In the third week, students had just completed the VR onboarding process through tutorial videos on GS's official YouTube channel. The student's comfort level, as shown in the excerpt, revealed a smooth learning curve or at least the intuitiveness of GS Co-Creation and Meta Quest 2 headset. As all the sketches were undefined structures (i.e., piles of geometric shapes), the authors speculated that the student had yet to develop the three revisions of their custom luminaire. In other words, the student was still exploring VR technology (i.e., GS Co-Creation and Meta Quest 2 headset).

The second observation confirmed the authors' speculation as the student kept creating and deleting their sketches. While stacking the geometric shapes on top of each other, they used different options each time (e.g., cubes, stars). The act of stacking designated a consistent theme in the student's creation, despite no defined form of a custom luminaire shown in the excerpt. While no hand sketches were brought into the virtual environment, their top choices among the 10 hand sketches indicated the same theme of stacked/piled geometric shapes (see **Figure 4**). In the third week of the project, there was still room for exploration as the student was in the early stage of the design process (i.e., developing three revisions of the custom luminaire from the 10 preliminary hand sketches). The student even tried the hexagon and star shapes to diversify the theme of stacking/piling. Another notable point was that the student showed a high level of concentration on their sketches. Except for a few times looking around the virtual environment, these students fixed their view on the sketches and dedicated themselves to trying different tools, colors, and shapes. At least for this student in the current excerpt, designing with VR in GS Co-Creation was attainable and enjoyable, as shown in their level of (fundamental) competency and

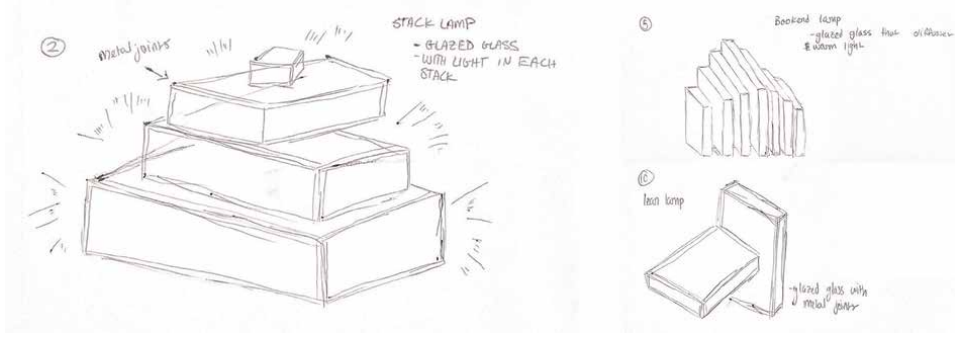


**Figure 4.**
*Three choices of hand sketches from the student in the VDA excerpt.*

persistency (i.e., the cycle of creating and deleting). The completion of their sketches, however, did not reflect the functional aspect of a luminaire. Again, this excerpt was from the third week and was not representative of the outcomes of this project.

## 6. Conclusion

The educational contribution of this study is two-fold. First, GS Co-Creation and Meta Quest 2 headsets were intuitive enough for a smooth learning curve in fundamental skills. Second, the student's tendency to prolong the exploration (of shapes, sizes, colors, and materials) was evident in this excerpt. The first contribution aims at educators and institutions wishing to include VR in their curricula. While VR and related technologies have become affordable [25, 26], the authors suggested the adoption of GS Co-Creation and Meta Quest 2 headsets for design education. As shown in the excerpt, despite having minimal VR experience and practicing GS for the first time in week three, the student participant could control the application and headset to create geometries. This observation resonates with the VR literature in Section 2, which indicated that specific technologies of VR were accessible and beneficial to learning, such as HMDs (e.g., Meta Quest 2) and GS. VR researchers also praised Meta Quest 2's balance between accuracy and affordability [43, 44]. The second contribution, however, is a reminder to educators and institutions that, despite being intuitive, VR technology still requires time and practice to attain advanced skills. The fact that the student participant could only use primitive or symmetrical geometries might restrict their ability to construct complex and detailed VR models for their custom luminaire. In other words, their works had limited demonstrations of the novel, resolution, and style aspects. Educators and institutions must ensure that students have ample time and access to applications and headsets to explore and develop their ideas when integrating VR into the curriculum. While VR technology allows students to create, erase rapidly, and recreate sketches, giving more room for creativity, time, and expertise might play again for the student to fully execute their VR models. Henceforth, the time constraints to practice and increase expertise might lead to partial learning outcomes, such as elevating some but not all aspects of creativity [15].

As the course instructor, the first author also made the improvements below in the custom luminaire design project in fall of 2022. Fellow educators who wish to apply VR to their teaching can consider such improvements as starting points for their classrooms.

A. GS Co-Creation and Meta Quest 2 headsets are still the choice of VR technology for students due to their smooth learning curve and intuitiveness. The first author/instructor provided a teaching assistant (TA) for students to accelerate their learning speed instead of the tutorial videos from GS's official YouTube channel. Co-Creation allows up to 10 students to work simultaneously, so the TA tutored a group of five students in the virtual environment. Students practiced with the TA step-by-step and asked specific questions for their VR models. The first author/instructor, thus, expects to see a clear improvement in student ability to demonstrate all the novel, resolution, and style aspects and, subsequently, significant statistical evidence for the positive impact of VR on creativity.

B. The tendency to prolong exploration in GS Co-Creation led to the adjustment in the project timeline. The first author/instructor added two extra weeks for students to explore and revise their sketches in VR. While this approach

increased the overall project time, it allowed students to build and revise complex idea representations, which were better for novel, resolution, and style assessments.

These improvements can also serve as references for design educators who wish to incorporate VR technology into their pedagogies to enhance student creativity.

One limitation of the VDA analysis in this study is that the authors only examined one student at a specific stage of their design process. Hence, the two observations in the discussion above are not generalizable for the whole sample ($n = 13$). While the authors have more recordings to dissect, VDA is a time-and effort-intensive method that requires an extended timeline for further analysis. In the scope of this chapter, the authors only presented a snapshot of the VR learning experience of interior design students in a nine-week custom luminaire design project through a typical excerpt among the recordings. For future research, the authors aim to analyze more recording excerpts from multiple students during the third and fifth weeks of the project. This extensive analysis will show whether the two observations in this chapter withstand different students.

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## Conflict of interest

The authors declare no conflict of interest.

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Chapter 4

# Holistic Thinking in the Implementation of Digital Learning Activities, with Due Regard to Implementation of a Learning Management System and Digital Learning Course: A Field Report

*Kai Karin Baum*

**Abstract**

Digital learning (DL) has enjoyed a huge amount of hype over the past two years. This is especially the case among businesses which just 5 years ago were convinced that DL could never replace in-person training. Looking back at the developments of the past years in the area of learning, the rollout of DL among companies, including the IT infrastructure that goes with it, has not always been without its issues. For this and other reasons, efforts are currently underway to rethink and revise the DL decisions of the last few years. Yet if there is so much to rethink, why not think holistically from the outset? In this respect, we might compare DL within an organization to the circulatory system in the human body: It reaches all areas of the organizations, supplying employees with important knowledge that is necessary for the survival of the organization. The present moment offers an opportunity to rethink what has been achieved so far. In order to ensure the success of this holistic redesign, this paper describes 7 steps for developing a DL approach, with tips from fieldwork which also cover the different areas of a company, such as learning strategy, roles and responsibilities.

**Keywords:** digital learning, learning management system (LMS), training strategy, implementation, human resources

## 1. Introduction

The world has been altered dramatically in recent years by events like the coronavirus pandemic. In many countries, working from home is now the rule, not the exception, and many companies frequently conduct a good deal of their business digitally, such as having online meetings. Yet it is in the area of learning where this shift and transition to a digital world has become particularly conspicuous. In light

of the situation outlined above that little to no in-person teaching could be offered during the pandemic; for example, we have seen a creeping transition towards DL. According to Koch et al. [1] digital learning means learning conducted in an environment that uses a learner-centric design and tools to support learners and teachers and that should be designed in such a way that active learning strategies can be applied and are supported by software tools (e.g. learning programs, open education resources, platforms or other technology-based systems) in order to improve teaching and measure learning through certificates (in [1]). In countries like Germany, this development was not one that could have been predicted, the reason being that while DL concepts have been around since the 60s, most notably in the work of Skinner and his work on a teaching arrangement for learning machines from 1958, a unique feature of which was a feedback process used for positive reinforcement in operant conditioning (1958 after [2], p. 18), only a few companies ever implemented this concept. There are many varied reasons why this concept was never introduced. In addition to the financial aspect of investing money in software and technical personnel, there was a failure to recognize both the point of DL and its associated benefits, such as the ability to learn anywhere, any time, and also the various opportunities to save money that DL offers, such as saving on the cost of renting spaces for trainings.

Now, 2 years after the start of the pandemic, most companies have introduced DL and used the associated hype around the subject to good effect. However, if we are being honest, these companies did not in fact have a choice and were practically forced into this move by the pandemic. But that does not mean that those responsible for introducing and implementing DL acted wisely (in some cases due to ignorance). One of the consequences of this is that employees rarely, if ever, take advantage of DL offers, while in many cases there are no reasonable offers available and it is hard to identify any structure or a set development path for each individual with respect to their learning.

As a way of preventing these mistakes from happening again, and so that they can also be corrected after the fact, we can apply a 7-step model, like shown in **Figure 1**, for developing and implementing digital learning concepts that has been tried and tested in the field:

It should be noted that an LMS can or indeed must also be implemented whenever introducing or correcting a DL strategy, depending on whether companies have

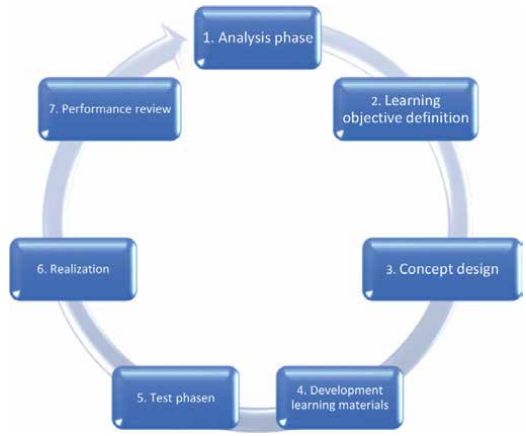


**Figure 1.**
*7-step model for developing and implementing digital learning, [3].*

already rolled out a professional LMS or have opted to introduce a new or perhaps different system in retrospect.

For this reason, implementation of an LMS is also mentioned tangentially here and there in the following 7-step model.

## 2. The 7-step model for developing and implementing digital learning

The basis of the 7-stage model that follows here is based on different quality management processes from education, such as the Excellence Model of the European Foundation for Quality Management (EFQM) with the 5 enabler criteria (leadership, employees, policy and strategy, partnerships and resources and processes) and four result criteria (results employees, results customers, results society and key results) ([4], p. 42–46) as well as from the simple management process (TQM) from the field of business administration with the phases planning, steering and control ([5], p. 83–84). Both models are very theoretical and extensive, which is why both have been compressed into a simple 7-step model for practical use. This way it can be applied and used in practice. Like the two basic models, the 7-step model for the development and implementation of a DL strategy can act not only as a one-off support, but is to be understood as a cycle that can and must be repeated at regular intervals. The 7-step model for developing and implementing a digital DL strategy can offer more than just one-off support. It should also be understood as a cycle that can, and indeed must, be repeated at regular intervals. This is similar to the typical ideal of the well-known management cycle.

However, what is key to bear in mind at the start of the first cycle is that the initial analysis phase is hugely important and also takes time. For this reason, this paper will focus largely on this phase. The more information there is for subsequent planning and designing, the better the later steps can be prepared, including purchases and so on, and the better the concept and documents can be developed in the following stages. Out-of-the-box thinking is a must here, and we should bring together as many of the stakeholders involved as possible.

We also should not forget that it is a good idea to conduct a monitoring phase at each individual stage so that any adjustments and, in particular, updates can be integrated at an early stage.

We will begin, however, by taking a closer look at the crucial and comprehensive analysis phase.

### 2.1 Analysis phase

While it is actually no longer necessary per se to describe an analysis phase within the context of implementing a digital learning strategy and when implementing an LMS, we should be aware of the purpose of such a phase. According to Lachenmaier [6], the purpose of an analysis phase is "to dive to the very bottom of an issue, to sound out its opportunities and identify the client's requirements, and ultimately to use this information to create a stable model of analysis. [...]" [6]. Even where a DL strategy is to be implemented within a company in the holistic sense, the aim is to fully explore all opportunities so that we end up with a suitable DL model. This phase should be planned and worked on intensively, if for no other reason than to have as much information as possible and as many contact partners

on board as possible, and correct contacts at that. In order not to overlook any aspect of this important phase, the following section looks at individual steps and offers practical tips.

*2.1.1. Training strategy*

Traditionally, the pillars for developing a training strategy comprise, on the one hand, the classic analyses regarding need for training, target group(s) and competition (see below) and the internal resources and on the other the training or learning goals. These days, however, matters are complicated by the fact that the internal resources a company has at its disposal have a greater impact on the future training strategy than was previously the case as they no longer have sufficient time to prepare in-house trainings (due to the prevailing skills shortage), or because only the bare minimum of time can be dedicated to managing the training process, even with an LMS. We must also remember that the implementation and associated go-live of a new training strategy (and the situation is even more volatile when going live with a new LMS) often come with a change in the previous learning culture which should be understood "as the totality of learning and development potential that arises from the cooperation of members in interaction and communication processes [...]" ([7], p. 4), and therefore this should be accompanied by professional change management and communication as a matter of urgency. After all, one aspect that we must bear in mind is that HR decisions made in relation to a training strategy always have an impact on ALL areas of the business, and hence, it is advisable to also have a holistic training strategy.

Definition of the training needs analysis: Even today, the training needs analysis is still conducted with regard to employee wishes based on concrete events, interviews, employee surveys or even employee discussions (Source: p. 99, Strategische Personalentwicklung in der Praxis – Instrumente, Erfolgsmodelle, Praxisbeispiele [Strategic HR Development in Practice—Tools, Models for Success, Practical Examples], 3rd ed., Christine Wegerich, Springer-Verlag Berlin Heidelberg 2015). It must be noted here that surveys, specifically, or the expressing of wishes, can also be conducted using a technology solution, such as an LMS.

Definition of the target group analysis: According to Baum ([8], p. 243), a target group analysis is a meaningful description of the group of persons who constitute the primary training group and on which all possible data is collected.

Definition of the competition analysis: The competition analysis, also known as benchmarking, is defined by Mühlstein and Schumann ([9], p. 6) as a "continuous process, in which both products and services, and in particular processes and methods of operational functions are compared across multiple businesses".

TIP:

At the start of a development project for a (new) holistic DL strategy, with or without implementation of an LMS, it is advisable to bring all peripheral departments, and persons, together at a kick-off meeting. One of the major challenges at the beginning is clarifying the different wishes and requirements regarding the new strategy (and system, where applicable), which often also throws up the question of what resources and skills are still available among the current workforce, and considerations must be made regarding configuration and/or procuring external skills and resources from outside. This is often complicated by the fact that within the internal departments there exist different definitions of terms like "E-learning" or "digital learning", while in some cases internal company terms have been defined and need

to be clarified accordingly. It is vital that everyone involved is "speaking the same language" in order to guarantee consistent understanding for quick progress on the project.

### *2.1.2 Value creation model*

When it comes to learning, value creation can be demonstrated, and also recorded, using a number of different KPIs (KPIs are key performance indicators relating to the success, performance or outreach of a business, its individual organizational entities or a machine [10]). According to Wegerich [11], classic KPIs include "Average number of days annual leave taken by employees, Average number of days annual leave taken by senior executives and senior management, Average number of days annual leave taken by employees over 50 years of age, Implementation rate after workshops, or Optimization rate after coaching sessions" ([11], p. 107). The KPIs that are actually implemented in practice differ from company to company.

However, it goes without saying that all online and blended-learning courses can be included in the KPI model, allowing us to break down the model into face-to-face, online and hybrid. The reason why this has to be mentioned at this point specifically is that the cost breakdown is significantly different in this case compared to times when the focus was solely on face-to-face events. It is no wonder, therefore, that often the number of trainings has increased dramatically, but the costs for trainers are lower.

TIP:

At most companies, all employees have to pass mandatory trainings in the form of compliance trainings. As the name suggests, these trainings are mandatory, and so it might make sense to break down the KPIs into mandatory and optional trainings. The reason behind this is that this makes it easier to list the costs incurred according to their purpose. Investigations mostly ask about the expenditure spent on optional trainings, not mandatory trainings, and query the costs associated with such.

A small example of a KPI table is shown in **Table 1**.

| KPI | Detail 1 | Detail 2 | Who/Where/What |
|---|---|---|---|
| Number of trainings | Mandatory | Optional | Per year |
| | | | Per division/department/team |
| | | | Per employee |
| Average duration of trainings | Mandatory | Optional | Per employee |
| | | | Per division/department/team |
| Training costs | Mandatory | Optional | Per year |
| | | | Per employee Per division/department/team |
| Special trainings (IT) | Mandatory | Optional | Reduction of tickets |
| | | | Reduction of the error rate |

**Table 1.**
*Practical example for KOIs in learning, [3].*

In the case of a new product, such as implementation of a blended-learning course developed in-house or externally, different areas need to be taken into account and structured from a financial point of view: the technology (e.g. an LMS), the content (e.g. creating scripts and exercises and creating specific areas of responsibility internally), sales (e.g. training sales employees) and marketing (e.g. creating a communication plan).

Let us take a closer look at developing internal trainings in-house: many companies still have most of their training documents from pre-pandemic times in the form of slide decks or internal videos. These must be conceived and modified in a holistic concept before they can be integrated into a new DL strategy. It seems banal, but it must be reiterated that there are key differences between, say, face-to-face and online trainings, especially with respect to the existing training documents. Let us briefly put ourselves in the learners' shoes. In a face-to-face session, learners can ask the trainer questions immediately which the trainer can then answer. While it is possible to ask questions on an online course regarding a subject and the accompanying documents, it can take some time for the trainer to respond. In order not to unnecessarily delay the learning process, questions should always be pre-empted before they arise. This means that the content of the course script and its didactic approach must be formatted in such a way that it provides a depth of content that is appropriate for the target group and at the same time does not allow for questions as far as possible.

Tip:

If you have developed an online course in-house, make sure you always take advantage of other tools and aids, such as a glossary, FAQs or additional and accompanying media, such as explanatory videos. In order to ease the anxieties of inexperienced/anxious learners regarding a new system such as the LMS, it has been shown that designating a concrete point of contact in case of questions can be helpful, as can a forum for dialog where the group can work on problems and solve them together. There are a lot more possibilities which vary from LMS to LMS. Use them without fail!

Past experiences have shown that there is only something to be gained from revising and restructuring old face-to-face materials. In terms of the quality of the documents and the course concept, it has proven to be a clear success, especially for participants who can compare and contrast both course formats.

However, as is customary in a holistic analysis, let us take a step away from the area of training. After all, alongside optimizing the content we need to also start work on developing a communication strategy for the new DL strategy. While many companies have communication departments, most of which have previously overseen other rollouts, other companies have to find new paths here and entrust this job to employees who are perhaps not as experienced in the area. Some readers must be shaking their heads now and wondering why we need to take that into account? Well, good communication that is prepared well ahead of time and anticipates potential issues, and that was also promoted using internal findings from marketing, can provide positive support. While a major change process may not be clear at first glance, this is indeed the case in practice. A named communication strategy can be hugely beneficial in making this change as smooth and pleasant as possible.

Discussion: Offering internal company trainings/courses for external learners.

If a company has considered the possibility of offering its own trainings to external learners as well, then the basis for strategizing must be good communication between the different groups of people involved (e.g. IT, IT security, personnel development, HR, Marketing, etc.) which should be supported by regular fixed dates. When offering in-house trainings externally as "products", advertising measures should focus on marketing as well as developing the course. For example, the first job for the marketing team should be to conduct a competition analysis in order to gain an overview of the market. Alongside this, the personnel development/HR team needs to define the target group for each training product and then derive next steps from this. Points such as the name of the course or the marketing presence on different communication channels (not necessarily in that order) should be discussed at length, and social media strategies and additional advertising materials should be determined.

Tip:

Another aspect of expanding services to external learners is the fact that in larger organizations the rule is that contractors (i.e. external employees) should be engaged here. These, too, will usually have to complete the relevant compliance trainings. However, what is particular about this is that most of the time they do not have access to the same system. Therefore, you should consider developing a special strategy for external employees from the very outset. The time and effort that goes into implementing this later is enormous and can be prevented by proactively taking it into consideration.

### *2.1.3 Skills, staff, roles and responsibilities*

The success of a digital learning strategy implemented holistically essentially depends on whether the skills required can be covered by current employees. The issue of new hires and/or procuring external skills and capabilities to supplement those of existing employees has already been discussed above under Section 2.1.1. In the event that the preceding analysis indicates that staff with certain skills are required, then the HR department and/or personnel development department should be engaged as a matter of urgency. The lead times for recruiting new staff (e.g. advertising positions or acquiring new hires) are extensive, which could have a significantly negative impact on the progress of the implementation process in the event of delays in the hiring process. They must therefore be involved in the project in good time.

The roles and responsibilities of the persons involved will change significantly if their company is one that has previously only offered face-to-face sessions since the changes involved in transitioning to a digital learning strategy will be enormous for these organizations. In this case, each individual employee must be aware that the implementation of such a learning strategy will have an impact on the entire business and thus also on all employees. The same is true with regard to the introduction of a new or different LMS. Here, too, roles and responsibilities within day-to-day business frequently change.

Usually, companies are unable to hire new employees during implementation of a DL strategy for cost reasons and instead have to use pre-existing resources, as a result of which these employees require intensive and comprehensive trainings. These trainings can be conducted digitally and adapted to a new DL course format, for example, both technologically and with respect to methodology. At this juncture, it is vital to once again highlight how a digital format differs significantly from a purely face-to-face format since the former uses various technical media (e.g. videos

and learning packages), with these media and thus also the learning documents usually being made available on an LMS. We must also remember to train teachers/trainers in the new software system via train-the-trainer trainings. It may additionally be necessary for teachers/trainers to encounter not just an LMS in a digital learning strategy, but also other software, such as software for webinars and author tools. These must also be taken into account in the train-the-trainer concept as a matter of urgency.

Tip:

Practice has shown that with technical trainings, it is necessary to make clear that these must never be conducted as purely theoretical trainings. A blended-learning format is advisable here. The participants must have sufficient opportunity to also practice what they have learned in a safe space. The more intensive the trainings were, the more confident teachers/trainers were in using the new software. Following the trainings, teachers were also able to maintain their courses themselves, adding new content and providing adequate support to participants. The skills acquired have also been very much evident in the feedback provided by participants, in that the teachers were mostly described as "very capable", "outstanding support" or even "best teacher ever".

However, with a new DL strategy the most obvious change is in the role of teachers who have previously taught face-to-face. Before an online course was introduced, the teachers and their responsibilities were focused on preparing, conducting and following up on purely face-to-face sessions. They had years of experience here. In their new role as courses leaders for a blended-learning course, for example, they need to acquire new skills and capabilities for managing courses online and working with new media (e.g. running a course on an LMS or using media correctly for a webinar).

The online management aspect should be highlighted here. It cannot be underestimated and must be communicated to the teachers clearly. 24/7 availability must be arranged and carried over into daily business. As a result of this availability, consultations "one after the other" during the in-person lesson are shifted to multiple smaller sequences via email. Initially, it would appear that this requires significantly greater effort but upon further inspection this is not the case. That is not to say, of course, that the communication system does not need to be structured.

#### *2.1.3.1 Organizational structure*

A new DL strategy must be integrated into an existing organizational structure. The advantage of modern businesses is that they mostly have an existing, flexible structure that has been tried and tested. Here, a flexible structure is understood such that employees are not bound to fixed organizational structures or roles, such as a straight line organizational system or static matrix structure. Ionescu [12] defines a flexible organization as: "A flexible organization initiates and develops periodically strategic changes. Organizational change corresponds to a new orientation, fundamental and radical, concerning manners of business conduct, having essential implications on all its members' behaviour. Launching a process of change supposes acknowledgment of change need, manifesting wish of change, gathering knowledge, as well as forming abilities to implement change. Flexible organization, change oriented is, by excellence, a learning organization" ([12], p. 283). The core of a flexible organization is thus the willingness to change, such that it is possible for the employees of such an organization to take on multiple roles within the company. However,

this does not mean that the structures do not need to be properly established. Quite the opposite. The structures must be described in detail and communicated clearly and also adapted quickly and easily where necessary. Company visions, missions, values and norms, as well as a good ability to adapt the flexible areas mentioned, also play a major role in this regard.

Embedding a new DL strategy in a flexible organizational structure often proved unproblematic. However, this requires that all affected employees are integrated into the transformation process, as was recommended under Section 2.1.1 above. In this regard, it is necessary to once more highlight the aspect of communication within the organization. Transparent communication between all interfaces is not just advisable, it is a "MUST".

Tip:

As already discussed, that learning in a digital learning concept will change significantly in the event of simultaneous implementation of an LMS cannot be overlooked here either. Previously, it was often stipulated for learners what they were expected to learn by when. With an LMS, the learner must organize and manage their learning themselves, which represents a major change. Therefore, a team from communication and change management should be engaged here through appropriate measures and the change process supervised.

### *2.1.4 Supporting systems*

When a new learning strategy, and in particular a DL strategy, is implemented at a company which previously had only conducted purely face-to-face sessions, new technologies must be embedded in the old IT infrastructure, in addition to the new strategy. This affects the entire company, not just individual sections as is usually the case when implementing software.

A learning management system (LMS) is the foundation of a DL IT strategy. Roughly speaking, when it comes to LMS, we should differentiate between open-source and paid-for, licensed software. The range of offers available in this regard is enormous and hard to wade through. It is therefore evident that the selection process itself will take up a lot of time. In addition to functionality, the focus is often also on finances, meaning that particular attention is paid to license costs. Costs for connecting the LMS to the previous HR system via interfaces should not be overlooked either.

Tip:

At larger companies, in particular, it is not usually the HR department that makes decisions on software purchases. This is the job of either purchasing or IT. However, in order that the software ultimately also suits the new DL strategy, all departments should come together in good time and reach a decision together on WHICH system to purchase. After all, HR staff will ultimately have to work with the software and also offer it to colleagues internally and motivate them to use the system. These employees are easier to motivate when the HR employees involved in the process can also vouch for the system.

In addition to an LMS, there is lots of other helpful software that can be used alongside a DL strategy (e.g. author tools, video tools etc.). Here, we must think about whether we are planning to develop courses ourselves in the near future or to purchase content. Both options have their pros and cons.

Let us take a quick look at developing content in-house: In each organization, there is knowledge that is used only in this organization specifically. Today, it is more important than ever to also pinpoint and retain this knowledge. However, simply recording and saving this is usually not enough. Therefore, this content must also be prepared

in a consumer-friendly way. This means, for example, that content must be ordered logically or formulated for each target group specifically. This can be achieved using so-called author tools, such as Articulate Rise or Easy Generator, as well as tools intended solely for producing teaching/learning videos. The market for these tools is also extensive, and purchases depend on what future intentions are. However, it is important that the employees who use these tools are also given sufficient training. Purchasing software and letting the rest of it take care of itself is not sufficient! A major advantage of this "Make" strategy is that there is a lower risk regarding data privacy.

This is not the case with a "Buy" strategy involving the purchase of external content. Technologically speaking, professional companies can certainly prepare special content better than a layperson in the HR department. However, not all of these companies have their servers in Germany, for example. And this is a major problem as many companies have a strict privacy policy (and rightly so!).

Tip:

In recent years, many companies have also relied on an international server strategy, which makes sense in many respects. However, it does not make sense with respect to learning since this is an area where lots of personal data is exchanged, which is exactly what makes it attractive to external attackers. Therefore, when purchasing external content, we must pay close attention to where the provider has their server. For this reason, the data protection officer must be brought along to the negotiating table. At the same time, we must consider and pay attention to how this external content reaches the LMS. Will you receive Scorm files (special files for E-learnings) or is there an option of jumping to the provider's page? Here, too, it will be important how data such as test results are presented, and how these end up in the in-house system.

When purchasing external content, we must also make sure that academic content is prepared individually for a specific target group. Not all content can be equally consumed by all users. Let us look at an example: Perceptual speed decreases with age. This speed slowly declines, starting at the age of just 20 ([13], p. 707). It is quite easy to spot that children using a computer can click the mouse faster or scroll up and down quicker than adults. This must absolutely be taken into account when creating teaching videos. A video that contains too many and too rapid changes may not be taken in by an adult. This can lead to frustration and even rejection.

It may also be necessary to consider which software can be used for webinars. The market for these tools has grown significantly too, and the offers available are hard to wade through. Decisions should be based on factors such as costs and usability for employees and participants, but also stability. Participants will not put up with interruptions caused by technical difficulties. In addition, technical support should be available (where possible) for teachers and participants free of charge.

### *2.1.5 Controlling and governance*

Generally speaking, the job of a company's controlling department is to manage and regulate set processes. The processes mentioned also include reviewing these processes according to KPIs (see 2.1.2 Value creation model) and fixed reports. This is based on using these KPIs to determine whether the strategies and measures set out are in fact having their desired impact and whether they actually make sense.

Within the context of developing individual DL trainings, this area is only marginally affected. In this regard, it may be necessary to highlight fee calculations or invoicing, cancelation and payment processes, insofar as these trainings are also offered and

sold externally. Sometimes, however, the management also wants to know the costs for developing these courses.

When calculating trainings (which also includes webinars), in particular, we must bear in mind that the costs for the software and for preparing the webinar content will be lower the more often the webinar or training is conducted with the same teachers and software. Preparing the teacher's content as a one-off and making temporary updates will reduce costs from just the second webinar. The software costs (mostly license costs) will decrease the more often the software is used.

A further area relevant for controlling, which is affected by training management, is the invoicing, cancelation and payment process. At companies which purchase external trainings, these processes are mostly already present and should be reviewed at least once a year. Failing this, the price of the external course (and/or teacher) will have to be renegotiated. NB: If purchasing a purely online course solely via the Internet, we must bear in mind the 14-day returns policy for Internet purchases.

The situation is different when implementing an LMS, as opposed to developing individual courses. In each LMS, there is the ability to create reports. In some LMS systems, this comes preconfigured, while in others, it can be adapted individually. However, all this reporting relies on the management and evaluation of personal data. For this reason, this is a highly sensitive area and must be handled using predefined company rules appropriate for regulations on privacy and data protection.

Tip:

If your company has not yet defined a role for reporting, you should do this no later than when implementing an LMS with a reporting function. Make sure that external employees (such as external consultants through intermediaries) do not have access to this! You should also remember that access should be limited for internal employees as should their rights for the LMS. That is, where possible a minimum of just two employees should have access to this. The processes for reporting should be captured and defined here too. This also includes the processes for passing on personal data in the context of trainings within the organization.

No less important is the area of governance which is mostly accompanied by a document containing all the specifications for the learning documents to be created (including in what format, what font, what font size, colours etc.), and the role concept, i.e. which employee has which role in the LMS. Within IT, the latter usually takes the form of a workbook. This workbook sets out all the LMS specifications. This is particularly important in the event of problems with the system. It allows errors to be identified faster.

Having covered controlling and governance, the theoretical part of the analysis phase is complete. However, practice shows that now all areas intersect in parallel and that often one or the other has to be redefined or re-implemented. It is almost impossible to work with all of these areas one after the other as these processes mostly overlap with others. Here too, good and transparent communication between all parties involved is fundamental and makes a logical contribution to success.

This approach is also advisable with respect to the following processes, such as defining learning objectives, developing a concept, developing learning materials, test phases, execution, and monitoring, albeit these areas do not take up as much space in the implementation as the analysis phase. It is, however, subsequently of huge importance. Each individual issue could have its own paper, and hence, they are addressed only briefly due to the restraints of this paper.

## 2.2 Defining learning objectives

Defining learning objectives is not as easy as it sounds. It is often based on one's own understanding of the term "learning". If we consider learning from the perspective of psychology, then it is "[...] an experience-based process resulting in a relatively constant change in behavior or potential behavior" ([14], p. 200), meaning the fundamental change in a behaviour brought about by learning. In defining learning objectives, the term "learning" should be defined insofar as this definition includes the fundamental change in behaviour caused by learning. With respect to learning, this perception is significant insofar as it makes the different learning objectives more tangible. After all, in addition to the commonly known cognitive learning objectives which relate to the reproduction of acquired knowledge, there are also affective learning objectives (attitude and developing values) and psychomotor learning objectives which are restricted solely to manual skills ([15], p. 37–38). It may be that all three areas are addressed in a single training.

To make the process of formulating a learning objective smooth, we can consider the following:

- The subject is mostly the learner or participant.
- An objective is often described as a measurable or observable behaviour.
- An active verb circumscribes what the subject should be capable of by the end of the course.
- Further information on what skills/abilities should be attained by the end of the course.
- How the learning objective will be examined at the end of the course.

A cognitive learning objective for an area within management training can therefore be defined as follows:

After attending the online course, the participant is able to logically use the communication models they have learned in their practical activities and to infer instructions in the form of concrete work steps which they will set out in writing over the coming 3 months.

## 2.3 Developing a concept

In order to make the design of a DL course or blended-learning course easier to grasp, it can be helpful to establish the instructional design at the outset in order to have a foundation. The instructional design "is a large part of the definition. Instructional design is the process by which instruction, computer-based or not, is created. Instructional design provides a framework for the creative process of design, and ensures the learners' needs are met" ([16], p. 16). In this design, we must describe specifically what the new course should be capable of doing. Most often, the requirements come from either the company management or the relevant departments. For example: If the requirements for a DL course are to be about saving time and money, we can consider whether it might be advisable to get a purely online

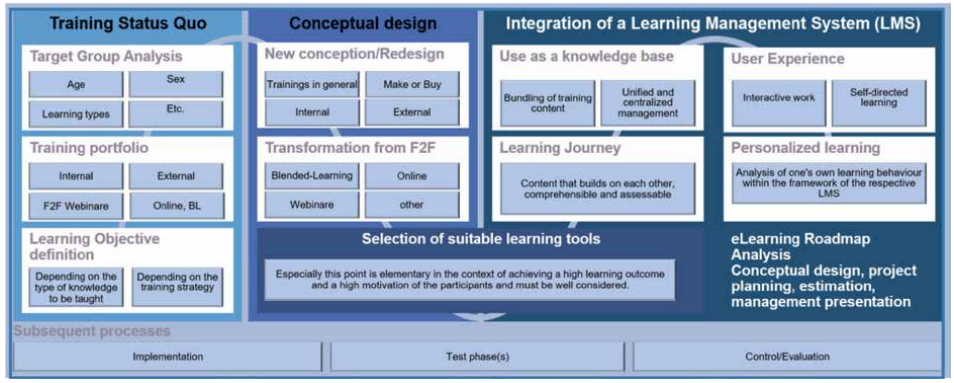


**Figure 2.**
*Example of modular project planning for initial project steps using roughly defined milestones, Baum [3].*

product. However, if it should also be possible to explain complex and complicated content in a face-to-face session as well, and also to practice this content, then a blended-learning format may be more appropriate.

However, the final teaching and learning format can only be decided on, together with the company leadership and project management, after the existing documents have been properly reviewed. Once this decision has been made, the instructional design for the established format, and subsequently rough project planning with key milestones, can be illustrated as shown in **Figure 2**.

In this illustration, we can identify the individual steps of the project (e.g. target group analysis or training portfolio) and the individual associated areas (e.g. analysis of internal and external training portfolio). What is important in this context is that these steps and areas differ from project to project and from company to company.

Tip:

An instructional design with three concept phases has proven successful when it comes to executing a DL course. These must be contained in blended-learning and purely online formats, as well as in purely face-to-face trainings:

Before the training: General awareness of the subject must be created at the outset.

During the training: In addition to activating prior existing knowledge, the focus of the subject should also be clearly underlined. In addition, activities which can be used to check whether the participant has in fact understood the subject must never be overlooked.

After the training: A summary of the subject can be useful in order that the participant can actually apply what they have learned in practice. The participant can then take this back to their workplace and perhaps take another glance at it. Feedback on the course should also always be collected from participants. To conclude, the application of what was learned in practice should be examined.

### 2.4 Developing learning materials

The development of learning materials for a DL course depends on several factors. One key factor is the target group (e.g. age, prior knowledge), while another is the subject itself. It is undisputed that there exist countless media for developing DL courses, such as learning packages (E-learnings), videos, electronic diaries, etc. Which medium

is selected for which subject and for which target group is very individual and must therefore be determined on a project-by-project basis. Because it is so individual and the selection of media is a special and also important issue, this is not addressed in more detail here.

Tip:

When preparing teaching/learning media, make sure to always observe the findings of the summary in Baum [3] of studies by Falkenstein et al. [17] and Schapkin [18] in order not to reduce the motivation of older learners/participants.

- Avoid constant changes to the process (e.g. module design in the LMS).
- Avoid constant changes to the learning process.
- Give older learners/participants more time to complete tasks.
- Allow an appropriate amount of time between different examinations so learners can recover.
- Prepare learning content in a way that it addresses above all factual knowledge, problem-solving strategies and biographical and operational areas.
- Use self-led learning as much as possible.
- In management training, teaching videos (with practical application of certain methods), scripts and questions are often used to track learning.

### 2.5 Test phases

It goes without saying that the correct implementation of a piece of software and any newly developed course must be properly tested. However, there are key differences here with respect to the degree of testing.

With LMS software, it very much makes sense to first fully configure the software to at least 85% with all participants and to then test it in a test mode or even a separate test system. During testing, the radius of the test group should be increased successively. At the beginning, it is sufficient for the IT department to test the technology, while the employees who will later be working with the system test the functionality.

Tip:

Please use your initial personal experiences with LMS and note down your questions and issues. Both are helpful when it comes to designing training documents. After all, if there is one thing that is certain it is that your first experience using the system will most likely be the same as it is for others, above all end users.

Many companies have their own quality system for testing where test cases are defined and input. Use these test cases for initial end-user trainings. Following this, more and more users should be added to the system as testers. It has been shown to be beneficial when critics of the new LMS are engaged here, in addition to advocates. This way, differing points of view and criticisms can be obtained and worked into the training and communication concept.

With respect to the development of a new DL course, experience from recent projects has shown that the test phase should be split into two phases: pre-pilot and pilot phase. In the pre-pilot phase, the product can be properly tested by the

employees involved and maybe colleagues as well. In the pilot phase, a pilot group must test the new DL course under "normal" conditions, meaning that the course must be tested in a regular process. This requires a questionnaire to be developed in advance which can provide insight into whether improvements or other modifications must be made to the new course. Surveying the test group properly is fundamental to this test phase.

### 2.6 Execution

Once the first 5 steps have been sufficiently reviewed and constantly questioned and correctly modified, there is nothing standing in the way of execution. It is a very good idea to survey the learners/participants in this phase as well. Every group is different, meaning they have different demands and perceptions of the content. For this reason, it is always vital that the course be adapted and modified as a matter of urgency to the needs of learners/participants wherever necessary. However, this is what makes it exciting time and again. Do not forget to update the content regularly in this regard.

### 2.7 Monitoring

Steps 1–7 should be reviewed at regular intervals and at least once a year after successful implementation. Particular attention should be paid to regularly updating the teaching/learning documents that were discussed briefly in the preceding section.

In addition to a structured approach to the implementation of DL strategies and courses, the motivation of learners/participants should never be overlooked either. It is therefore crucial that motivation for and acceptance of new LMS software or a DL strategy be created. The pandemic has definitely had a positive impact on increased acceptance among company management. However, this is still not enough. After all, while DL should be used to a greater extent, the demands placed on the strategies and content of employees and learners have also increased.

## 3. Creating motivation for and acceptance of the new digital learning model

This article does not intend to answer the question of where the concept of motivation comes from. What is particularly important with respect to implementing a DL strategy or a new LMS is understanding the motivation process which, according to Heckhausen & Heckhausen ([19], p. 3), comprises the determinants of person, situation, action, result and consequences which is then characterized by the fact that this process can be understood as a short-term personality trait (cf. [20]: 39). Colloquially, the concept of motivation is frequently used interchangeably with the concept of motive which differs from motivation in that it is a long-term personality trait which is frequently established during childhood. The motive furthermore has the characteristic that, among other things, it causes "a person to [...] initiate a motivation process" ([3], p. 22; cf. [19], p. 3 and 198; [21]), whereby the strength of the motive, according to Rheinberg & Vollmeyer [22], depends on previous experiences. Thus, the motive is the stumbling block, while the motivation keeps this block moving. However, learning is not an independent motive, and hence, the concept of learning motive must be considered in particular. Within motivation research, therefore, learning is seen as a consequence of motivation since "in the long-term organisms

only retain and develop those actions and forms of expression which help to satisfy the motive" ([3], p. 24; cf. McClelland, [23] in [19], p. 57). Therefore, the DL must also serve to satisfy the motive, which in turn must be reflected in the concept and strategy.

The main aim with DL is that all learners/participants should enjoy working with the new LMS software, be able to use it intuitively, and also learn something from using the new DL courses which either advances them in their daily working lives or develops their personality ..... all while enjoying and having fun learning. Which is precisely what we must never lose sight of!

## 4. Conclusion

It goes without saying that currently DL is seen as a passing fad. Currently, there are lots of companies examining how to implement a (new) DL strategy with or without simultaneously introducing an LMS. Other companies have already succeeded in doing this in recent years and are at the stage of modifying their implementations.

It is important in this regard that during implementation, the perspectives of other participants, such as IT, Marketing & Communication, Works Council or Worker Representatives, are also integrated into the new strategy and not just the perspectives of the HR department. The cooperation of all parties involved is crucial for the success of the project. Therefore, a holistic approach is applied.

A 7-step model which specifically includes an intensive analysis phase has proven successful in implementing DL in practice. The foundation underlying this includes the training needs analysis, target group analysis, competition analysis, and internal resources analysis, as well as analyses of training and learning objectives. However, when conducting this analysis, we must always be aware that decisions in this area affect all areas of the business.

With respect to creating value in the area of DL, we should also bear in mind that the usual indicators need to be considered from a different perspective since these are mostly handled differently by the company management. For this reason, a sensible perspective and evaluation should be prepared in consultation with the company management. The differences in perspective include externally purchased or internally developed trainings which can also be sold externally (if possible). However, the focus here is mostly on the different evaluation of compliance or optional courses. The compliance training KPIs, in particular, function such that they must also be reported to third parties in many respects.

As at most companies, the project at companies which wish to implement a DL strategy also rises and falls with the companies' internal resources. However, in times of international skills shortages, these are hard to come by, and hence, we must often consider engaging external specialists at an early stage. There should also be a prevailing willingness to change within the company because roles will also change during implementation of a DL strategy, repeatedly and at shorter intervals. In this regard, the issue of training internal employees should also be reconsidered. So that expertise on the new DL strategy and any new LMS remains within the company, all parties involved should be trained sufficiently and intensively. Implementing a DL strategy is easier in a flexible organizational structure which is open to change. This type of organizational structure paves the way for a learning organization and makes it easier to develop a new strategy. Communication is a good tool here for providing all parties involved with

sufficient transparency regarding the processes and procedures for implementation. Communication also accompanies the change process when implementing an LMS.

Additionally, other supporting systems which might logically accompany such an implementation should also be taken into account and considered. It should not always be the price that is the decisive factor, but also functionality and how intuitive such systems are for individual participants to use.

In addition to technical resources, we should not skimp on documentation of the implementation. The focus here is in particular on the technical specifications of new software and on the overall framework conditions for the design of digital teaching/learning offers.

Additionally, the implementation of a new DL strategy is supplemented by the conception of in-house DL courses, the development of learning documents, of the test phase, of the execution and of monitoring, thus rounding off the 7-step model.

However, we must not overlook that the core of a DL strategy is still learners who should be motivated and enjoy completing their courses. Which is why the issue of motivation must never be overlooked.

All in all, it is vital when implementing a new DL strategy to consider a holistic perspective in order to guarantee success at the end of the implementation and get all participants in one boat. This also means that a holistic view of digital learning should be applied in the future. However, it remains to be seen what changes will come in the next few years, especially in the area of digital learning and in the development of learning software. Perhaps it will then be necessary to modify the 7-step model as well as the perspective of the respective implementation.

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Section 2

# Case Studies Using Technology-Integrated Learning in Context

Chapter 5

# Ludus Reading and RoboKind™ Robots Increase Early Literacy Rates

*Jessica Redcay*

## Abstract

The research study aimed to examine the influence of a new model for reading instruction combining Ludus Reading and RoboKind™ Robots on first-grade students' phonics skills and attitudes toward reading. Ludus Reading phonics instruction involves explicit and systematic lessons with underpinnings in play-based, technology, and multisensory techniques. RoboKind™ Robots are facially expressive, assistive humanoid robots that can be coded to talk, move, and display images on their chest screen. The RoboKind™ Robots were programmed to act as teaching assistants and help the teacher during the Ludus Reading phonic lesson. A quasi-experimental pre-post design was used to examine three research questions comparing the differences between pre-and post-scores when using Ludus Reading and RoboKind™ Robots in terms of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS®) Correct Letter Sound (CLS), DIBELS® Whole Words Read (WWR), and Elementary Reading Attitude Survey (ERAS) scores between the group receiving Ludus Reading and RoboKind™ Robots instruction and the control group. The null hypotheses for Research Questions 1–3 were rejected. The results supported the use of Ludus Reading and RoboKind™ Robots to teach phonics because the experimental group demonstrated a statistically significant increase in their ability to decode and a positive attitude toward reading.

**Keywords:** early literacy, humanoid robots, science of reading, phonics, decoding, multisensory learning, early intervention, play-based learning

## 1. Introduction

Visualize this … a first-grade teacher brings five first-graders with the lowest reading scores in her class to the cafeteria to receive a new kind of reading tutoring. Each student is greeted by a pre-service teacher with a table set up with hands-on learning materials and a humanoid robot as a teaching assistant throughout the lesson. The student receives explicit, systematic, and one-on-one phonics instruction for the next half-hour. At one table, a student, Sophie, is looking at the image of a mouth on the chest screen of the robot and listening to the robot state, "The letter a is a vowel, and the short sound is /ă/. Look at my mouth. Now you try it." At another table, a student, Davin, is writing closed-syllable words with an invisible ink pen and shining the light

on the letters to decode the different phonemes. As the half-hour unfolds, students practice their phonics skills using various multisensory strategies across the various learning modalities, also known as I-VAKT (Interactive Technology, Visual, Auditory, Kinesthetic, and Tactile) strategies. Students are eager to participate in the lesson as they self-select materials from a choice menu to practice the targeted skill for the lesson. Students giggle as they receive rewards and praise from the robots throughout the lesson. Students activate the four literacy domains (speaking, listening, writing, and reading) as they complete various interactive activities. After practicing sound and word recognition in isolation, students apply it as they write their own dictated sentences and decode a passage. Instead of appealing to the teacher, as they read the passage, students attend to the words and tap out the sounds in them until they figure it out on their own. After reading a passage, a student smiles confidently and states, "Wait? I didn't know that I could read." Then the teacher returns to take the students back to class, and the students sigh and ask if they can stay longer because they are enjoying learning to read.

The previous scenario occurred 11 times at an elementary school in Fayetteville, North Carolina, United States. Pre-service teachers at Methodist University enrolled in a reading foundation course and helped facilitate the tutoring. The pre-service teachers learned to bridge the Science of Reading (body of research about how students learn to read) and practice. The students learned how Ludus Reading is aligned with the Science of Reading and how to use RoboKind™ Robots as teaching assistants. Ludus Reading was developed by the instructor of the course, Dr. Jessica D. Redcay. Ludus is a Latin word that means play; subsequently, students learn phonics through explicit and systematic lessons using technology, play-based, and multisensory strategies. Ludus Reading and RoboKind™ partnered to create an app used by the pre-service teacher that prompts the robots to deliver content and rewards 10 times throughout the half-hour lessons.

## 2. Literature review

### 2.1 Illiteracy and alliteracy issues

In 1955, Rudolph Flesch explained the crisis of illiterate Americans stemmed from a lack of phonics instruction in schools [1]. Thirty years later, Jonathan Kozol continued recognizing the problem by publishing "Illiterate America" [2]. Seventeen years later, The Reading First Initiative provided $1 billion to schools to teach phonics, and 5 years later, a research study demonstrated that regardless of funding, students did not improve in learning to read [3]. Sixty-seven years after Flesch identified an illiteracy crisis in America, 65 percent of U.S. fourth graders scored below grade level in reading [4], and more than 43 million adults in the United States cannot read or write above a third-grade level [5].

Further, of the 43 million adults in the U.S. who are literate, only 23% read a book or a part of a book over the last year [6]. In addition to having a culture of illiteracy (an illiterate person is unable to read), the U.S. has an issue with aliteracy (an aliterate person can read but does not select to read). Illiteracy rates span beyond the United States. In the world, 781 million people are illiterate (cannot read a single word) or functionally illiterate (with a basic or below basic ability to read) [7].

The high illiteracy rates in adults still need to reflect the impact COVID-19 in 2020 will have on future adult literacy rates. A Stanford study found that second and

third graders in the United States are 30 percent behind the expected typical year of learning due to the pandemic. The researchers explained that teachers need to find practices that will accelerate learning for the students who have fallen behind [8].

A new approach to teaching phonics is needed to accelerate students' learning. The effectiveness of new reading programs needs to be examined. The research study explored the effectiveness of the new reading approach that combined Ludus Reading and RoboKind™ Robots in terms of the students' phonics scores before and after the intervention between an experimental and control group. In addition to creating literate students, students need to develop positive attitudes toward reading, so the students' attitudes were also considered.

### *2.1.1 Early intervention*

Early Interventions need to be implemented because research has demonstrated that 75% of third graders who struggled with reading continued to struggle in the subsequent years in schools [9]. Research has shown that children need intervention (systematic, structured, and explicit teaching focusing on a targeted area of need) early (first 2 years of school). Essentially, students need explicit, systematic phonics instruction before age six because 95% of students will learn to read by the end of first grade with proper instruction. The remaining 5% of students will need additional reading support in the future [10]. Out of the students identified with learning disabilities, 80% have reading disabilities [11]. With effective Early Intervention, most reading problems could have been prevented [12]. The research study focused on supporting first-grade students identified by the teacher as having the greatest reading need. If students are provided with targeted, Early Intervention before the end of first grade, it is possible to offset future reading problems for the student.

### *2.1.2 Neuroplasticity and improving reading performance*

The risk of future reading struggles decreases when students receive effective instruction in kindergarten and first grade. The good news exists for struggling readers, regardless of age, because the brain is pliable. Neuroplasticity is the idea that explains that students' brains can change for the better or worse. The brain can be re-wired when an effective teacher can create new neuropathways that help change students' attitudes and knowledge about reading [13].

Reading research demonstrates that reading performance increases for students when students are provided with an increase in books and opportunities to read. In addition, reading performance increases when students receive quality reading instruction from a well-trained teacher and a quality program [14]. According to the National Reading Panel Report reading instruction needs to include the five pillars of reading: Phonemic Awareness, Phonics, Vocabulary, Fluency, and Comprehension. Further, research has demonstrated that programs are effective when the phonics instruction is taught in a systematic (sequential) and explicit (direct) manner [15]. The findings are consistent with the recommendations by the International Dyslexia Association that students need to participate in programs based on Structured Literacy. Structured Literacy involves teaching students to decode words explicitly and systematically. Students learn systematically, so the content follows a logical order that builds from the easiest and most basic concepts and builds based on the previous concepts learned. Explicit instruction involves directly teaching concepts between the student-teacher instead of naturally learning concepts [16].

School leaders sometimes equate explicit, systematic phonics instruction with the need to adopt a scripted reading program. However, research has demonstrated that scripted reading programs have a negative impact on teachers because it often undermines their ability to teach. Further, studies have shown that students who received instruction from scripted programs lagged behind their peers who did not use a scripted program [17]. A need exists for a program to provide teachers with guidelines and prompts systematically and explicitly without telling teachers what to say and without taking away differentiated learning opportunities for students. Further, the program needs to provide clear directions to be implemented with fidelity. Ludus Reading is crafted to provide teachers with clear guidelines to ensure that the instruction is delivered explicitly, and the program is sequential or systematic. The lesson plans are structured using a Gradual Release of Responsibility Model for teachers because scaffolds (supports) are provided if the teacher needs the information. Still, the teachers are not told what to say. Even though the program is not scripted, there are a couple of embedded scripts for the robot or teacher to ensure the instruction is taught with fidelity and accuracy. When Ludus Reading was used in combination with RoboKind™ Robots, then explicit instruction was provided by the teacher and robot. Whereas the robot was programmed with a script, the teachers were treated as professionals who were provided with targets and guidance but not told what to say.

### 2.2 Science of reading and Ludus reading

Ludus Reading has underpinnings in the Science of Reading. The Science of Reading (SoR) refers to the body of research about students learning to read. The research consists of thousands of studies, billions of dollars, and at least five decades of research. The research helps informs teachers about the best practices for helping students learn to read. The researchers have developed similar ideas about how students learn and do not learn to read. Even though thousands of studies can inform teaching practices, students are still not learning to read. Therefore, the goal of Ludus Reading is to use existing research and implement it in better ways to help students learn to read and enjoy learning to read.

#### *2.2.1 Reading theory and research*

Various Functional MRIs of the brain have demonstrated how students are learning to read. People naturally learn to speak but reading has to be taught. Reading occurs within the Four-Part Processor on the left hemisphere of the brain. The Phonological Processor and Orthographic Processor work together for students to decode words. The phonological Processor uses sounds (phonemes) to process words. Orthography refers to the writing system. Orthographic Processors involve recognizing the letters and combinations of letters within the written language. After decoding the word, the word moves to the meaning and context processors [18]. Tolman's Hourglass further explains the two processors (phonology and orthography from the Four-Part Processor. The top of Tolman's Hourglass is referred to as phonological awareness. The levels range from early (syllable, alliteration, onset-rime), basic (segmenting, blending), and advanced (deleting, substituting, and reversing). Phonological Awareness directly connects to phonics and transitions learning into orthographic processing (the ability to understand the spelling system) [19].

In 1986, Gough and Tunmer introduced The Simple View of Reading (SVR) formula. The formula is used to explain the two basic components of reading. The SVR

is word reading (decoding) x language comprehension = reading comprehension. If one part of the equation is zero when you multiply, you will not successfully have a student comprehend the text [20]. Scarborough's Reading Rope is a visual representation that expands upon The Simple View of Reading. Scarborough's Reading Rope states that reading consists of language comprehension (background knowledge, vocabulary, language structure, verbal reasoning, literacy knowledge) and word recognition (phonological awareness, decoding, and sight recognition). The two parts come together to help develop skilled readers [21].

In 1995, Linnea Ehri introduced the concept that students' progress through four phases of language development. The Pre-Alphabetic Phase involves students understanding the general concepts of print and incidental visual cues. The Partial-Alphabetic Phase involves students developing phonological and phonemic awareness skills. Students recognize syllables, onsets-rimes, initial phoneme matching, letter names, and some letters. The Full-Alphabetic Phase involves students segmenting and blending 3–4 phonemes. Students understand an initial set of phoneme-grapheme correspondences and start to recognize words automatically. During the Consolidated-Alphabetic Phase, students develop advanced phonemic awareness skills. In addition, students focus on orthographic mapping of words, phoneme-grapheme links, phonograms (word families), syllable patterns, and morphemes, and increase automatic word recognition [18]. Ludus Reading has a systematic approach, and the lessons help students progress through Ehri's Phases.

### *2.2.2 Phonics*

Orthography means writing system. English uses a deep morphophonemic (opaque) orthographic system. English includes morphemes (meaningful parts) and speech sounds (phonemes). The English writing system has evolved over time. It started with the earliest form of writing (pictograms) from the Egyptians (5000 BCE). It developed with the Phoenician Alphabet in 2000 BCE; 19 of our 26 letters are from it. Over time the language evolved with the Greek (800 BCE), Ancient Roman (600 BCE), and Modern Roman (1840 CE) [22]. Since English uses a deep morphophonemic orthographic system, it takes readers time to develop skills to read sentences like: "It can be understood through tough thorough thought though."

There are 26 letters in the English language alphabet and 44 different phonemes (sounds). A grapheme is the smallest writing unit to represent phonemes [23]. Phonics instruction involves matching phonemes and graphemes. Approximately 84% of English language words follow phonetic patterns [24]. There are two types of letters: Vowels and Consonants. Vowels are open, unobstructed speech sounds. There are 18 vowel phonemes. The vowels are a, e, i, o, and u. Sometimes y and w. The schwa is a lazy, unstressed sound commonly occurring in unstressed syllables. Examples of a schwa include a, the, of, and away. Students learn the vowels best when they are organized within the Vowel Valley. The Vowel Valley refers to the arrangement of vowels to match the formation of the mouth and jawline [25]. Vowels are short or long based on the type of syllable. Short vowel sounds are denoted with a curve above them. This symbol is called a breve. The long line above the vowel is referred to as a macron and represents a long vowel sound. A consonant is an obstructed sound with teeth, tongues, or lips. When two consonants keep their sound but blend together, we refer to this as a consonant blend (ex., bl, cr). When two consonants come together to make a new sound, called a consonant digraph, and three letters together are called a trigraph. Ludus Reading involves explicitly teaching the students the different phonemes and

graphemes. Students focus on their mouth and jaw positioning when pronouncing the sounds. Further, Ludus Reading includes the Vowel Valley technique to help students pronounce the sounds. The RoboKind™ Robots were used throughout the lesson to display images of how the mouth looks connected to the different sounds.

Students learn best when the six syllable types are introduced. Closed Syllables end in a Consonant (C), and the Vowel (V) is short (CVC, VC). Open syllable words end in a vowel, which is long (CV). The silent e makes the vowel long (CVCe). A vowel team makes the long vowel sound in the word (CVVC). R-Controlled vowels do not allow the vowel sound to be heard in the word. The [le] comes after a consonant for the final syllable type. Teachers start with closed syllable types and short vowel sounds before moving on to long ones [26]. Students learn the concept best when a closed door represents the consonant at the end of a word. The consonant closes the door, and the vowel is short in the word. The vowel makes a long sound when the door opens (no consonant). Ludus Reading involves teaching the different syllable types, and the students learn the closed and open-door techniques. The RoboKind™ Robots displayed different syllable types on the chest screen and explained them further to the students.

### *2.2.3 Play-based learning*

The idea for "Ludus" emerged from Huizinga's Homo Ludens: A Study of Play Element in Culture. Huizinga described play (Ludus is Latin for play) as essential to human life [27]. Research has demonstrated that guided play yields superior learning retention and academic achievement in young children [28]. Meaningful play opportunities are spontaneous and not scripted, and students find that play is enjoyable [29]. Ludus Reading includes a focus for the lesson, and students use play-based activities to practice the content. Play-based activities should help students retain information.

### *2.2.4 Gradual release of responsibility model*

In 2008, Fisher and Frey developed the Gradual Release of Responsibility (GRR) Instructional Framework that involves shifting the responsibility from the teacher to the student throughout a lesson. The GRR model was developed further from the work of Pearson and Gallagher in 1983. There are four components of the GRR model. This first component is often called "I do." Explicit skills are taught during the first component of the lesson. Guided Instruction includes the teacher and student's responsibility, and the component is referred to as "We do." The next component involves Collaborative Work, and the final component involves Independent Work or "You do it alone." The lesson transitions from the teacher's responsibility to the student's responsibility [30]. Students benefit from using the GRR model because they develop control and ownership over their work, and scaffolds are provided to help students transition into independent learners [31]. The lesson plans for Ludus Reading use the GRR Instructional Framework. The lessons start with the teacher and RoboKind™ Robots explicitly teaching the targeted phonics skill. The teacher interacts with and guides the students through activities to practice the lesson's focus. The students transition into practicing the skill independently using different self-selected, play-based activities.

### *2.2.5 Student choice*

Universal Design for Learning (UDL) is a framework to create a classroom environment that accommodates the needs and abilities of all learners. Teachers present

information in multiple ways, and students are provided with numerous ways to demonstrate their learning [32]. A Choice Menu is an approach that aligns with the UDL framework. Teachers organize learning activities in rows and columns. The students are given choices about which activities they want to complete to practice the targeted skill or demonstrate their learning in different ways. A Choice Menu gives students more ownership over their work, and students are more intrinsically motivated [33]. Ludus Reading is centered upon the UDL framework, and a choice menu is used for students when self-selecting play-based activities during independent practice. The RoboKind™ Robots displayed the targeted words on the chest screen and described the different options on the choice menu to the students during the lesson.

### *2.2.6 Repetition of practice*

Repetition is needed to strengthen neuropathways. Synaptic connections occur when a person learns something. Practice needs to happen to transfer learning from short-term to long-term memory. Everyone needs a different number of opportunities to practice something before retaining new knowledge. Gifted students can learn a new letter or sound after 1–4 repetitions. Typical students can learn a new letter or sound after 4–14 repetitions. Students struggling can learn a new letter or sound after 14–40 repetitions. Students with dyslexia or learning disabilities can learn a new letter or sound after 40–200 repetitions [34]. Ludus Reading considers the importance of repetition in learning new letters and sounds. Each phonics lesson includes 40 opportunities for students to practice different letters and sounds. Additional practice is provided to students if needed as well. In addition, when Ludus Reading was combined with the RoboKind™ Robots, students could practice the letters, sounds, and syllable types more often because the robot could continue to repeat the instruction.

### *2.2.7 Multisensory input*

As previously stated, Various Functional MRIs of the brain have demonstrated how students learn to read using Four-Part Processor within the brain's left hemisphere [18]. Students need to strengthen various brain areas to activate the left hemisphere for reading. Students benefit from active participation [35] and the use of VAKT (Visual, Auditory, Kinesthetic, and Tactile) strategies [36]. In 2014, Dr. Jessica Redcay coined the term I-VAKT and expanded further upon the VAKT strategies. The letter I placed in front of VAKT represents Interactive Technology. Students do not use technology in passive ways; instead, students interact within the lesson [37]. The I-VAKT strategies are integrated throughout the lessons. Throughout the lesson, students interact with embedded features in the slides, and they interact with the RoboKind™ Robots. During each lesson, the students practice across the various modalities as they: 1. See It 2. Hear It 3. Do It 4. Touch It. Specifically, during the independent practice, the students self-select from a choice menu one of the play-based I-VAKT strategies to practice the target skills. For example, the students might select a Kinesthetic Activity that involves bouncing a ball to the different words. Another student might choose a Tactile Activity of making the syllable type out of Play Dough.

### *2.2.8 Assessment and effective feedback*

Research has demonstrated that students benefit when feedback is provided to a learner throughout a lesson. The student should use the feedback to improve

performance [38]. In the Ludus Reading lesson plans, instructional coaching notes are provided to offer suggestions to teachers on what to say when students demonstrate different common articulation errors. The comments were added as pre-service teachers asked questions when working with students. For example, if a student makes the /f/ sound instead /th/, then you prompt the students to look in the mirror to see that their tongue pushes slightly through your teeth when you make the /th/ sound. We call the /th/ sound naughty because you stick out your tongue a little. These instructional coaching notes help teachers provide specific and clear feedback throughout the lessons.

Research has demonstrated that clear learning targets aligned with the assessments help determine if students have shown mastery before moving on to the following target skills [38]. Assessment is included after each lesson within Ludus Reading. If students still need to demonstrate mastery, additional lessons are provided so the student can continue to practice the targeted skill. However, only 11 sessions were included in the research study, so remediation was unavailable. However, feedback throughout the lessons was used.

*2.2.9 Previous research supporting Ludus reading*

In 2014, a research study with 75 kindergarten students demonstrated that students in the experimental group scored higher on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS®), Nonsense Word Fluency (NWF), Correct Letter Sounds (CLS) with a mean of 53 compared to the control with a mean of 32. Essentially, the students in the control group could identify 32 letter sounds per minute, and the students in the experimental group could identify 53 letter sounds per minute. In addition, the students in the experimental group increased their overall reading level score to a mean of nine compared to the control group, with a mean of five on the Developmental Reading Assessment, Second Edition (DRA-2®). Further, the students in the experimental group retained the reading scores at the beginning of first grade. The embedded qualitative analysis of the study demonstrated that students in the experimental group showed higher levels of enjoyment in reading compared to the control group [37]. In the subsequent years, two additional teachers used the program to provide feedback about enhancing and improving it.

### 2.3 Ludus reading and RoboKind™ robots

In 2022, Ludus Reading partnered with RoboKind™ to create an app allowing teachers to prompt the robots to act as teaching assistants with 11 existing Ludus Reading lessons. Richard Margolin created the RoboKind™ Robots. RoboKind™ is an educational technology company that creates assistive, facially expressive humanoid robots used as teaching assistants to engage students in new ways while delivering research-based and quality lessons. The RoboKind™ Robots include four facially expressive humanoids (Milo, Veda, Carver, and Jemi), and the assistive robots help students learn. The humanoids can smile, laugh, walk, speak, and display images on a chest screen [39].

RoboKind™ has a CASE®-Endorsed Social Emotional Learning (SEL) Curriculum that addresses four key areas (Emotional, Conversational, Situational, and Calm Down). Refer to **Figure 1** for a picture of the RoboKind™ Robots. The curriculum helps students (1) tune in on emotions; (2) express empathy; (3) act more appropriately in social situations; (4) self-motivate; (5) generalize in the population. Research

**Figure 1.**
*RoboKind™ robots. The image is published with permission from Methodist University and Christian Naranjo (photographer).*

has demonstrated that students using the program achieve mastery of the concepts and generalize those skills to human interactions at a 90% rate [40]. One research study demonstrated that children on the Autism Spectrum engaged with Milo 87.5% of the time compared to 2–3% of the time with a human therapist alone [39]. In addition, to the research studies demonstrating increased outcomes for students and higher levels of student engagement, RoboKind™ has received various awards, including the Super Choice SEL Program of the Year by the Institute for Education Innovation [40].

Since previous research supported the effectiveness of using Ludus Reading [37] and RoboKind™ Robots [39, 40], the two programs collaborated to determine if the combination of both would help improve early literacy scores for students and influence students' perceptions of reading. Eleven lessons from Ludus Reading were combined with 10 prompts from the RoboKind™ Robots. Five of the prompts related to the instructional content. The robot would display an image on the chest screen and talk—five of the prompts related to rewards. Different images of rewards were displayed on the chest screen, and the robot would provide specific praise to the student. A total of 55 RoboKind™ Robots prompts were developed within an app to be used in combination with 11 Ludus Reading lessons.

### 2.4 Measures of reading

After receiving signed permission from the school, parents of the students, and approval from the IRB, the researcher for the current study obtained the achieved Dynamic Indicators of Basic Early Literacy (DIBELS®) and The Elementary Reading Attitude Survey (ERAS) data from the fall of 2022. Five pre-service teachers implemented Ludus Reading and RoboKind™ Robots tutoring sessions. The pre-service

teachers completed assessments for the students receiving tutoring and five students who were staying in the classroom who were randomly selected by the classroom teacher. The archived data were not analyzed to determine the effectiveness of tutoring. Archived quantitative data were available and necessary to evaluate the effectiveness of a new way to teach phonics. The researcher used pre-existing, archived data. The researcher did not want to interfere with what had already naturally occurred within the classroom setting. Further, the assumption is made that the pre-service teachers used the correct techniques to administer and score the archived data.

### *2.4.1 DIBELS®*

Dynamic Indicators of Basic Early Literacy Skills (DIBELS®) is a standardized assessment tool to monitor kindergarten through third-grade students' progression in becoming a reader. The tests are timed and last about 1 minute each [41]. The DIBELS® used standardized administration and scoring procedures. The pre-service teachers read directions from scripted directions and used the directions in the manual to score the results. The research study used DIBELS® NEXT, which has been renamed to Acadience®. However, for the research study, the test will be referred to as DIBELS®.

The raw scores fell within a corresponding score range that reflected a recommendation category: intensive, strategic, or benchmark. Students were considered at risk if they scored within the lowest 20th percentile of the norm across the country; these students were categorized as intensive. Students were considered at some risk if they performed between the 20th percentile and 40th percentile of the norm across the country; these students were categorized as strategic. Students were considered at low risk if they performed above the 40th percentile of the norm across the country; these students were categorized as benchmark or core [41].

The DIBELS® Nonsense Word Fluency (NWF) Correct Letter Sound (CLS) measures student ability to recognize letter sounds within 1 minute [41]. The students were allotted 1 minute to read as many letters sounds as possible. The raw score consisted of the total number of sounds correctly produced within 1 minute. The researcher for the current study used DIBELS® NWF CLS scores recommended benchmarks for the beginning of Grade 1. Students scoring 0–17 were considered below the norm; students scoring 18–26 were considered equivalent to the norm, and students scoring 27+ were considered above the norm [41]. The pre-post data on DIBELS® NWF CLS between the experimental and control group provides information about students' ability to sound out individual phonemes (sounds) automatically and accurately within 1 minute.

The DIBELS® Nonsense Word Fluency (NWF) Whole Words Read (WWR) measures student ability to read an entire Vowel-Consonant (VC) and CVC nonsense words, make-believe words within 1 minute [41]. Nonsense words were used instead of real words because it measures students' ability to decode an unknown word [42]. The students were presented with a paper with Vowel-Consonant (VC) and CVC nonsense words. The students were allotted 1 minute to read as many whole words as possible. The raw score consisted of the total number of whole words read correctly within 1 minute. The researcher for the current study used DIBELS® NWF WWR scores recommended benchmarks for the beginning of Grade 1. Students scoring 0 were considered below the norm; students scoring 0 were deemed equivalent to the norm, and students scoring 1+ were considered above the norm [41]. The pre-post data on DIBELS® NWF WWR between the experimental and control group provides

information about students' ability to decode and read whole words with closed syllable (VC and CVC) patterns automatically and accurately within 1 minute.

### *2.4.2 ERAS*

Dennis J. Kear developed the Elementary Reading Attitude Survey (ERAS) in 1989. In 1990, McKenna and Kear completed a research study of 18,000 students across the United States to establish percentile ranks at each grade level to be converted from the raw data. The ERAS is a reading attitude survey that includes pictures for students to self-report their feelings toward recreational and academic reading. Twenty questions are included on the survey that starts with "How do you feel ..." Jim Davis and Paws Incorporated® approved the use of Garfield® within the survey. The students select a very upset through a very happy Garfield® in response to the question. Very happy is scored with four points, each with a consecutive declining number. The highest raw score a student can earn is a total of 80 points [43]. When the pre-service teachers administered the test, they read aloud the questions to the students, and the students selected the different pictures. The pre-service teachers reported the raw data scores.

According to McKenna and Kear, the developers of percentile scores, when analyzing the data, the raw scores should be used and converted into percentiles later. Further, for any pre-post score difference to be considered a real change for students, the change must be at least seven points when data is in the raw form [43]. After analyzing the raw data, convert the scores to percentiles. Percentile ranks range from 1 to 99, and 50 is considered average. The results can be interpreted from a norm-referenced test that the percentile demonstrates that the student performed better than the total percental of their peers. For example, a student who scores in the 85 percentile performed better than 87% of their peers [44]. Research has demonstrated that attitudes toward reading influence the reading performance of students [44]. The pre-post data on the ERAS between the experimental and control group provides information about students' attitudes toward reading.

## 3. Research questions and hypotheses

**RQ1:** What, if any, is the difference in the pre-and post-DIBELS® (Dynamic Indicators of Basic Early Literacy Skills) CLS (Correct Letter Sound) scores between the group who used Ludus Reading and RoboKind™ Robots and the control group?

**H1o:** There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**H1a:** There is a difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**RQ2:** What, if any, is the difference in the pre-and post-DIBELS® (Dynamic Indicators of Basic Early Literacy Skills) WWR (Whole Words Read) scores between the group who used Ludus Reading and RoboKind™ Robots and the control group?

**H2o:** There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**H2a:** There is a difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind Robots™ and the control group.

**RQ3**: What, if any, is the difference in the pre-and post-Elementary Reading Attitude Survey (ERAS) scores between the group who used Ludus Reading and RoboKind Robots™ and the control group?

**H3o:** There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**H3a:** There is a difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

## 4. Research design and procedures

The research study used a convenience sample of 10 first-grade students. It is assumed that the sample can be generalized to all other first-grade students within the United States, with certain limitations. The researcher for the current study did not use anything specific to North Carolina; instead, the research study involved using nationally-normed DIBLES® and ERAS tests. A sample size of 10 participants was used. The test would demonstrate statistically significant results with an alpha score of .05. In social science research, an alpha of .05 is a common standard score, meaning that the risk of being wrong is five times out of 100 [45]. The researcher only had access to four robots during the study; two students shared a robot. Further, only five pre-service teachers were in the class to participate in the assessment and tutoring sessions during the fall of 2022. The 11 tutoring sessions were administered one-on-one for a half-hour 11 different times. The tutoring sessions occurred during the same time that the teacher was teaching phonics in the classroom to the whole class.

The quasi-experimental pre-post retrospective design used archived data from 10 first-grade students in the fall of 2022. The research design is depicted in **Figure 2**. The research study contained one independent variable with two levels (control and experimental group) across three dependent variables (PostDIBELS® NWF-CLS, PostDIBELS® NWF-WWR, and ERAS). The covariates (PreDIBELS® NWF-CLS, PreDIBELS® NWF-WWR, and Pre ERAS Score) controlled for the natural differences between the control and experimental groups. A quasi-experimental pre-post design is the most appropriate design to use in an educational setting to test the

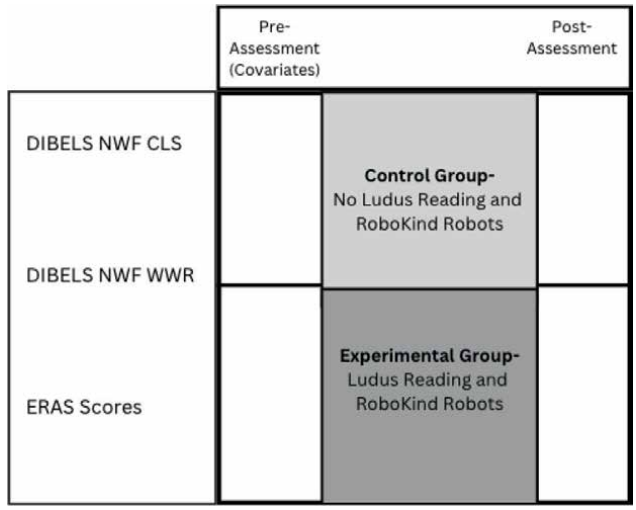


**Figure 2.**
*Quasi-experimental pre-post design.*

effectiveness of a new program [45]. The best way to compensate for a convenience sample is to include a pre-post assessment, control, and experiential group [46].

Five pre-service teachers were enrolled in a reading foundations course at Methodist University. The pre-service teachers went to a local elementary school to tutor five first graders identified by the teacher as having the greatest need in reading. The five pre-service teachers completed pre-post assessments for five students who the teacher randomly selected who remained in the classroom for reading instruction; these students represented the control group in the study.

The five pre-service teachers completed pre-post assessments for five students in the experimental group. In addition, the students in the experimental group completed 11 tutoring sessions with the pre-service teachers using Ludus Reading and RoboKind™ Robots. The 11 lessons focused on short vowel sounds and closed syllable words (2 Lessons-Short A, 2 Lessons-Short E, 2 Lessons-Short I, 2 Lessons-Short O, 2 Lessons Short U, and 1 Review). Every student was absent from at least one of the 11 lessons. The assumption is that every student in the experimental group received at least 10 full lessons. When a student was absent, the pre-service teacher did a quick review before starting the new lesson.

The research study included three quantitative research questions. Each research question had a supporting null and alternative hypothesis. After analyzing the data, the research accepted or rejected the null hypothesis. If the null hypotheses were rejected, then the Ludus Reading and RoboKind™ Robots improved the reading performance of the experimental group. If the null hypotheses were accepted, then the Ludus Reading and RoboKind™ Robots program did not improve the reading performance of the experimental group.

## 5. Data analysis

The quantitative data were analyzed using Analysis of Covariance (ANCOVA) to examine three dependent variables (DIBELS® NWF-CLS, DIBELS® NWF-WWR, ERAS Scores) between the independent variables (control and experimental groups). The ANCOVA tests were used to examine Hypotheses 1–3. The ANCOVA was analyzed through a computer statistical software program called Statistical Package for the Social Sciences Version 28 (SPSS).

Analysis of covariance (ANCOVA) was used for the control and treatment participants on their post-test scores after adjusting their pretest achievement level. Adjusted means with 95% confidence intervals were reported and interpreted for each ANCOVA analysis. The assumptions of normality, homogeneity of variance, linearity, and homogeneity of regression slopes were assessed before model interpretation. Partial eta-squared was reported as a measure of effect size, and post hoc statistical power was also reported for each test.

## 6. Data results

There was a statistically significant difference between the treatment groups in terms of the adjusted means and 95% confidence intervals for DIBELS® CLS, $F(1,7) = 6.93$, $p = 0.034$, partial eta-squared = 0.50, power = 0.62. For DIBELS® WWR, another significant difference was detected between the groups on their adjusted values, $F(1,7) = 78.97$, $p < 0.001$, partial eta-squared = 0.92, power = 1.00. Finally, for the

| ANCOVA analyses | | | |
|---|---|---|---|
| **Test** | **Control*** | **Treatment*** | ***p*-value** |
| DIBELS CLS | 30.60 (21.86–39.34) | 45.60 (36.87–54.34) | 0.034** |
| DIBELS WWR | 1.82 (−0.68–4.31) | 15.18 (12.69–17.68) | <0.001** |
| ERAS | 58.07 (54.71–61.44) | 72.73 (69.36–76.10) | <0.001** |

*Values are adjusted means with (95% CI).
**Statistical significance, $p < 0.05$.

**Table 1.**
*Adjusted values for each comparison.*

ERAS, a significant difference was found between the control and treatment arms on the adjusted values, $F(1,7) = 45.64$, $p < 0.001$, partial eta-squared = 0.87, power = 1.00. The adjusted values for each comparison can be found in **Table 1**.

### 6.1 Hypothesis 1 results using ANCOVA

**H1o:** There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**H1a:** There is a difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 6.93$, $p = 0.0341$, such that the average mean was significantly higher post-DIBELS® CLS mean score for the experimental group (M = 46) than the control group (M = 31), after controlling for pretest scores (partial eta-squared = .17, power = 0.62). After analysis, the raw data can be compared to the national norms. The students in the control group had an average of 31, and the cutoff score was 27, so the students were considered low risk for reading struggles. The students in the experimental group had a mean of 45, and the cutoff score was considered 27, so the students were regarded as having a low risk for reading struggles. The results for Hypothesis 1 are reflected in **Tables 2** and **3**. Accordingly, the null hypothesis for Research Question 1 was rejected.

### 6.2 Hypothesis 2 results using ANCOVA

**H2o:** There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

| Estimates | | | | |
|---|---|---|---|---|
| **Dependent variable: DIBELS CLS posttest** | | | | |
| **Group** | **Mean** | **Std. Error** | **95% confidence interval** | |
| | | | **Lower bound** | **Upper bound** |
| **Control** | 30.597[a] | 3.696 | 21.858 | 39.335 |
| **Treatment** | 45.603[a] | 3.696 | 36.865 | 54.342 |

*Covariates appearing in the model are evaluated at the following values: DIBELS CLS Prettest = 20.60.*

**Table 2.**
*Hypothesis 1: DIBELS® CLS posttest.*

| **Tests of between-subjects effects** | | | | | |
|---|---|---|---|---|---|
| **Dependent variable: DIBELS CLS posttest** | | | | | |
| | | | | **Partial Eta** | **Observed** |
| **Source** | **df** | **F** | **Sig.** | **Squared** | **Power[b]** |
| **Corrected model** | 2 | 3.474 | 0.090 | 0.498 | 0.460 |
| **Intercept** | 1 | 29.086 | 0.001 | 0.806 | 0.995 |
| **DIBELSCLSPre ttest** | 1 | 2.604 | 0.151 | 0.271 | 0.287 |
| **Group** | 1 | 6.925 | 0.034 | 0.497 | 0.619 |
| **Error** | 7 | | | | |
| **Total** | 10 | | | | |
| **Corrected total** | 9 | | | | |

*Computed using alpha = 0.05.*

**Table 3.**
*Hypothesis 1: Tests of between-subjects effects DIBELS® CLS posttest.*

**H2a:** There is a difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 78.97$, $p < 0.001$, such that the average mean was significantly higher post-DIBELS® WWR mean score for the experimental group (M = 15) than the control group (M = 2), after controlling for pretest scores (partial eta-squared = .92, power = 1.00). After analyzing the raw data, the scores were compared to the norm-referenced criteria. The norm-referenced criteria are for students to benchmark if they can read one whole word, so both groups benchmarked. The results for Hypothesis 2 are reflected in **Tables 4** and **5**. Accordingly, the null hypothesis for Research Question 2 was rejected.

## 6.3 Hypothesis 3 results using ANCOVA

**H3o:** There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

**H3a:** There is a difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

| **Estimates** | | | | |
|---|---|---|---|---|
| **Dependent variable: DIBELS WWR posttest** | | | | |
| | | | **95% confidence interval** | |
| **Group** | **Mean** | **Std. Error** | **Lower bound** | **Upper bound** |
| Control | 1.816[a] | 1.056 | −0.681 | 4.313 |
| Treatment | 15.184[a] | 1.056 | 12.687 | 17.681 |

*Covariates appearing in the model are evaluated at the following values: DIBELS WWR Prettest = 1.10.*

**Table 4.**
*Hypothesis 2: DIBELS® WWR posttest.*

| Tests of between-subjects effects | | | | | |
|---|---|---|---|---|---|
| **Dependent variable: DIBELS WWR posttest** | | | | | |
| **Source** | **df** | **F** | **Sig.** | **Partial Eta Squared** | **Observed Power[b]** |
| **Corrected Model** | 2 | 40.605 | <0.001 | 0.921 | 1.000 |
| **Intercept** | 1 | 65.253 | <0.001 | 0.903 | 1.000 |
| **DIBELSWWRPr ettest** | 1 | 8.949 | 0.020 | 0.561 | 0.728 |
| **Group** | 1 | 78.970 | <0.001 | 0.919 | 1.000 |
| **Error** | 7 | | | | |
| **Total** | 10 | | | | |
| **Corrected Total** | 9 | | | | |
| *Computed using alpha = 0.05.* | | | | | |

**Table 5.**
*Hypothesis 2: Tests of between-subjects effects DIBELS® WWR posttest.*

| Estimates | | | | |
|---|---|---|---|---|
| **Dependent variable: ERAS post** | | | | |
| | | | 95% confidence interval | |
| **Group** | **Mean** | **Std. Error** | **Lower bound** | **Upper bound** |
| **Control** | 58.072[a] | 1.424 | 54.705 | 61.440 |
| **Treatment** | 72.728[a] | 1.424 | 69.360 | 76.095 |
| *Covariates appearing in the model are evaluated at the following values: ERAS pre = 56.70.* | | | | |

**Table 6.**
*Hypothesis 3: ERAS posttest.*

| Tests of between-subjects effects | | | | | |
|---|---|---|---|---|---|
| **Dependent variable: ERAS post** | | | | | |
| | | | | **Partial Eta** | **Observed** |
| **Source** | **df** | **F** | **Sig.** | **Squared** | **Power[b]** |
| **Corrected Model** | 2 | 101.822 | <0.001 | 0.967 | 1.000 |
| **Intercept** | 1 | 7.536 | 0.029 | 0.518 | 0.655 |
| **ERASPrettest** | 1 | 51.085 | <0.001 | 0.879 | 1.000 |
| **Group_B** | 1 | 45.637 | <0.001 | 0.867 | 1.000 |
| **Error** | 7 | | | | |
| **Total** | 10 | | | | |
| **Corrected Total** | 9 | | | | |
| *Computed using alpha = 0.05.* | | | | | |

**Table 7.**
*Hypothesis 3: Tests of between-subjects effects ERAS.*

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 45.64$, $p < 0.001$, such that the average mean was significantly higher post-ERAS mean score for the experimental group (M = 73) than the control group (M = 58), after controlling for pretest scores (partial eta-squared = .87, power = 1.00). After analyzing the raw data, it was converted to percentiles. The experimental group mean was 73, increasing by 16 points. A change is notable when the increase is at least seven points [43]. The raw score of 73 is converted to the 84th percentile. The treatment group mean was 58, increasing by two points. The change is not notable because a notable difference is at least seven points [43]. The raw score of 58 is converted to the 40th percentile. The results for Hypothesis 2 are reflected in **Tables 6** and 7. Accordingly, the null hypothesis for Research Question 3 was rejected.

## 7. Discussion

The research study results added to the existing body of knowledge in the area of reading, phonics instruction, assistive humanoids, and the Science of Reading. Previous research demonstrated that Ludus Reading increased kindergarten students' reading scores and perceptions of reading [37]. Previous research studies have shown that RoboKind™ Robots increase students' engagement and transferability of academic skills [39, 40]. However, previous research did not exist on the impact of using assistive humanoids as teaching assistants to help students learn essential phonics skills. The effectiveness of combining Ludus Reading and RoboKind™ Robots needed to be examined. The three null hypotheses for the research study were rejected, demonstrating that when Ludus Reading and RoboKind™ Robots were combined, first-grade students could identify more letters and decode words better in 1 minute. Further, the students in the experimental group demonstrated higher levels of enjoyment with reading. Both of these aspects attempt to address issues in America with illiteracy and aliteracy. Further, early intervention provided before the end of first grade can help offset further reading difficulties for students.

Several key aspects of Ludus Reading and RoboKind™ Robots appeared to be helpful for students in the research study, and the aspects and findings are consistent with previous research studies. Students benefit from programs that use the Gradual Release of Responsibility Model [30, 31]. Students benefit from explicit and systematic instruction [15. 16] with embedded play-based centers [28, 29], multisensory strategies [35, 36], and student choice [32, 33]. Repetition helps students retain information [34], and Ludus Reading and RoboKind™ Robots provided students with at least 40 opportunities to practice the target letter sounds or syllable type. Throughout the lessons, teacher tips are provided to help teachers provide improved and immediate feedback to students [38].

### 7.1 Discussion of Hypothesis 1

The null hypothesis for Research Question 1 for DIBELS® NWF-CLS was rejected. The DIBELS® NWF-CLS is a sub-test of reading used to measure students' ability to recognize letter sounds within 1 minute [41]. The students in the experimental group scored an average (M = 46) that was higher than the average (M = 31) of the students in the control group. The results indicated that the students in the experimental group were better able to recognize letter sounds than the students in the control

group. Both groups were above the cutoff score of 27, so both groups are considered low-risk and performed above the 40th percentile of the norm across the country [41]. Notably, the experimental scores met the goal for the beginning of first grade and surpassed the goal for the middle of first grade with a goal of 43. In addition, the mean pre-test score was 21, so the experimental more than doubled their score with a post-test mean score of 45.

### 7.2 Discussion of Hypothesis 2

The null hypothesis for Research Question 2 for DIBELS® NWF-WWR was rejected. The DIBELS® NWF-WWR is a sub-test of reading used to measure students' ability to read an entire Vowel-Consonant (VC) and CVC nonsense words, make-believe words within 1 minute [41]. The students in the experimental group scored an average (M = 15) that was higher than the average (M = 2) of the students in the control group. The results indicated that the students in the experimental group were better able to decode words than the students in the control group. Both groups were above the cutoff score of one, so both groups are considered low-risk and performed above the 40th percentile of the norm across the country [41]. Notably, the experimental scores surpassed the goal for the beginning of first grade with a goal of 13. So, the students in the experimental had scores that jumped to the next grade level. In addition, the mean pre-test score was 1, so the experimental group progressed to being able to read 15 words, whereas the control group only increased by one word.

### 7.3 Discussion of Hypothesis 3

The null hypothesis for Research Question 3 for ERAS was rejected. The Elementary Reading Attitude Survey (ERAS) is a reading attitude survey that includes pictures for students to self-report their feelings toward recreational and academic reading [43]. The students in the experimental group scored an average (M = 73 and 40th percentile) that was higher than the average (M = 58 and 84th percentile) of the students in the control group. The results indicated that the students in the experimental group developed better attitudes toward reading than the control group. Notably, the original researchers of norm-referenced criteria explained that a minimum of seven points differences in the raw score between the pre-post data signify a change in perception of reading [43]. Accordingly, the control group showed a change with two points, which is not considered notable. However, the experimental group increased by 16 points, signifying the students in the experimental group shifted their attitudes and perceptions of reading. Further, the students in the control group scored within the 40th percentile or below the average. The experimental group scored above 84% of their peers across the nation. The students in the experimental group demonstrated better attitudes toward reading.

## 8. Future research

The results were significant, but the study was limited because it only included 10 students and 11 lessons. The students in the experimental group demonstrated a lot of growth in a short amount of time. Future studies are needed that include more students from various schools. In addition, additional lessons (beyond 11) should be explored to develop a complete picture of the effectiveness of combing Ludus Reading

and Reading and RoboKind®. Other reading assessments or Various Functional MRIs of the brain are different aspects to explore in future studies. In addition, a qualitative researcher might look for emerging themes to describe students' experiences learning to read. Additional studies might expand beyond kindergarten and first grade to see if the program is effective for students in older grades with dyslexia or learning disabilities.

## 9. Conclusion

The quasi-experimental pre-post research study added to the existing body of reading and humanoid research because it tested the effectiveness of combining Ludus Reading and RoboKind™ Robots. Ludus Reading phonics instruction involves explicit and systematic lessons that include play-based, technology, and multisensory techniques. RoboKind™ Robots are facially expressive, assistive humanoid robots, and the robots were programmed to act as teaching assistants and help the teacher during the Ludus Reading phonic lesson. Previous research demonstrated that Ludus Reading increased kindergarten students' reading scores and perceptions of reading [37]. Previous research studies have shown that RoboKind™ Robots increase students' engagement and transferability of academic skills [39, 40]. However, previous research did not exist on the impact of using assistive humanoids as teaching assistants to help students learn critical phonics skills. Three research questions were explored, and the null hypotheses were rejected, demonstrating that students in the experimental were able to identify sounds and decode words better than the control group. Further, the students in the experimental showed higher levels of enjoyment toward reading.

Null Hypothesis 1 was rejected: **H1o:** There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 6.93$, $p = 0.0341$, such that the average mean was significantly higher post-DIBELS® CLS mean score for the experimental group (M = 46) than the control group (M = 31), after controlling for pretest scores (partial eta-squared = .17, power = 0.62). The students in the experimental group more than doubled their score with a post score of 45 and a pretest score of 21. Further, the experimental scores met the goal for the beginning of first grade and surpassed the goal for the middle of first grade with a goal of 43.

Null Hypothesis 2 was rejected: **H2o:** There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 78.97$, $p < 0.001$, such that the average mean was significantly higher post-DIBELS® WWR mean score for the experimental group (M = 15) than the control group (M = 2), after controlling for pretest scores (partial eta-squared = .92, power = 1.00). The mean pre-test score was 1, so the experimental group progressed to being able to read 15 words, whereas the control group only increased by one word. The experimental scores surpassed the goal for the beginning of first grade with a goal of 13. So, the students in the experimental had scores that jumped to the next grade level.

Null Hypothesis 3 was rejected: **H3o:** There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and

experimental group, $F(1,7) = 45.64$, $p < 0.001$, such that the average mean was significantly higher post-ERAS mean score for the experimental group (M = 73 and 40th percentile) than the control group (M = 58 and 84th percentile), after controlling for pretest scores (partial eta-squared = .87, power = 1.00). The students in the control group scored within the 40th percentile or below the average. The experimental group scored above 84% of their peers across the nation. The students in the experimental group demonstrated better attitudes toward reading.

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Chapter 6

# Using Information and Communication Technology and Developing the Creative Abilities of Social Work Students

*Emad Saleh and Magdy Mostafa*

## Abstract

The research problem is to identify the impact of using information and communication technology (ICT) on developing the creative abilities of social work students. The research employed a descriptive-analytical approach in which a sample of social work students was surveyed. Field data was collected using a scale developed by the researchers to measure the impact of students' use of ICT on developing their creative abilities. After establishing the validity and reliability of the scale, data collection began in December 2022 when an electronic link was sent to all social work students *via* the official university mail. After processing the data using SPSS, the results were extracted, and a final research report was written. The results confirmed the students' high readiness to use ICT, while their reliance on ICT improved their academic and personal performance. In addition, the research results confirmed that students' use of ICT effectively influenced the development of their creative abilities. As a result, the study recommends that universities should focus on adequately training students and faculty members in the use of various types of ICT and encourage them to use them.

**Keywords:** social work, students, information communication technology (ICT), readiness, creative abilities

## 1. Introduction

The current era has witnessed an enormous knowledge and information revolution in all fields of science that significantly contributed to stimulating many essential developments in all aspects of life. Technological advancement, among other key aspects, has developed at an astonishing pace, from which societal institutions, especially in the educational field, should benefit. As a result, universities have rushed to capitalize on this tangible technological advancement by setting up establishing computer laboratories and connecting them to the Internet, making use of various programs, applications, and e-learning systems. Specialized laboratories have also been set up to provide training opportunities for students studying psychology,

geography, languages, or social work. Technological advances have also been used in equipping and preparing classrooms for the educational process by providing computers, data display devices, and audio and video systems that enable students in all disciplines to make the most of the educational opportunities available. Advanced technology is no longer limited to developing hardware and technical and electronic equipment, nonetheless; it has been achieved in the field of software and applications. Consequently, most universities are rapidly incorporating computer-related courses into the study plans of students in all disciplines so that they can benefit from this significant progress. Furthermore, one cannot ignore the unprecedented growth of the Internet in the 1980s, as its rate of spread had the greatest impact across all scientific fields at the daily and institutional levels. It also influenced the rate of technological progress across all sectors, including education [1].

In addition to scientific knowledge, higher education institutions seek to impart students with specialized and life skills, as well as creative abilities. Hence, the current research seeks to identify the benefit of students majoring in social work to information and communication technologies, as one of the methods of obtaining professional and life knowledge and skills, and employing them in developing their creative abilities. This raises a number of questions related to students' readiness to use information and communication technologies and the extent to which they benefit from them.

## 2. Research problem

Social work, as a profession, is relatively new. Despite its modernity, it has established a professional and value framework, allowing it to continue and flourish while delivering professional services at all levels of professional activity (micro, medium, and macro) with high efficiency and adequacy. Consequently, it gained societal recognition as an essential profession among professions operating in human societies, which enabled it to expand at the levels of social work education institutions and professional practice organizations in all areas of life and work, while the emergence of professional federations and unions have represented and enabled them to coexist with program planning and design at local, national, and international levels [2]. As a result, many institutions focused on social work education and aimed to monitor and support developments, topped by the Council on Social Work Education (CSWE). The Council on Social Work Education (CSWE) calls for the integration of computer technology into social work education, but there are no explicit standards for integration or student learning [3].

ICT and the Internet have advanced rapidly, to be not only more efficient, faster, and of higher quality but also easily accessible at any time and from any location for a low cost. As a result, education programs and applications in general, and e-learning in particular, have advanced rapidly. Programs and applications have made it easier for teachers and students to complete many educational tasks and assignments without difficulty or stress, providing them with excellent opportunities for excitement and attraction. Information and communication technologies (ICTs) are electronic tools used to transmit, process, and store information [4]. Not long ago, academic research, including social work research, turned its interest to discuss the relationship between new technologies and their use in the education of social work students. According to a study by Faux and Black-Hughes (2000), social

work students prefer traditional teaching methods, as their performance improved when they were taught face-to-face rather than using Internet-based technologies [5]. With the spread of ICT, positive attitudes toward its use in social work education have increased. The findings of some recent studies differ from those of earlier studies. For example, in a study conducted in Trinidad and Tobago, semi-structured interviews were conducted with eight social work educators from four tertiary institutions in Trinidad and Tobago that offer degrees in social work. Results indicate that previous experience with Internet-based technologies influenced the perspectives of social work educators and ultimately the range and mode of technologies used. Although the debate on the role of such technologies in social work education in Trinidad and Tobago has not been resolved, the aforementioned research found that there is a movement toward consensus about the utility of Internet-based technologies [6]. Although ICTs and the growth of the Internet are not without problems, the fact remains that both will continue to shape the global community. Other disciplines have recognized the importance of ICT and consider it a key part of professional development [4].

ICT and the Internet are two of the most significant products of human creativity that have a significant positive impact on all social sciences, academic fields, and professions. The creative abilities of students in all disciplines are expected to develop and improve as technology becomes more prevalent in education. As a result, the social work profession has prioritized the development of the creative abilities of its students. Social work is concerned with the gifted creators and innovators, an interest that frequently extends to the work of social workers in educational institutions, particularly basic education institutions. Social work aims at discovering creators and innovators, identifying their needs, assisting them in achieving psychological compatibility and social adjustment, enabling them to face difficulties and problems, and implementing enrichment programs that develop their capabilities. Furthermore, the interest in creators is not limited to the social work profession, as this category is of great interest and care in both developing and underdeveloped societies. This could be due to the high-quality achievements of this category in a variety of social, economic, technical, artistic, literary, and political fields.

A society loses the most valuable resources of its renaissance if it does not find exceptional creators and innovators and provide them with the tools they need to grow and use their energies in a variety of spheres of existence. Consequently, professional development programs must foster social work's interest in innovation. These programs shall be based on multidimensional education that emphasizes memorability, comprehension, analysis, application, evaluation, and creativity. In professional practice, the social worker's approach to various problems and situations of individuals, families, institutions, and societies depends on professional processes. These processes include understanding the situation, analyzing and evaluating its various dimensions, and evaluating available alternatives, all of which must be creative because the cases and situations the social worker deals with are not typical but unique.

Finally, to adequately prepare future social workers, social work education needs to place greater emphasis on developing students' creative abilities. ICT is one of the main factors that can help students develop their creative abilities. Based on the above, the researchers define the research problem as determining the impact of social work students' use of ICT on the development of their creative abilities.

## 3. Research goals

The main objective of the research is to determine the impact of social work students' use of ICT on their creative abilities. This objective is divided into the following sub-objectives:

1. To identify the readiness of social work students to use ICT.
2. To pinpoint the aspects and level of development as a result of reliance on ICT.
3. To recognize the most actual key practices for students when using ICT in the educational process.
4. To determine the extent of the impact of the use of ICT and the development of creative abilities of students of social work.

## 4. Research questions

The research aims to answer the following main question: What impact does social work students' use of ICT have on developing their creative abilities? This question is divided into the following sub-questions:

1. What is the level of readiness of social work students to use ICT?
2. What aspects and levels of development result from the use of ICT?
3. What is the nature of the actual practices of using ICT among social work students?
4. To what extent does the use of ICT affect the development of creative abilities of social work students' abilities?

## 5. Main research concepts

### 5.1 Creativity

Although creativity, as a term, is commonly used in our lives today, it is still one of the problematic terms. In its simplest definition, creativity is the individual's transferable and developable ability to think freely, to examine complex problems and situations, and to reformulate the elements of experience into new patterns by presenting the greatest possible number of alternatives for reformulating this experience, using a variety of appropriate methods for the situation that the individual faces, so that these new patterns are characterized by modernity in relation to the individual and the society in which he/she lives. Creativity can also be described as the capacity to reason to achieve a diverse and new item that can be implemented, whether in science, arts, literature, or other fields [7].

On the other hand, Barker defined creativity as the mental processes and skills that result in an original product of value or quality, which includes thinking that goes beyond what is already known and results in original ideas and novel solutions to

existing problems [8]. Tierney and Lanford pointed out that creativity and innovation are two terms that are closely related, and carry multiple and overlapping meanings. Creativity is the ability to develop a new idea, while innovation is the application of the new idea or solution to the problem; innovation relates to the material part associated with the implementation or transformation from idea to product. They also emphasized that innovation, like creativity, is one of the key components of HEIs, achieved against the background of a creative environment that stimulates the creation of innovative works. They added that the axes for the development of education in the twenty-first century must include the development of innovation across three main axes: innovation in scientific research, innovative educational methods in the educational process, and innovative administrative structures in academic institutions [9].

Higher education development experts refer to creativity as the key to effective learning at undergraduate and postgraduate levels (Nissim, Weissblueth, Scott-Webber, & Amar, 2016), (Jahnke, Haertel, & Wildt, 2017), and (Rampersad & Patel, 2014) [10–12]. Livingston confirmed the above argument and considered creativity as a key skill that benefits a person throughout his or her life and is also relevant for students in higher education. He added that creativity is directly related to the development of students' ability to acquire knowledge and skills in a global cultural reality rich in new levels of study, research and investigation, cooperation, interdependence, and integration of knowledge and skills, and incorporation of information into new creative systems [13]. Jackson & Show emphasize that creativity is one of the daily educational requirements in universities, as the educational process aims to: "generate ideas and alternatives, find ways to investigate complex problems, institutions, systems and patterns, think innovatively, integrate ideas and objects in new ways, and find innovative solutions that result from using creative ways of thinking and acting" ([14], p. 105). Hence, Sheridan-Rabideau, an education expert for academic institutions, describes creativity as "the cultural wealth of the twenty-first century" ([15], p. 54).

### 5.2 Information and communication technology

ICT has become an integral part of our daily lives as most people use it, including researchers and experts, professionals, politicians and economists, pupils and students, and even the general public. They are also used for various purposes, for example, scientific, social, economic, political, and recreational. However, there is no universal valid definition of ICT. Various definitions define ICT as the sum of all devices, networking components, applications and systems that combined allow people and organizations (i.e., businesses, nonprofit organizations, governments, and criminal enterprises) to interact in the digital world [16].

ICT can be defined as the convergence of electronics, computing, and telecommunications. It has unleashed a tidal wave of technological innovation in the collecting, storing, processing, transmission, and presentation of information that has not only transformed the information technology sector itself into a highly dynamic and expanding field of activity-creating new markets and generating new investment, income, and jobs but also provided other sectors with more rapid and efficient mechanisms for responding to shifts in demand patterns and changes in international comparative advantage, through more efficient production processes and new and improved products and services.

UNISCO defines ICT as a set of technological tools and resources used to transmit, store, create, share, or exchange information. These technological tools and resources include computers, the Internet (website, blogs, and emails), live broadcasting

technologies (radio, television, and webcasting), recorded broadcasting technologies (podcasting, audio, and video players), and storage devices and technology (fixed or mobile, satellite, Visio/video-conferencing, etc) [17].

The term information and communication technology (ICT) is generally accepted to mean all technologies that, in combination, allow people and organizations to interact in the digital world. The importance of ICT for economic development and business growth has been so monumental, in fact, that it is seen as a precursor to what many call the Fourth Industrial Revolution (4IR). ICT also underpins broad shifts in society, as individuals en masse are moving from personal, face-to-face interactions to ones in the digital space. This new era is frequently termed the digital age. Therefore, the ICT system includes the following components: hardware, software, data, the Internet, transactions, communication technologies, and cloud computing.

ICT is employed in many different areas, the most important of which are commerce, business, space, the government sector, daily life, and education. According to numerous studies, the use of ICT in education has contributed to providing a reasonable level of education for many students in developing societies. ICT-related tools and facilities include radio, television, computers, the Internet in classrooms and computer labs, external computer centers, smartphones, and tablets [18].

In the light of the above definitions, creative abilities of students can be summarized as follows:

1. Free and open thinking skills.
2. The desire to address complex problems and situations.
3. The ability to generate new ideas from the available knowledge.
4. Providing possible alternatives for different situations.
5. Unconventional thinking patterns such as critical thinking.
6. The ability to find innovative new solutions to situations and issues.
7. Better use of abilities to improve academic performance.
8. Maintaining cooperation with colleagues.
9. Finding connections and integration between information and knowledge.

## 6. Research importance

The importance of the research is demonstrated by emphasizing the critical role of ICT in teaching and learning processes at the university level. Moreover, the results are expected to draw faculty members' attention to the positive impact of using ICT in developing students' creative abilities and their interest in encouraging students to use it. Finally, because of the positive impact of ICT on the educational process, the results will encourage faculty members to use ICT in teaching and research.

## 7. Research methodology

The research used a descriptive-analytic approach, applied in a comprehensive social survey method to all social work students (approximately 200 students) classified as pure social work, major social work, or minor social work. The researchers developed a scale to assess how ICT affects students' creative abilities. The scale was evaluated by presenting it to eight sociology and social work professors. From 13 December 2022 to 23 December 2022, all social work students received an electronic link to the scale *via* university mail. However, this number only represents the research sample because the researchers only received responses from 90 students. Students were reminded to fill out the scale three times during the ten days. After data processing, Cronbach's alpha internal consistency parameters were measured to ensure the reliability of the scale. The result was 0.95, indicating a high level of reliability. The researchers then proceeded to complete the analysis and draw conclusions.

## 8. Field data analysis

The researchers will attempt to answer the research's main questions through the analysis that follows. But first, in the following sections, an accurate description of the research sample will be given, as well as a demographic description in terms of gender distribution, distribution over the academic years, and distribution based on the nature of their social work specialization, and the average study rates of the research sample. The field data is then analyzed to answer the main questions, leading to the extraction of the relationship and nature of the impact of students' use of ICT on developing their creative abilities.

### 8.1 Description of the research sample

The research sample consisted of 58.9% females and 41.1% males, with an average age of 21.43 years and a cumulative grade point average (GPA) of 2.89. The sample included students from all years of study. Fourth-year students had the highest percentage of participants (34.4%), followed by fifth-year students (32.2%), third-year students (17.8%), second-year students (10.0%), and finally, first-year students (10.0%). 5.6% only. The **Table 1** below shows the gender distribution of students by academic year.

The distribution of the research sample by area of study in social work is shown in the **Figure 1** below. It is evident that pure social work students formed up the largest percentage of the sample 44.4%, followed by minor social work students at 28.9%, and finally major social work students at 26.7%.

### 8.2 Students' readiness to use ICT

The first research question, that is, "what is the level of readiness of social work students to use ICT?" is answered in the following sections. It can be inferred from the results that the students mastered computer skills to a very high degree, as their skills scored an average of 4.43 out of 5, which confirms the high level of computer literacy as one of the most important techniques of ICT. The following **Table 2** also reflects the variation in the level of the students' proficiency in these skills.

| | | | Gender | | Total |
|---|---|---|---|---|---|
| | | | Male | Female | |
| Year | First | Count | 2 | 3 | 5 |
| | | % of total | 2.2% | 3.3% | 5.6% |
| | Second | Count | 5 | 4 | 9 |
| | | % of total | 5.6% | 4.4% | 10.0% |
| | Third | Count | 4 | 12 | 16 |
| | | % of total | 4.4% | 13.3% | 17.8% |
| | Fourth | Count | 11 | 20 | 31 |
| | | % of total | 12.2% | 22.2% | 34.4% |
| | Fifth | Count | 15 | 14 | 29 |
| | | % of total | 16.7% | 15.6% | 32.2% |
| Total | | Count | 37 | 53 | 90 |
| | | % of total | 41.1% | 58.9% | 100.0% |

**Table 1.**
*Gender distribution of students by academic year.*

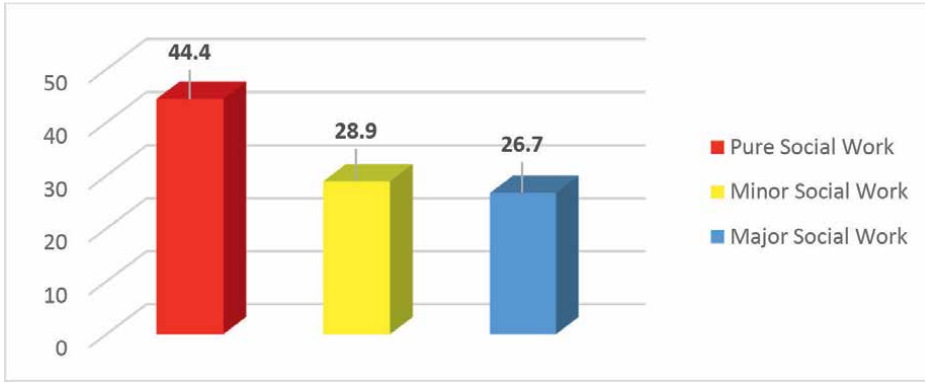


**Figure 1.**
*Distribution of students by social work specialization.*

The approximate estimate of the average daily number of hours spent using ICT tools to conduct academic tasks was 3.59 hours per day, while the highest number of hours of use reached 10 hours, and the lowest number of hours of use was only one hour per day.

Students were asked whether they had taken university courses to develop abilities and skills in using ICT. The majority of students (86.7%) confirmed that they had taken such courses, while 13.3% stated that they had not. The average number of courses taken by a student to develop their ability to use ICT was 1.73 courses. From our point of view, this average reflects the inadequacy of these courses. Hence, we recommend that the university provide more opportunities for students to take courses related to developing skills and abilities to use ICT. For the extent to which the university provides suitable laboratories for training students to use ICT, the majority of students (90.0%)

| | | Frequency | Percent (%) |
|---|---|---|---|
| Valid | Very good skill | 31 | 34.4 |
| | Good skill | 29 | 32.2 |
| | Intermediate skill | 16 | 17.8 |
| | Excellent skill | 13 | 14.4 |
| | Weak skill | 1 | 1.1 |
| | Total | 90 | 100.0 |

**Table 2.**
*Student computer proficiency.*

reported that these types of laboratories are available at the university, while 10.0% believed that these laboratories are insufficient to fulfill their mandate role.

The research team also enquired about the students' use of ICT programs and applications. The following **Figure 2** shows that the majority of students (96.7%) use these technologies, while a significantly low percentage of 3.3% indicated that they had never used them before. The remaining part of the analysis of the results, thus, will focus on those who have already used ICT during their courses, while those who have not used them are excluded, namely, the sample consists of only 87 respondents (N = 87).

The questionnaire also queried whether students had participated in training courses to develop their ICT-related skills; a percentage of 81.6% confirmed that they had not participated in any such courses, while 18.4% reported that they had previously participated to develop their ICT-related skills. In terms of the type of courses students most benefit from in relation to ICT, the majority (82.8%) asserted that they benefit from all types of courses, while 10.3% stated that they only benefit from courses related to college requirements, and 4.6% confirmed that they benefit from courses related to university requirements. The rest of the results are included in the following **Table 3**.

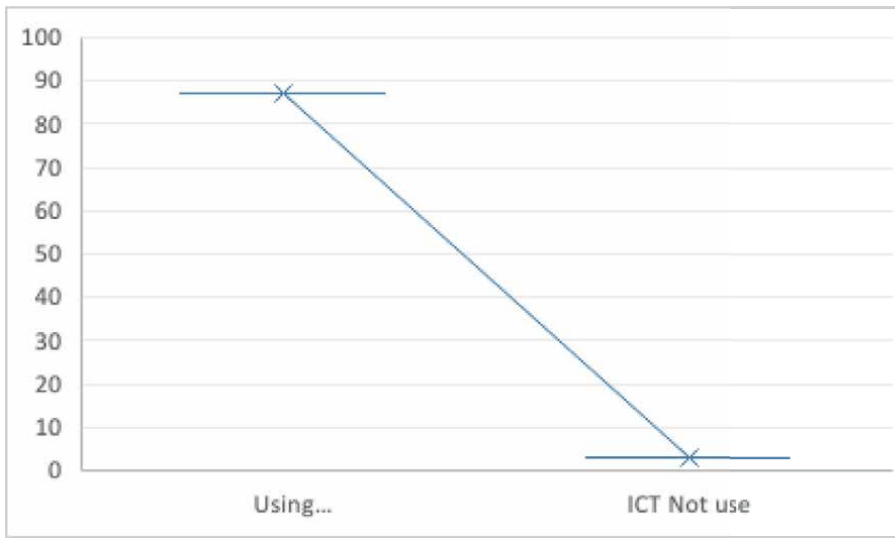


**Figure 2.**
*ICT usage.*

| | | Frequency | Percent (%) |
|---|---|---|---|
| Valid | All courses | 72 | 82.8 |
| | College requirements | 9 | 10.3 |
| | University requirements | 4 | 4.6 |
| | Minor social work | 1 | 1.1 |
| | Never used | 1 | 1.1 |
| | Total | 87 | 100.0 |

**Table 3.**
*Types of courses that students have benefited from ICT.*

| | | Frequency | Percent (%) |
|---|---|---|---|
| Valid | Strong | 43 | 55.8 |
| | Average | 31 | 40.3 |
| | Slightly | 3 | 3.9 |
| | Total | 77 | 100.0 |

**Table 4.**
*Level of development of the students' performance as a result of using ICT.*

The results of the field data analysis showed a positive effect of the students' collaboration with their colleagues on preparing assignments (presentations – research – reports) (N = 87), based on 88.5% of the students, a percentage that may be attributed to the students' realization of a significant growth in their ICT-related abilities and skills, and their impact on their performance in terms of the assignments in academic courses. The following **Table 4** also illustrates the level of improvement that has occurred in terms of the students' performance as a result of using ICT, as approximately half of the students (51.7%) emphasized that the effect of using ICT was strong, while 41.4% confirmed that there was a moderate effect, and a minority of 6.9% believed that the effect was limited.

### 8.3 Level of development as a result of reliance on ICT

Concerning aspects of the development of the students' performance in academic courses as a result of reliance on ICT, the results included in the following **Figure 3** reflect the quality and level of development, as the use of ICT led to the development of multiple skills among students, for the average of development reached 22.47, while the relative strength of development reached 94%. Therefore, development in terms of the students' skills is considered very strong. We can draw from the previous **Figure 2** that the highest level of development lies in research skills as it climbed to 83%, then thinking skills which scored 76%, while the lowest level was in the development of personal skills at 70%.

### 8.4 ICT systems, programs, and applications

In relation to the third question related to the nature of actual practices of ICT among social work students, the analysis showed the students' dependence on many ICT systems, programs, and applications for complete learning processes (presentations, implementation of reports, assignments, statistical analyses, etc.).

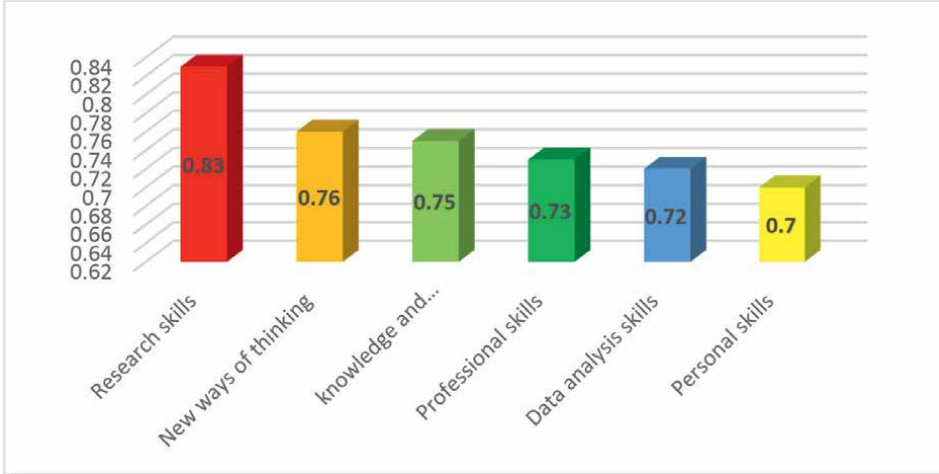


**Figure 3.**
*Level of development as a result of reliance on ICT.*

| ICT | Mean | Std. deviation | Relative mean | Ranking | Usage level |
|---|---|---|---|---|---|
| Word | 2.92 | 0.27 | 0.97 | 1 | Very strong |
| PowerPoint | 2.85 | 0.36 | 0.95 | 2 | |
| Moodle | 2.72 | 0.50 | 0.91 | 3 | |
| PDF | 2.68 | 0.49 | 0.89 | 4 | |
| Google Meet | 2.24 | 0.63 | 0.75 | 5 | Strong |
| Social work websites | 2.18 | 0.76 | 0.73 | 6 | |
| Educational films | 2.05 | 0.75 | 0.68 | 7 | |
| Videos-Pics | 2.00 | 0.72 | 0.67 | 8 | |
| Kahoot | 1.99 | 0.56 | 0.66 | 9 | |
| Zoom | 1.70 | 0.65 | 0.57 | 10 | Acceptable |
| Excel | 1.48 | 0.50 | 0.49 | 11 | |
| SPSS | 1.45 | 0.54 | 0.48 | 12 | |
| Prezi | 1.40 | 0.58 | 0.47 | 13 | |
| Relative mean = 0.77 | | Mean = 27.67 | | Std. deviation = 3.81 | |

**Table 5.**
*ICT systems, programs, and applications.*

The following **Table 5** shows these systems and applications and the degree[1] of their use by students.

**Table 6** shows that the use of ICT systems, applications, and programs varies among the students. For example, programs such as Word, PowerPoint, Moodle, and PDF were "heavily" used, with a relatively average usage of more than 80%. Moreover,

[1] To determine the levels of relative strength or relative averages that will result from the analysis of field data for the current research, the researchers will use the following criterion: weak (less than 50%), acceptable (from 50% to less than 65%), strong (from 65% to less than 80%), and very strong (more than 80%) [19].

| ICT Devices | Mean | Std. deviation | Relative mean | Ranking | Usage level |
|---|---|---|---|---|---|
| Multimedia laptops, notebooks, and computers | 4.79 | 0.53 | 0.96 | 1 | Very strong |
| Smartphone | 4.75 | 0.58 | 0.95 | 2 | |
| Internet | 4.74 | 0.58 | 0.95 | 3 | |
| local information network | 4.71 | 0.61 | 0.94 | 4 | |
| Internet connection with personal computers | 4.67 | 0.56 | 0.93 | 5 | |
| Digital libraries | 4.43 | 0.83 | 0.89 | 6 | |
| Email, newsgroups, discussion boards, and chat | 4.38 | 0.81 | 0.88 | 7 | |
| Online databases | 4.14 | 1.01 | 0.83 | 8 | |
| Video conferences | 3.25 | 0.94 | 0.65 | 9 | Strong |
| Digital/video cameras | 3.16 | 0.87 | 0.63 | 10 | Acceptable |
| Diskettes, CDs, and DVDs | 2.82 | 1.05 | 0.56 | 11 | |
| Interactive TV and radio | 2.77 | 1.03 | 0.55 | 12 | |
| Relative mean = 81.0% | Mean = 48.60 | | | Std. deviation = 5.06 | |

**Table 6.**
*Students' use of ICT devices in educational processes.*

some programs and applications, such as Zoom, Excel, SPSS, and Prezi, were moderately used, where the relative average of use was less than 65%. For more details, see **Table 6**. The researchers believe that the type of specialization has a significant impact on students' preference for certain applications and programs over others.

### 8.5 Students' use of ICT devices in educational processes

**Table 7** provides an overview of the ICT devices students use to undertake academic assignments, where the levels of use of technologies varied. For example, students relied on certain devices very strongly, such as multimedia laptops, notebooks, computers, smartphones, and the Internet, where the relative average of use was over 80%. The relative average of use for some devices of limited use was less than 65%. Examples of these devices are video conferences, digital/video cameras, diskettes, CDs, DVDs, and interactive TV and radio. The researchers explain that the low level of use of these devices may be attributed to several reasons, the most important of which is that ICT technology requires a high level of training and skills to benefit from its technological capabilities, in addition to the fact that the nature of specialization of social work may not require high levels of technological devices.

### 8.6 The impact of ICT on developing creativity abilities

Regarding the answer to the main question of the research concerned with identifying the impact of the students' use of ICT on developing their creative abilities.

| The impact of ICT | Mean | Std. deviation | Relative mean | Ranking | Level |
|---|---|---|---|---|---|
| Obtaining information and data from its original sources | 4.56 | 0.66 | 0.91 | 1 | Very Strong |
| Providing the level of effort necessary to obtain information and data | 4.55 | 0.64 | 0.91 | 2 | |
| Saving the necessary time to obtain information and data | 4.55 | 0.66 | 0.91 | 3 | |
| Presenting data and information in a creative way | 4.53 | 0.66 | 0.91 | 4 | |
| Obtaining necessary information for the study | 4.49 | 0.70 | 0.90 | 5 | |
| Creating novel ways of displaying data and information | 4.43 | 0.77 | 0.89 | 6 | |
| Gaining confidence when making presentations | 4.39 | 0.78 | 0.88 | 7 | |
| Increased ability to conduct a detailed search for topics | 4.39 | 0.77 | 0.88 | 8 | |
| Gaining the skill of presenting information in a more interesting and effective way | 4.36 | 0.73 | 0.87 | 9 | |
| Facilitation of information updates | 4.34 | 0.70 | 0.87 | 10 | |
| Thinking in a more creative way | 4.34 | 0.73 | 0.87 | 11 | |
| Maintaining motivation toward achievement and achieving more successes | 4.31 | 0.70 | 0.86 | 12 | |
| Acquiring a new way of thinking | 4.31 | 0.75 | 0.86 | 13 | |
| Gaining the appreciation and praise of colleagues | 4.30 | 0.86 | 0.86 | 14 | |
| In general, I feel that I have creative abilities | 4.28 | 0.79 | 0.86 | 15 | |
| Accessing multiple visions, experiences, and perceptions | 4.26 | 0.83 | 0.85 | 16 | |
| Identifying innovative solutions in areas of study and life | 4.26 | 0.75 | 0.85 | 17 | |
| Gaining the appreciation and praise of professors | 4.23 | 0.89 | 0.85 | 18 | |
| Generating new ideas and visions | 4.21 | 0.90 | 0.84 | 19 | |
| The ability to analyze the addressed problems and issues | 4.16 | 0.85 | 0.83 | 20 | |
| Maintaining flexibility when addressing situations and events | 4.09 | 0.95 | 0.82 | 21 | |
| Increasing the semester and cumulative achievement rate | 3.89 | 1.02 | 0.78 | 22 | Strong |
| Relative Mean = 0.87 | Mean = 95.24 | | | Std. deviation = 11.95 | |

**Table 7.**
*The impact of ICT on increasing creativity of social work students.*

The following **Table 7** reflects an effective positive effect of the students' use of ICT on developing their creative abilities, as the results confirm that the level of influence was very strong (as per the standard used in the aforementioned measurement), according to the degree of relative strength of this dimension, which amounted to 87%. The overall average of the mean was 95.24, bearing in mind that the maximum degree that can be reached is only 120 degrees (N = 87).

Despite the very strong effect of using ICT on increasing the creative abilities of students, statistical analysis of this dimension shows that this effect is variable among students, as shown in the following **Figure 4**, which shows the extent of the differences in developing their creative abilities.

**Figure 4** shows the difference in the level of impact of using ICT on the development of the students' creative abilities. The results show that 39% of the students scored 100

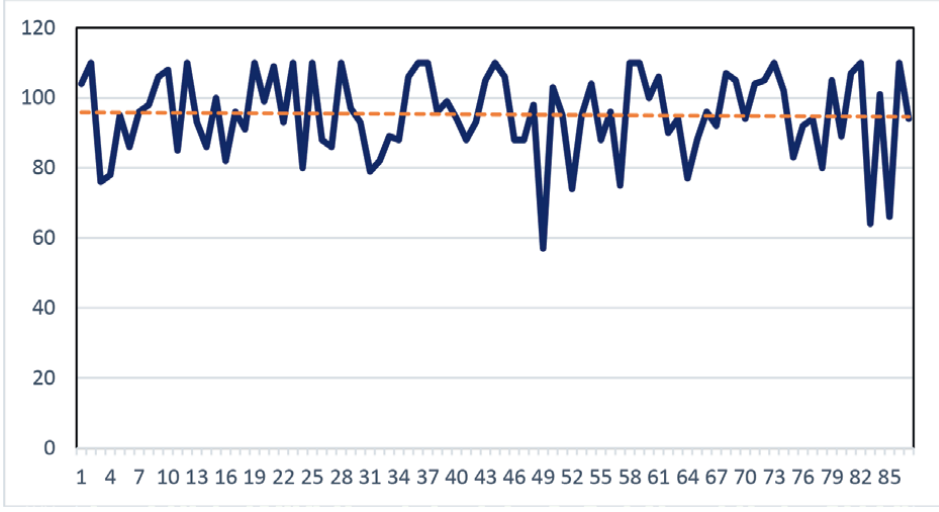


**Figure 4.**
*Various levels of impact of ICT use on the development of the students' creative abilities.*

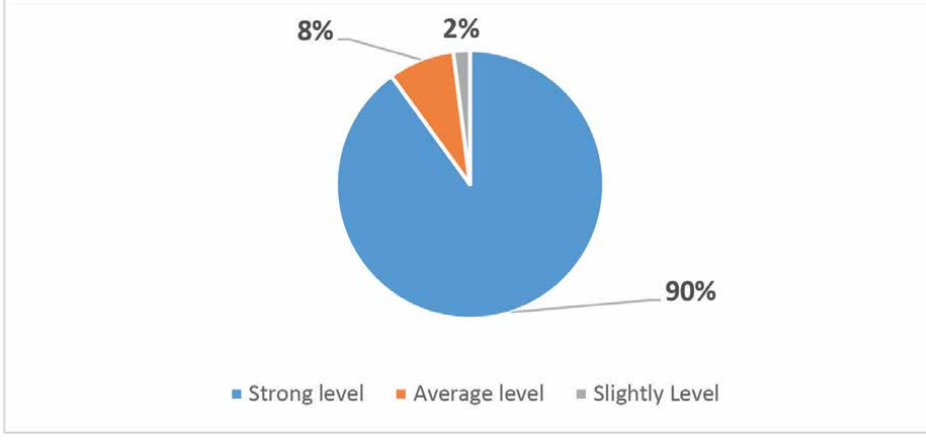


**Figure 5.**
*Different levels of impact of ICT use on the development of students' creative abilities.*

or more out of a total of 120 degrees, which is the maximum score for this dimension. Further analysis indicated that 90% of the students developed their creative abilities at a very strong level (scores: ≥ 80), while 8% had a medium level of development (scores: 65 ≥ 80), and only 2% had a very limited level of development (scores: < 65). The researchers presented the result of this effect graphically in **Figure 5**.

The final result that can be drawn is that the students' use of ICT had a very strong impact on the development of their creative abilities, taking into account that the extent of influence varies from one student to another according to many variables, including training, motivation, and individual differences among students.

## 9. General results and conclusion

The current research sought to answer several pivotal questions in order to accurately determine the extent of the impact of the use of ICT on the development of creative abilities among social work students. From the analysis of the field data of the answer to the first question, that is, "What is the level of readiness of social work students to use ICT?", it was inferred that the students show a high level of readiness, as they have high skills in using one of the most essential ICT tools used in the educational process in all academic disciplines—the computer. The results show several reasons that contributed to the students' proficiency in using ICT technologies, including the high average of daily use hours of ICT technologies, which was 3.59 hours per day on average. In addition, the majority of students placed importance on taking academic courses (average = 1.7 Course) aimed at developing their abilities to use ICT.

The analysis of the results also revealed, in terms of the actual use of ICT, that the majority of students used a considerable number of ICT programs and applications. However, a minority of students indicated that they had never used them when completing academic tasks and assignments, so, they were excluded from the analysis in the remaining part of the research (the research sample became 87 not 90). The analysis also showed that a significant percentage of students participated in training courses to develop their ICT-related skills. They have employed these skills in various courses, whether related to specialization or university and college requirements. Thus, the impact of this use is expected to develop their creative abilities in the future.

The results of the study also showed a positive relationship between cooperative education and the development of creative abilities among ICT students; the majority of the students confirmed that cooperation with their colleagues led to the exchange of many experiences and ideas, and thus the development of their abilities and skills in terms of the application and use of ICT when performing the assignments in courses, and access to a greater amount of knowledge and information.

For the answer to the second question related to the aspects and level of development in performance as a result of reliance on the use of ICT, the analysis showed that reliance on the use of ICT led to the development of performance, where the highest level of development was the development of research skills, then thinking skills, and the lowest level was of personal skills.

Concerning the third question related to the nature of the actual practices of using ICT among students of social work, the research tried to identify systems and programs of ICT that students use when performing academic assignments and tasks, where some of them were highly used, while others were moderately or little

used. Examples of the most frequently used programs and applications were Word, PowerPoint, Moodle, and PDF, while the least used applications were Zoom, Excel, SPSS, and Prezi. In order to use these programs and applications, students rely on the use of several ICT devices used in the educational process. Computers, laptops, notebooks, and smartphones are deemed the most frequently used devices by students, while interactive TV and radio were the least used. The researchers explain that the low level of use of these devices may be attributed to several reasons, the most important of which is that ICT technology requires a high-level training and skills to benefit from its technological capabilities, in addition to the fact that the nature of specialization of social work may not require high levels of technological devices.

For the answer to the main question of the research related to determining the impact of the students' use of ICT on developing their creative abilities, the results showed a strong positive effect of using ICT social work students on developing their creative abilities. The final conclusion that can be drawn is that the students' use of ICT when fulfilling the requirements related to the educational process has a very strong impact on the development of their creative abilities, taking into account that the extent of influence varies from one student to another according to many variables, including training, motivation, and individual differences among students.

## 10. Implications

The results of the current research proved that there is an effective impact of the use of ICT by students on the development of their creative abilities. Hence, the recommendations of the current research are as follows:

- Universities shall show interest in helping students enhance ICT-related skills by involving them in specialized training courses and developing study plans for them to ensure that more technology-related courses are offered.

- The research also recommends that faculty members give adequate opportunities tostudents to use cooperative education due to its positive impact on the development of their creative skills and abilities.

- The results revealed the need to conduct more research on creativity in higher education institutions in the following areas: management of higher education institutions and the environment of creativity, faculty staff and creative education, and developing students' motivation toward creativity.

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Chapter 7

# The Influence of Social Media Networking Platforms on Promoting EFL Learners' Lexical Competence Repertoire: An Exploratory Study

*Husam Mohammed Kareem Al-Khazaali*

## Abstract

Language learning is significantly influenced by social media. The growth of social media has become an international phenomenon. People now spend the majority of their time on online services like social networking. These social media platforms give students access to effective learning tools including automated learning and visualisation techniques. Using social media to learn English is engaging and inspiring. This study focuses on how social media enables people to automatically or unintentionally learn English fluently. All second-year students at the AL-Maymona secondary schools for boys in Missan, Iraq, for the academic year 2017–2018 make up the population of this study. There are two courses at the college: A and B, each having 51 and 52 pupils, respectively. The experimental group, Class A, was selected at random. Facebook was the social media platform used to teach students at the EG. With regard to the CG, students were instructed utilising the methods suggested by the required textbook, English Grammar in Use. The researcher taught both the EG and the CG. The study results include that the EG has more achievement and better performance in English vocabulary than those who took the traditional method. It can be concluded that using social media platforms serves the educational and instructional settings for both teacher and learners. Those social media support and increase the performance of the study sample based on the current procedures. The researcher recommends using and adopting social media networking platforms in educational environments because they support and enhance the teaching and learning results and they are fruitful as teaching strategies in the educational process.

**Keywords:** language learning, social media, self-independence, Facebook, lexical competence repertoire

## 1. Introduction

For the most majority of people, it is fairly typical that the revolutionary advancements in technology, and the Internet in particular, make it feasible and easier to

receive things in a better method than it was previously. Technology is crucial for first language teaching and learning, and it is used in all educational situations to help facilities and governments accomplish their key objectives. Social media opened the door to discovering efficient and successful strategies for improving student learning. Students have unrestricted control over and settings for their learning environments because to social media, for example Facebook and Twitter supply learners with many sources in writing or learning to communicate well. Social media Facebook creates a platform through which teacher and students can form pages, as it will be discussed in details later. EFL students can benefit from the rich information such websites provide for their customers or students. Besides, they provide authentic and reliable manners of learning a language vocabulary. Many applications of learning vocabulary have been proven to be very effective and influential.

It is now widely acknowledged that using technology makes teaching and learning easier in linguistics classes. According to Nur and Syarifuddin [1], the instructor should when selecting any resource take into account certain factors to enhance the learning experience. The learning content should be able to effectively and intellectually engage the students to attain communication goals and expertise in language experience. Using the Social media has also developed with the advancement of technology. Social media has been very popular, popular among users of all ages, but especially young people, ever since their creation. Additionally, they are designed to be inspiring and demonstrate to students the real-world use of the target language.

Using social media fantastic qualities that English teachers and students may find to be very helpful would make the process of teaching and learning English easier, more colourful, endlessly fascinating. Social media usage and its advantages could be helpful. They should remain energetic, competent, effective, and prolific so that teaching English would be never monotonous.

## 2. The statement of the problem

Students' language skills are severely hindered by their inadequate vocabulary learning capacity. Therefore, a lot of work needs to go into discovering novel and efficient methods through which students can acquire knowledge and express themselves with ease. The researcher examines the effects of Facebook on students' vocabulary growth generally in terms of social media (because there are many applications in social media, the focus remains on Facebook).

## 3. The aim of the study

The purpose of this research is to determine if and how social media influences the vocabulary acquisition and retention of English language majors in their second year of college.

## 4. Hypothesis of the study

The null hypothesis proposed here is that there is no statistically significant difference between the mean score of students using the traditional teaching of vocabulary and that of the teaching adopted by the researcher or using social media Facebook.

## 5. The question of the study

The following question has been adopted in this study:
"Does social media have any significant on Iraqi EFL learners' vocabulary repertoire?"

## 6. Definitions of social media

Due to the rapid development and growth of social media, it is impossible to provide an accurate definition of the term. The application of social media in real-world settings alters how individuals think and act due to its significance and control over a significant amount of our everyday routine difficulties.

Social media is defined as "online media enabling users to interact with one another online through various web applications allowing users to create, distribute, share and manipulate a variety of contents including texts, pictures, video, songs, etc. to other net-users, and these contents can be accessible publicly. Social media investigated in this study include blogs, YouTube, Twitter, Instagram etc." ([2], p. 1).

Social media can provide students with several chances and activities that enable them to establish peer- or group-work activities through which vocabulary can be acquired naturally. Today, the world has shrunk to the size of a village, and students are able to communicate their ideas and opinions with their peers and friends without expending as much work or time as in the past. The platforms and services provided by social media make students more motivated and enthusiastic about acquiring vocabulary.

## 7. Literature review

### 7.1 Definitions of vocabulary

Vocabulary occupies a strong permanent position in language learning. There is no language without acquiring enough vocabulary, since any languages consist of words. Siriwan ([3], p. 19) suggests that "Vocabulary learning is referred to as learning a collection or the total stock of words in a language that are used in particular contexts." Additionally, vocabulary can be defined as "a set of lexemes, including single words, compound words and idioms" ([4], p. 629). Vocabulary knowledge is very essential for students to acquire because it enable them to interact naturally; hence, Nation ([5], p. 22) states that "vocabulary knowledge implies knowing a word in the spoken form of the word and the spoken form can be recognized and understood it in and out of context rather than guessed."

### 7.2 The position of vocabulary in language learning

The social media can provide students with several chances and activities that enable them to build peer- or group-work activities through which language can be learned naturally. Today, the globe has shrunk to the size of a village, and kids are able to communicate their ideas and opinions with their peers and friends in a short amount of time and with minimal effort. Social media platforms and the services they provide engage and excite students in their pursuit of language vocabulary acquisition.

It is quite difficult to communicate with our group without a wide vocabulary. People can express their interests, wants, and thoughts freely and autonomously through words. They can talk and write, comprehend the spoken language, and discriminate between the meanings of different sorts of writings. There are two principal types of language acquisition: direct and indirect or incidental. Chacon et al. [6] contend that incidental vocabulary learning is necessary for language development; however, this does not imply that deliberate instruction of vocabulary plays no function.

When speaking on the importance of vocabulary, Adrian and Mirabela ([7], p. 123) comment that "Vocabulary, the core of any language, is probably the most challenging and time consuming part of learning a foreign language. It takes time and flows like a continuous process, once you have settled the fundamentals of a language (pronunciation, orthography and basic grammar). Throughout this process, learners become familiarized with the words they come across."

### 7.3 Social media forms

As social media is well known, there are numerous social media websites or formats. This study will focus on Facebook because it is widely used, accessible, and user-friendly for students. Facebook's platforms provide students with several options and possibilities for language study and improvement. According to Dewing ([8], p. 5), "social media websites like YouTube, Twitter, and Facebook" have grown increasingly popular among Internet users who seek to share their ideas, films, and other online activities. Social media encompasses numerous digital tools, including Facebook, YouTube, Instagram, Twitter, LinkedIn, and MySpace. Email and SMS are also social media tools. This current technology employs a variety of efficient tools and solutions that help students to learn in depth in a variety of ways. **Figure 1** depicts the present application as assumed by Solis in 2012 [9].

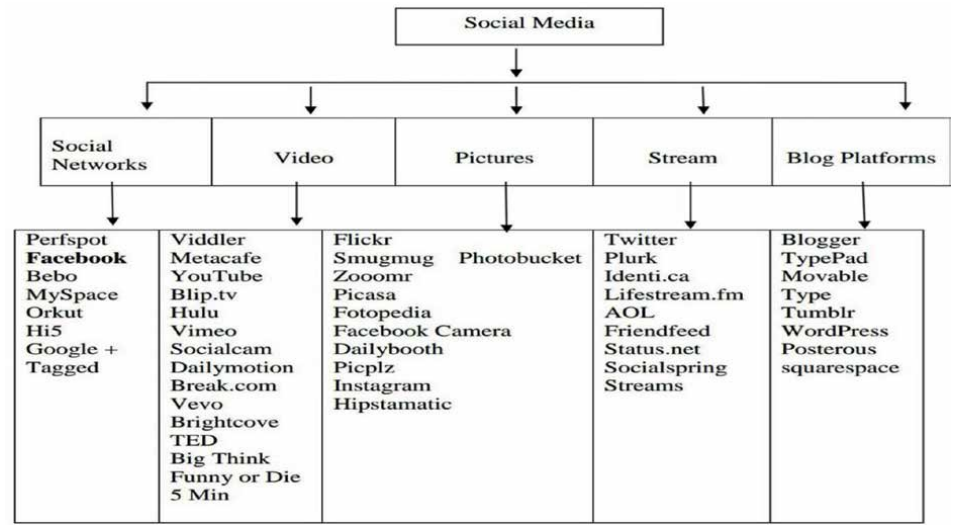


**Figure 1.**
*"Introducing the Conversation Prism," Adapted from Solis ([9], p. 24).*

### 7.4 Facebook networking site

Facebook is a big online programme that is regarded as one of the most renowned sites on the worldwide web, which was founded in 2004 by "Mark Zuckerberg". Rosen ([10], p. 17) explains that the name Facebook suggests from "the small photo albums that colleges once gave to incoming freshmen and faculty to help them cope with meeting so many new people." Facebook enables the students that registered to make profiles, upload photos and videos, send texts, or share ideas with groups, international groups or school group that should be scheduled by their teacher. Awl [11] states that "in a paper Facebook, you see photos and biographies of your classmates. On Facebook, you see your friend's latest photos and videos with, at times, an extensive biography." Hence, Facebook has become one of the most successful social media sites because of its feature platforms that set itself apart from other social media and that made the word "social media" become well known. This application provides an appropriate instructional environment through which students can learn English vocabulary naturally through chatting, sharing information with others, and creating Facebook pages, furthermore through skimming and scanning for the pages and posts available on Facebook; therefore, this application can develop and improve students' vocabulary knowledge. Adriana and Mirabelle ([7], p. 128) demonstrate that incorporating Facebook into classroom activities improves students' performance and vocabulary confidence.

### 7.5 Learners and social media platforms

Students can now use social media with relative ease and accessibility. Students should be equipped with computers, smart phones, or tablets for enhanced classroom learning because these technical gadgets give the best learning platforms necessary for their studies and enable access to social media websites. Despite what many claim, presenting social media in the classroom is not a simple undertaking.

However, Jones and Shao ([12], p. 87) find that "students positively respond to the incorporation of new technologies into the teaching and learning process provided that the technology usage is well-conceived, purposeful, and properly integrated into the learning process. Students spend as much (or more) time online in an informal learning environment--interacting with peers and receiving feedback--than they do with their teachers in the traditional classroom."

### 7.6 The performance of social media in EFL classrooms

Technologically speaking, current social media have superseded our previous way of thinking, since technology has become an integral part of our daily lives. In the previous year, people became accustomed to reading magazines and newspapers, but today, the majority of them are compelled to read the newest news *via* social media because it is a demand of modern life, technology being an integral component. The official demand for mandating the use of social media in educational EFL settings has developed significantly in recent years due to its utility and accessibility. According to Chen and Bryer ([13], p. 89), "social media have rapidly expanded for academic use and permeated the education sector."

Consequently, when technology is utilised efficiently in the classroom, the real world can be viewed and no limitations can be imposed on the teacher and pupils, such as distance, time, or problems. Accordingly, numerous researchers have adopted social media and class in their studies, such as the study presented by Gumport and

Chun, whose findings indicate that through the use of social media applications in the classroom, a strong relationship develops between the teacher and his students, and secondly, quality instruction emerges, which leads to effective outcomes ([14], p. 64).

Lewis and Candito ([15], p. 16) assert that "students use three top- used social media tools: Facebook, Wikipedia and YouTube, for social engagement, direct communication, speed of feedback, and relationship building." Aikten ([16], p. 93) argues that using social media improves teaching and makes communication among students better. Consequently, the students will learn vocabulary in an unplanned manner or indirectly by the use of these applications to communicate fluently with their peers.

### 7.7 Social media and vocabulary promotion

As previously noted, social media provides registered students and users with educational platforms that offer a variety of options and possibilities. When a student profile is shared with a number of Facebook pages, he or she is able to communicate with overseas students informally and benefit from their experiences and information. Formal teaching and learning are established and administered by the teacher, who also provides his students with broad instructions. Teachers provide students with usernames and passwords. They can see their grade on a Facebook page made by the teacher, as well as any additional drills or exercises they must do in addition to their assigned duties. In addition, further programmes and explanations are presented on the students' formal page.

As previously indicated, the researcher chooses Facebook due to its popularity, utility, and accessibility. It fills the kids with motivation and self-assurance, and they may freely express their thoughts. Such sharing is impractical and time consuming to implement in the classroom. From the following websites or connections, students can share or learn vocabulary:

- Learn AND Teach English Vocabulary and Grammar
- Learn English vocabulary and grammar
- Learn English Vocabulary
- Learn English Vocabulary through pictures
- Learn English Vocabulary Now
- Vocabulary – Learn New Words
- English Vocabulary/Learn English Online
- How to Learn Vocabulary and never forget it
- Learning Living Room Vocabulary/Talking Flashcards
- School Subjects Vocabulary in English – Learn with Games
- Movie Vocabulary
- Free English Vocabulary Tutorial

- YouTube is yet another essential social media platform. It is a massive resource that provides a vast quantity of vocabulary-learning movies. These movies are really beneficial and vital for pupils to learn. Teachers should advise their pupils about the value of YouTube and how it impacts their academic achievement. The effective links and websites YouTube contains are as follows:

- How to learn and use 1000 English vocabulary words

- How to learn 100 English words a day

- Learning English vocabulary with pictures

- Learn English Vocabulary

- 150 House Vocabulary Words: Expand your English vocabulary

- How to increase your vocabulary

- Improve Vocabulary and Listening Skills

- Kids vocabulary

- Test your English vocabulary

- Learning English vocabulary

- How to learn English vocabulary and remember it

- Improve English vocabulary

- Instagram is another social networking website. When a student logs in to the Instagram platform, he or she can gain access to a huge number of vocabulary items using the following open-access applications:

- English Vocabulary

- Learn Vocabulary

- Eng. Vocabulary

- English vocabulary Learning

- Vocabulary Master

- Vocab-rainbow

### 7.8 Benefits of social media platforms in EFL classes

Despite a few downsides, the vast majority of education specialists, practitioners, and theorists concur that current social media networks can have enormously positive effects on the performance and growth of language learners when

they are exploited and used correctly. Students can collaborate with classmates or peers on projects. They can also collaborate with other foreign groups and exchange ideas. Numerous and diverse links and websites have been developed and utilised by enrolled students in order to expand their vocabularies, as demonstrated above when students utilise the YouTube, Instagram, and Facebook platforms and pages.

These links and websites are essential and countless. Since global networking is free access, students should be incentivised to utilise, implement, and teach with new technologies. Students will also get knowledge of cultural diversity, other social traditions, and customs. This will aid in better comprehending the external world.

## 8. Data collection and procedures

### 8.1 Design of the Study

The study research design was then customised utilising a pre-test–post-test experiment and group framework to determine the impact of the Facebook educational programme on students' vocabulary achievements. The exam is made up of multiple-choice questions. Before the study began, the students' prior knowledge was tested *via* a pre-test given to both groups (control and experimental). The pre-test was designed to examine the pupils' prior knowledge of terms. The same pre-test was utilised as a post-test at the end of the study to assess the students' achievement on the issue, namely the acquisition of new vocabulary items. The post-test was designed to measure the impact of both instructional approaches (Facebook and traditional) on learners' achievement.

### 8.2 Sampling of the study

The population of this study consists of all second-year students at AL-Maymona secondary schools for boys in Missan, Iraq, during the 2021–2022 academic year. The college offers two courses, A and B, with 61 and 62 students in A and B, respectively. Class A was selected at random to serve as the experimental group (henceforth EG) and class B served as the control group (henceforth CG). All random decisions were determined by drawing lots. One student in Section A and two students in Section B were removed from the experiment because they were repeating the grade. During the duration of the trial, the repeaters were kept in their classes, but their performance on the post-tests was disregarded. Thus, the final number of sample subjects was 120 students, with 60 students in each group.

The experiment began on December 16, 2017 and concluded on March 15, 2018. The experiment lasted approximately 10 weeks. In this study, pupils had comparable educational possibilities. In other words, the two sets of students had identical conditions with the exception of the use of social media on EG. The researcher instructed both study groups.

Facebook, a social networking programme, was used to instruct EG students. Regarding the CG, students were instructed using the methods specified in the required textbook, English Grammar in Use. The researcher instructed the EG as well as the CG. A portion of the presentation focused on the applications of social media, in which students participated. In each lecture, one or more social media, such as Facebook, YouTube, and e-mail, were highlighted.

### 8.3 Ethics of the study

The study includes all of its data and information that are related to the research own properties. No violation can be seen through this investigative study.

### 8.4 The instructional design

This study employs an online project design methodology. The researcher develops a Facebook application that facilitates student-to-student and student-to-teacher communication at home. A twelve-week programme was designed with two primary foci: vocabulary and grammar. Each week, a variety of teaching methods, including discussions, exams, further exercises, and information searching/sharing, were utilised to educate students about a self-governing topic. For the EG, Facebook was chosen due to its accessibility and usefulness to the students, because it provides the students with a vocabulary-learning platform for chatting, debating, working together, and cooperating to complete home projects, as well as involving each member's personal experience. The CG employs conventional practise, debates, and group projects as a mode of instruction. In the CG's head, there is no internet connection; this is the primary distinction between the treatments. **Table 1**, adapted from Wang and Chen ([17], p. 137), illustrates the researcher's various methods.

### 8.5 Validity and reliability of the instrument

Face validity of the test has been assured by presenting the instrument to a jury of members who have lots of experiences in the field of teaching English language. For reliability of the test, it is estimated as having more than 90%; henceforth, the rest is reliable and yields the same results after some trials by the students.

### 8.6 Results

After delivering the post-test for achievement, the collected data were evaluated to see whether there are statistically significant differences between the mean scores of EG and CG on the first and second post-tests. Consequently, the study's objectives to validate the hypotheses indicated in the current investigation will be met. This study also includes a discussion of the outcomes and implications drawn from the study's findings. A series of recommendations and proposals for pedagogical purposes and potential future research expansions are provided.

| Activity | EG | CG |
|---|---|---|
| Communication | Teacher-student dialogue | Teacher's lecture |
| | Student–student dialogue | Students ask questions |
| Collaboration | Teacher runs discussion topics | Teacher runs discussion topics |
| | Student online debates | Students discussions in groups |
| Sharing Resource | Student uploading projects | Teacher hand out remediation |
| | Teacher/student feedback | Material |

**Table 1.**
*Vocabulary learning activities through Facebook.*

*8.6.1 Comparison between the vocabulary performance of EG and CG on the achievement of post-test*

The t-test formula for two independent samples is used to compare the mean achievement post-test scores of the EG and CG. The average EG score is 54.36, whereas the average CG score is 42.24. The estimated t-value is 4618, but the tabulated value is 1987 at a significance level of 0.05 and 98 degrees of freedom. This suggests that there is a statistically significant difference between the two groups; specifically, the EG is superior to the CG in terms of vocabulary achievement. This, in turn, indicates that the researcher's Facebook-based vocabulary education method is more effective and fruitful than traditional methods (see **Table 2**).

*8.6.2 Comparison of the pre-test and the achievement of post-test of the EG performance*

The typical pre-test score for the EG is 38.55, whereas the post-test score for achievement is 49.73. The paired sample t-test method is used to determine whether there is a statistically significant difference between the mean scores. The estimated t-value is −13.674, whereas the tabulated value is 2.012 at a significance level of 0.05 and 49 degrees of freedom. This shows that there is a statistically significant difference between the two groups, with the EG performing better than the CG. Therefore, the originally given null hypothesis is rejected (see **Table 3**).

## 8.7 Interpretation of the results

The results indicate that the adopted application, i.e. Facebook, is an excellent method for teaching and acquiring vocabulary, which may be attributable to the following:

Returning to **Tables 2** and **3**, it is evident that the performance of the EG *via* Facebook is superior to that of the CG. Due to the efficiency of the implemented programme, this is a natural conclusion. Facebook has proven to be incredibly useful for language learners at various stages. Studies examining the use of this application indicate a large increase in pupils' vocabulary.

| Group | No. | M | SD | DF | t-value | | Level of significance |
|---|---|---|---|---|---|---|---|
| | | | | | Calculated | Tabulated | |
| EG | 60 | 54.36 | 13.83 | 98 | 4.618 | 1.987 | 0.05 |
| CG | 60 | 42.24 | 12.37 | | | | |

**Table 2.**
*Comparison between the vocabulary performance of EG and CG on the achievement of post-test.*

| Types of test | No. | M | SD | DF | t-value | | Level of significance |
|---|---|---|---|---|---|---|---|
| | | | | | Calculated | Tabulated | |
| Pre-test | 60 | 38.55 | 14.59 | 49 | −13.674 | 2.012 | 0.05 |
| Post-test | 60 | 49.73 | 13.82 | | | | |

**Table 3.**
*Comparison of the pre-test and the achievement of post-test performance of the EG.*

Students' vocabulary improves more on Facebook than on the accomplishment pretest, indicating that their language repertoire, which enables them to communicate effectively and organically, will be larger. If students are taught language using social media, they will recall it well. Teacher feedback and assessment are required while teaching vocabulary because social media play a significant role in the development of students' vocabularies, which in turn enables students to speak and communicate successfully due to their word repertoire. Such chosen applications make pupils more self-assured, independent, and motivated, which reflects their improved academic performance.

### 8.8 Educational recommendations

Based on the findings and conclusions of this study, the researcher suggests the following:

1. Since English vocabulary is a challenge for college students in Iraq, greater emphasis should be placed on the teaching of vocabulary, as it is just as vital as other language components.

2. When it comes to vocabulary knowledge, extensive practise is necessary. The greater the frequency with which kids are exposed to these words, the higher their proficiency with them.

3. Teachers and authors of textbooks should recognise the significance of vocabulary knowledge as an effective method for teaching and learning natural English.

4. Teachers should be familiar with certain useful and fruitful applications for teaching and learning vocabulary, given that social media websites facilitate vocabulary management.

5. The presentation of vocabulary should be reinforced by engaging and authentic materials that allow students to create the FL mostly out of curiosity and motivation.

6. The criterion for picking vocabulary should be given great consideration when teaching vocabulary.

7. EFL teachers should be abreast of current events, methodologies, and tactics for teaching EFL in order to enhance vocabulary acquisition and reading comprehension in the most effective, motivated, and engaging manner.

8. Teachers of English as a second language should focus more on the production aspect of acquiring vocabulary than the recognition aspect by offering social media, activities, and meaningful events.

9. Social media apps should be considered by curriculum designers since they create an engaging and stimulating learning atmosphere.

## 9. Conclusions

Based on the obtained results, the following conclusions can be drawn:

As seen by their performance on the pre-test, the vocabulary knowledge of college students in Iraq can be characterised as rather weak. The teaching and learning of vocabulary through social media, using Facebook as an example, is more effective than the traditional methods specified by the textbook.

The traditional strategies used to teach vocabulary in Iraqi college classrooms are effective, as demonstrated by the pre- and post-test results of the CG (the achievement of post-tests). However, the researcher's applications have been shown to be more fruitful and effective in promoting the pupils' vocabulary.

The accepted application provides pupils with more options than the textbook for storing and readily remembering what they have been taught or learnt. When taught to vocabulary approaches such as the Facebook learning strategy, the EG appeared to be more engaged because such techniques increased their autonomy. Students that are motivated perform better in vocabulary. Therefore, teachers must pay close and precise attention to motivation. Vocabulary forgetting can be reduced to a minimum by focusing on social media services that improve vocabulary retention.

It has been found that using social media platforms in the field of teaching and learning foreign language will serve the educational and instructional process largely based on the current findings of this study. Besides, the researcher recommends adopting such social media applications in the educational settings after getting agreements from the policy and government of the state, since these social media are available to high extent by almost all people and all students.

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Chapter 8

# Perspective Chapter: The Relationship of Technology and Creativity in Childhood Period

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## Abstract

Thanks to technology, which has the potential to go to the most remote places and which concerns individuals of all ages and from all walks of life, many actions that were previously impossible can be done. Especially children constitute the important human resources of technology. However, the conscious use of technology is considered important. Creativity is a phenomenon that can be utilized in the conscious use of technology. Creativity is defined as the ability to create original products, to think and feel differently. The innate creativity ability may decrease over time. The decrease in creativity can pave the way for the emergence of individuals who think and act in a uniform way. Such a situation can undoubtedly be an important obstacle to social progress. For this reason, it is necessary to support the creativity abilities of children. In supporting creativity, the use of technology, in which children spend most of their time, will ensure the realization of two-way purposes. Based on these considerations, it is aimed to explain how the technology-creativity relationship can be combined in childhood.

**Keywords:** technology, creativity, childhood, electronic book, robotic coding, virtual trip

## 1. Introduction

One of the important skills of the 21st century is to be ahead in the technological field and to gain creativity skills at the same time [1]. As a matter of fact, the most important feature expected from the people of the 21st century is to be able to express themselves in different ways and to use the important opportunities brought by technology while expressing themselves in different ways [2–7]. The importance of the childhood period is obvious in realizing the stated situations and making them a lifelong attitude. All kinds of behaviors and habits that will be taught to children from a very early age will be one of the important strengths that they will have for a lifetime [8, 9]. In this context, it can be considered as an important necessity to deal with the relationship between technology and creativity in childhood. In particular, not combining technology and creativity or combining them incorrectly can harm children due to the immaturity of their developmental areas [2, 10–21]. At this point, it is thought that it is important to deal with the definitions of technology and creativity and to explain their connection with childhood.

Technology is defined as combining technical and theoretical knowledge [22]. With the emergence of the industrial revolution, technology and technological developments continued to turn heads at full speed [23]. Especially today, technology makes significant contributions to people by bringing the distances closer, helping their free time become quality, and providing information [22, 24]. However, considering this contribution in a one-way manner, in other words, individuals with whom technology interacts only receive what is imposed on them, can bring many negative consequences. The most important of these negative consequences is the destruction of creativity [25]. Creativity can be expressed as the ability to come up with original products, to think uniquely and to make different inventions by separating from the general [26, 27]. In this context, combining technology with creativity is among the 21st century skills [1].

21st century skills can be expressed as fulfilling the requirements of the current age. Individuals with 21st century skills are expected to be in a good position in technology and to be able to express themselves through technological means. At the same time, these individuals should be able to think and act new and original while expressing themselves. It is obvious that all these will be gained by combining the technology and creativity skills that will be provided to children from infancy [28]. In the following, how technology and creativity take place in children from infancy and what can be done to support children in this process will be discussed in the light of current studies conducted in the country and abroad. Thus, it will be possible to apply the studies conducted in future studies on different samples. In addition, parents will not only offer these tools to their children in order to keep their children entertained or conduct behavior management, but also support their children's innate creativity abilities in the technological tools they will offer to their children. They will play an important role in supporting creativity with technological tools while performing educational activities for teachers and other people interested in the field, just like parents. Thus, the upbringing of children who have 21st century skills and who will adopt these characteristics will be discussed in a broad perspective and investments will be made in the future. For these purposes, the following questions will be answered throughout the research.

- What should be done to ensure that babies communicate with technological tools in the desired direction during infancy? Do the actions support the creativity of babies?
- How can the relationship between technology and creativity be supported in early childhood?
- How can technology be used to support children's creativity at home and at school during childhood?
- How can children's creativity skills and existing technological interests be combined during adolescence?

## 2. Technology-creativity relationship in infancy

Infancy period can be expressed as one of the important periods in human life. The most important factor underlying this importance is that the baby does not recognize the environment in which he was born and needs caregivers to make sense of this world. Moreover, this need is of vital importance not only in terms of getting

to know the world, but also in terms of supporting all development areas. Synapse myelination in the brain during infancy requires mutual communication and interaction [29]. The caregiver's response to the baby's sounds and a warm interest become important in supporting the baby's developing creativity. However, technological tools that will be presented to the baby in this period and not respond to the baby's communication efforts as expressed, harm the baby's development and do not have any positive effect on the creativity ability [30]. In other words, non-interactive publications presented to infants during infancy in the literature increase the probability of infants to experience reactive attachment disorder, cause delays in language development, and do not bring significant gains in cognitive development [31, 32], children and adults who think uniformly, do not criticize, do not question, and take what is given to them as they are [18, 33]. In other words, the ability to be creative has disappeared. However, on the contrary, it has been found that the technological tools offered interactively for children have significant benefits on the creative thinking ability of babies both at the moment and in the future.

Şirin [34] worked with babies older than 18 months in the research he conducted on babies. These babies were presented with thematic television or computer programs and the babies were watched for a certain period of time. As a result of the research, it was determined that there was a difference in the information processing speed of the babies in the following processes. Şirin [34] explains this situation by prioritizing the educational feature of the programs offered to babies. He states that the images given to the baby through television, computer programs, DVD and MP3 are useful, and he argues that the repetitions in the stimuli received by the baby from these tools have the feature of supporting the development in the information processing process, thus contributing to the completion of the parts of the whole. Similar to the opinion expressed by Şirin [34], it is emphasized that the innate creativity ability of the baby is supported by educational programs, the brain is active in this process and therefore creative solutions can be found [35, 36]. In addition to these studies, electronic books and music are also used to combine technology and creativity in infancy.

Audiobooks have the ability to appeal to imaginative and emotional intelligence and talents. The creativity ability of the baby can also be supported with an appropriate tone of voice or background music studies that are specific to the developmental period of the baby [25]. Çer [37] examined how the baby's creativity ability and concept development were in the electronic books he presented for 0–24 months old babies. In the research, books were read with the caregivers of the babies and one-year observations of the babies were made. At the end of the research, it was concluded that babies made significant gains in both language development and creativity after one year. Thanks to the system developed by Costa-Giomi and Benetti [38], which helps to make music and sing at home during infancy, it has been concluded that babies can sing songs and produce their own music.

In the light of the studies expressed and reached in the literature, while technological tools are offered to babies in infancy, they should have an interactive feature and support all developmental areas of the baby. Thus, the baby will be protected from the harms of technological tools and his creativity abilities will be supported.

## 3. Technology-creativity relationship in early childhood

As a result of the achievements of the child in all areas of development during infancy and the breakthroughs he has made in his development, he enters the early

childhood period. In this period, the progress in the developmental areas of the child still continues and all the gains gained in this period follow him for a lifetime. In this sense, the child in early childhood researches, watches, wants to see and evaluate everything that happens around him, and asks questions. There is a perspective towards the world [30]. Under this point of view, he can produce creative products to the extent that his cognitive development allows. Although the child in early childhood is an individual who tries to discover and learn about the world, his caregivers and teachers after starting school become an important role model for him. He appropriates all the behaviors of these role models and adds them to his attitudes. Here, the use of technology can also come to the fore [39, 40]. However, as in the previous period, children's being together with non-interactive technological tools and technological tools that are not suitable for their development can harm them, undesirable problems can arise in all areas of development, they can become content with what is given to them, and their creativity blunts [41–45]. For this reason, it is an important necessity to present programs that will support creativity while providing technological tools to children in this period.

The relationship between technology and creativity in early childhood has been collected in different dimensions in the literature. The first of these was electronic books, as in the previous period. Bozkurt Yükçü et al. [46] stated in their compilation research that e-books offer children a world rich in stimuli and that their creativity and language development develop through this world. In their research, Naranjo Bock [47] wanted to examine the impact of the development of electronic books for children in early childhood on the developmental areas and creativity of children. As a result of the research, they have reached conclusions that children's learning becomes enjoyable, they can think critically, and positive results are obtained on their creativity abilities through e-books prepared for children's development levels. In her compilation study, Odabaş [48] offers suggestions that e-books increase children's learning motivation and improve their ability to think differently. Tanrıverdi [49], on the other hand, worked with 12 children attending pre-school education institutions in his research. In the research, children were read books with augmented reality application. At the end of a period, he has reached conclusions that children can think differently, as well as achieve significant gains in their language and cognitive development. Reich et al. [50] conducted a study to determine the effect of e-book applications on creativity and other developmental areas of children in early childhood. They worked with 54 children under the age of five for 11 weeks in the study. As a result of the study, they reached conclusions that e-books prepared for children have significant effects on the developmental areas of children and that they can think differently and ask different questions. Behnamnia et al. [51] conducted a study to determine whether digital game-based learning has an effect on the creativity of three- to six-year-old children. In the research, the programs loved by the children were installed on tablets and smart mobile phones. As a result of children's use of these applications, their creativity abilities were determined by the Torrance creativity scale. As a result of the research, it has been concluded that the programs used by children on digital game platforms have important consequences on their creativity skills. Another area used to combine technology and creativity in children in early childhood is robotic applications.

Sullivan et al. [52] developed robotic applications in a preschool education institution and conducted a study to investigate the effect of these developed robotic applications on children's thinking skills. In the study, robotic applications were presented to children for a week. As a result of the research, as a result of the post-test applied to the children, they concluded that the children were able to think differently

and produce unusual answers. Another study was carried out by Bers et al. [53]. Researchers developed a construction-based robotics application for four-year-olds, looking at whether children could learn computational and math skills, and also wanted to examine their thinking styles. Teachers also took part in the research, which was carried out with 57 children for one year. As a result of the research, they concluded that children learned robotic coding, used mathematical problems and calculations, and were able to produce original thoughts at the same time. Mioduser and Levy [54] developed a robotic application that shows spatial-temporal situations in children and carried out their research in order to determine the effects of the developed application on children. In the study, six children were studied during five sessions. As a result of the research, it has been concluded that very complex results can be achieved as a result of supporting children and that it is necessary to focus on practices in this direction. Canbeldek [55] conducted a research to determine the effect of the robotic coding program he developed on the developmental areas and creativity of children. He worked with 80 children for a period of time in the study. As a result of the research, it was determined that there was a significant difference in the creativity dimension from the post-test scores of the children. Another area that we frequently encounter in robotic applications has been STEM and coding education.

Atabay and Albayrak [56] conducted a research to teach children algorithm training and technique in coding. It was studied with 12 preschool children for one semester. As a result of the research, they have reached conclusions that children can learn the concept of order in their algorithm abilities, divide what they have learned into parts, and think differently. In the compilation study of Sayginer and Tüzün [57], in which they compared coding trainings in Turkey and abroad, it was concluded that these trainings were started later in Turkey and they made suggestions on the necessity of making it systematized. Şimşek [58] conducted a research to determine the effect of STEM activities on children's creativity skills. In the study, 31 children at the age of five were studied for 8 weeks. As a result of the research, it was concluded that there was a significant increase in children's creativity skills. Another similar study was carried out by Güldemir and Çınar [59]. The researchers worked with 60 children from the age group of five-six for 8 weeks, accompanied by six STEM activities. As a result of the research, a significant increase was found in the creativity abilities of children. Üret and Ceylan [60], on the other hand, investigated whether STEM activities have an effect on the creative thinking skills of five-year-old children. It was studied for 8 weeks with 30 children. As a result of the research, significant differences were found in the level of creativity skills of children who were applied STEM activities. Stylianidou et al. [61] aimed to determine the effect of STEM activities applied to children in early childhood on the creative thinking skills of children in their 30-month study, which they called junior scientists. As a result of the research, they concluded that STEM activities applied to children had a positive effect on children's creative thinking skills.

When the above-mentioned studies on the use of technology and creativity of children in early childhood are evaluated in general, it is seen that technological programs suitable for the development of children support their creativity and also have positive outputs on other developmental areas.

## 4. Technology-creativity relationship in childhood

In childhood, the child has officially started a school. During this period, the child has desires to be successful and to be appreciated. For this reason, children sometimes

seek the interest and closeness they cannot find from their peers or teachers in virtual environments. In this case, risks that are not suitable for their age and development may be encountered [30]. However, childhood can be considered as an area where children need to structure their future professionally correctly. In studies on children being together with technological tools, it has been concluded that academic failure, emotional and behavioral problems can be seen as a result of these children's exposure to inappropriate programs or technological tools [62, 63]. At the same time, in the period when the child starts school, the child may stay away from creativity from time to time in an effort to be successful academically. As a result of not supporting this innate ability or lack of the necessary environment to support it, the creativity ability of the child may also atrophy [64–67]. In order to prevent all these negative situations, it is very important to support technology and creativity together in childhood, as in other periods.

Educational technological games were the first application encountered in the literature to support technology-creativity in childhood. Sayan [68] wanted to determine the effect on children's academic achievement and creativity skills by using educational games for primary school children. As a result of the research he conducted with 76 students over a period of time, he reached the conclusion that children gained significant gains in their academic achievement and creativity. Sayan and Hamurcu [69] conducted a research to determine whether the educational games they developed in the primary school science and technology lesson have an effect on children's creativity. In the study, 76 students were studied during a course period. As a result of the research, it was concluded that educational games have significant effects on children's creative thinking skills. Aljraiwi [70] developed a web-based educational game setup for primary school students and wanted to determine whether this setup is meaningful on children's creativity. As a result of the research, significant differences were obtained on the creative abilities of children. Bulut et al., [71] carried out a research to determine how the educational games developed by the students in the fifth and sixth grade of primary education affect their creativity. The study was conducted with 23 children and over a period of time. Children were asked to design and develop their own educational games. At the end of the study carried out in the technological environment, it was determined that the children enjoyed learning and that there were significant changes in their creativity. Yücelyiğit and Aral [72] conducted a study to determine the creativity abilities of children playing educational games in digital technology. In the study, 61 children aged between seven and fifteen years were studied. The games that children played in the digital environment were determined and they concluded that the creativity skills of the children playing these games were at a higher level. In addition to educational games, robotic coding for children in childhood is also very important.

Göksoy and Yılmaz [73] conducted a study to determine the creativity abilities of children receiving robotic coding training. Interview questions about different problem situations were asked to the children and the answers given were analyzed. As a result of the research, it was determined that the creativity skills of the children were at a high level. Haymana and Özalp [74] conducted a study to determine the effect of robotic coding education on children's creativity. Robotic coding training was applied for ten weeks with 30 children. As a result of the research, it was concluded that robotic coding education had a significant effect on children's creative thinking skills. Jiang and Li [75] conducted a study to determine whether Scratch language education has an effect on creativity on children studying in primary education in China. A five-week training was conducted with 336 Chinese children. As a result of

the research, it was determined that significant gains were obtained on the creativity abilities of children. Akçay et al. [76] conducted a study to determine whether the robotic coding activities they developed for children in the primary school period have a significant effect on children's creativity abilities. In the study, they worked with 30 students studying in the third and fourth grades of primary education for a period of four weeks in the after-school period. After four weeks, it was determined that there was a significant increase in the creativity abilities of the children. Aytekin et al. [77] in their compilation-type study in which they examined robotic coding programs, it was determined that such programs made significant gains on children's creative abilities, and therefore they presented their views on supporting all children in this area. Another study was carried out by Oluk et al. [78]. Researchers wanted to determine whether the Scratch robotic coding program has an effect on the creativity levels of primary school fifth grade students. As a result of the research they conducted with 62 children, it was determined that there were significant differences in the creativity abilities of the children as well as their computational thinking skills. In this context, there are studies that show that STEM activities have significant effects on the creativity of children in childhood.

Jawad and Majeed [79] developed activities using STEM activities with 32 primary school children. As a result of the activities applied to the children, the creative abilities of the children were measured. As a result of the research, it was determined that there were significant differences in the creative abilities of children. Kang [80] worked with children in primary schools in South Korea. As a result of the longitudinal research, it was found that the children who participated in STEM activities in the primary education period were quite advanced in their creative thinking abilities both at the moment and in the future. Today, in addition to STEM activities, augmented reality application is an application used in every education period.

Buluş Kırıkkaya and Şentürk [81] carried out a research to determine how children's academic achievement and creativity abilities are supported in the science lesson held with the augmented reality application. Information about the solar system was presented to the children with augmented reality technology for three weeks with 24 children. In the post-test application performed three weeks later, they concluded that the academic achievement of the children increased considerably compared to the control group, and the creativity abilities of the children were supported. Yousef [82] conducted a study to determine whether augmented reality applications affect the creativity abilities of sixty-two students in Egypt. In the research, the subjects were presented to the children with augmented reality applications during a learning period. As a result of the research, it was determined that both academic success and creativity skills of children increased significantly. Yılmaz and Göktaş [83] conducted a research to determine whether story activities prepared with augmented reality applications have an effect on children's creativity. In the study, 100 children were studied over a period of time. The story activities were presented to the children with the augmented reality application. As a result of the research, it was determined that there was a significant difference in the creativity of children. Chen, Chen, and Wang [84] tried astronomy learning in primary school with augmented reality application. As a result of the research, it has been concluded that children's learning is supported, learning becomes enjoyable and their creativity skills develop.

It is also seen in the researches that the use of technology and creativity together in childhood causes important results in both academic success and creativity of children, as in other periods.

## 5. Technology-creativity relationship in adolescence

Combining technology with creativity is also very important for adolescents. It can be stated that there are basically two reasons underlying this importance. The first of these is that children in this period use technology intensively and sometimes inappropriately. Another reason is the war that children in this period fight to build their future [85]. The efforts of children to shape their futures may prevent them from using their creativity [85, 86]. For this purpose, it is necessary for adolescents to feed their interest in technology with creativity.

The first application made with adolescent children is a program developed by Prensky [87] and called "Developing Children's Worlds", in which technology is used intensively. Prensky brought adolescents together with the problems they may encounter in the real world in a simulative environment, asked them to find solutions to these problems, and stated that their creativity skills were supported by the solutions they found. In connection with this project, children in adolescence produced original projects for themselves and shared their original projects on social media platforms. One of the other applications for adolescents was on programming and coding education. İrkin and Akbulut [88] wanted to adolescents to produce original products and embody their thoughts in the Technology and Design course. In this context, children were presented with programs coded in accordance with their age and developmental characteristics, different problem situations were produced in these programs and children were asked to find different solutions to these problem situations. As a result of the evaluation, it was determined that the children found different solutions to new problems and applied them.

STEM activities make positive contributions to the academic achievement of children in adolescence, as in every period. Based on the developmental characteristics of children, STEM activities focus on different areas. One of them is the "ALGODOO" program. This program can be expressed as a program developed based on Archimedes' physical theory. The first of the studies reached by the program is the research conducted by Çelik et al. [89]. The aim of the researchers is to teach physics to 10th grade high school children through the program and to determine what the children's achievements are. After the program they applied for a period, it was determined that the academic success of the children in the adolescence period increased in the physics course and they offered original solutions to the problems. Çayvaz and Akçay [90] is another of the researchers who implemented the "Algodoo" program and tried to determine its effects. Researchers applied the program to 6th grade students and determined the achievements as a result of the program. As a result of the research, it was concluded that there were positive changes in the attitudes of the students towards the lesson and that they were able to think critically at the same time. Turan Güntepe and Dönmez Usta [91] applied the program to 23 sixth grade students. As a result of the study, other research findings were supported and it was determined that children showed critical and creative thinking abilities. Karakuzu and Bektaş [92] conducted a study using the program with seventh grade students with low academic achievement. As a result of the research, it was concluded that children participate in learning with pleasure, their academic achievements increase and their scientific creativity is supported. Another example of the technology-creativity relationship in adolescence is found in the research conducted by Wang.

Wang [93] conducted a study to determine how the creativity abilities of adolescents change while producing music. He worked with 25 adolescents in the study. He wanted to determine the creativity abilities of adolescents while composing, singing

and vocalizing music in a music room. As a result of the research, he found a directly proportional relationship between creating music and creativity.

When the researches are examined, it has been concluded that when technological tools are applied in adolescence, taking into account the developmental characteristics of adolescents, they can cause significant effects on creativity abilities.

## 6. Method

In the research, which was carried out to determine and support the relationship between technology and creativity in childhood, a literature review was carried out. In this context, the "Google Scholar" database was used as the database. While searching in the research, basically two assumptions were emphasized. The first of these is how children use technology from infancy to adolescence and what is the effect of the technology used on children. The other assumption is how the technology-creativity relationship is handled in research on children from infancy to adolescence. While scanning the literature, the views of parents and teachers were excluded for the first assumption. In this sense identified, five studies were for infancy; eight studies were for early childhood; seven studies were for childhood and two studies were for adolescence. Experimental studies were also taken into account in the relationship between technology and creativity, which is the second postulate of the research. In this context, it was determined that six studies were for the relationship between technology and creativity in infancy, fifteen studies were for the relationship between technology and creativity in early childhood, seventeen studies were for the relationship between technology and creativity in childhood, and seven studies were for the relationship between technology and creativity in adolescence. Studies whose full text can be accessed were included in the study. Articles that are not open access are excluded. At the same time, the opinions of teachers and teacher candidates were also excluded from the scope of the study. Only three studies included compilation studies in order to see the situation in Turkey and in the world. In addition, while the studies were included in the study, special attention was paid to the studies of the last 10 years (2012–2022).

For the studies reached, it was first determined how technology was used from infancy to adolescence. In this context, it has been determined that technology is frequently used by children in every period. However, at the same time, research results were found that these tools, which are found in the literature, have the potential to cause harm when they are not used in accordance with their purpose, and the researches are explained by considering the scope of the subject. In the research, it was investigated which studies on the technology-creativity relationship from infancy to adolescence. In the studies reached, the sample group, with whom and how the study was conducted, and the results were explained within the scope of the subject.

## 7. Discussion

In the research conducted to examine the technology-creativity relationship in childhood, it was concluded that technology supports children's creativity as a result of using different activities and in accordance with the developmental levels of children [94–96]. However, on the contrary, it is seen that as a result of the inappropriate use of technology by children, it can damage their developmental areas and bring many negative consequences. It is possible to deal with this situation with

the immaturity of the developmental areas of children [19, 22, 63, 97]. While the baby is trying to discover a world that he does not know in infancy, it is obvious that the important point for him will be possible with individuals or technological tools that have a pattern of mutual communication and interaction. As a matter of fact, the baby's synaptic connections will only be possible by responding to the sounds it makes and by offering different activities to the baby by the people who are interested in it. The environment to be arranged for the sounds babies make will support their cognitive development, primarily language development. Moreover, it is a necessity for the baby to have stimuli that he can pick up and touch for his developing motor activities. All these will make it easier for the baby to use his innate creativity and transfer it to other environments [30]. Thematic broadcasts on television or computer programs to be organized for babies, electronic books will support all developmental areas of babies, and as a result, the stimuli in the technological tools that the baby sees, hears, feels and touches will make it easier for him to make different discoveries, in other words, will pave the way for the nurturing of his creativity ability [25, 35, 36]. As a matter of fact, studies have also supported this finding [34, 37, 38]. The child's interest in technology and technological tools should be combined with creativity in the early childhood period, which results in babies starting to walk and exploring the environment.

Early childhood is a period in which the child can act more independently, manage his environment and contribute positively to his developmental areas. The child can behave more individually with the developing areas of development. However, although the situation is in this direction, the child's need for support continues. As a result of the child's establishing his relationship with the world on solid foundations, he will develop in a healthy way and in this case, he will be able to affect his whole life [8, 98, 99]. In this context, the technological tools that will be presented to children have more importance than is thought. In addition to the thematic publications for children in the previous period, electronic books that will feed early language and literacy skills will emerge as important. Again, it is clear that one of the developmental characteristics of children in this period is their sense of curiosity. In a way that satisfies this sense of curiosity, robotic applications, coding and STEM activities for children will both enable children to explore their surroundings and support their active structure [52, 54, 100, 101]. In the researches, it has been concluded that electronic books, STEM activities, augmented reality applications, robotic coding and applications applied for children in early childhood have a significant contribution to the development of creativity skills in children [46–61].

Another finding reached in the research was the gains obtained as a result of supporting the technology-creativity relationship in children in childhood. As it is known, during childhood, children officially start school, academic achievements come to the fore, and continue each year by building on the previous one [30, 66]. However, considering that children have individual learning differences, it turns out that not every child can learn in the same way [102]. In this context, electronic environments, robotic coding, robotic applications and STEM activities to be presented to children are more important than it is thought. Thus, through the programs to be developed for each child, the child will be able to learn, enjoy learning, and do more research with pleasure. This situation will increase academic success, especially social-emotional development. Increasing the academic success of children will also help increase the rate of school attendance. In addition to all these, as a result of children's development areas becoming more mature than in previous periods, the desired human profile of the 21st century will be revealed by combining technology

with creativity [10, 72, 103–105]. In the researches, it was concluded that web-based educational games, technological educational games, robotic coding, augmented reality applications and STEM activities in childhood increase the interest in learning, help each child learn according to their potential, and ensure the continuity of their creativity skills [68–84].

The last finding obtained in the study was the relationship between technology and creativity in adolescence. The fact that children are required to use technology in adolescence, which has a special importance in childhood, can bring them to an important position both in preparing them for the future and in supporting their creativity [85]. One of the important developmental characteristics of the child in adolescence is the feeling of being liked and appreciated. Realizing this feeling on the social media platforms that he has established and managed can become an important gain for him. At this point, the child's production of original products and sharing these products will provide a double benefit to children in adolescence. Not only will the child have the feeling of being admired, which is an important need of the developmental area, but also other peers like him will take initiatives for these initiatives [10, 106, 107]. Such a situation will also support them to use their creative potential. In the researches, it was concluded that web-designed models, STEM activities, and programming of different web applications to be used in adolescence increase the academic success of children and have important outputs on their creativity [87–93].

## 8. Conclusion and recommendations

In the research, which was carried out to examine the technology-creativity relationship in childhood, it was concluded that the creativity abilities of babies and children increased as a result of the use of technological tools and programs. However, although this situation has been revealed by studies, it is seen that the number of studies is not sufficient, and it is noteworthy that it concentrates especially in early childhood and childhood. In this context, it is thought that it is necessary to make some suggestions considering the use of technology in infancy and adolescence. In addition to all these, it has been revealed by research that the use of technology from a very early age and the use of programs that are not suitable for its purpose can harm children. If the statements are considered as a whole, it is possible to make the following suggestions.

- Conducting more experimental studies that will address the technology-creativity relationship with the entire childhood period,
- Providing interactive applications to babies by caregivers and teachers who take care of babies during infancy,
- Creating publications with thematic content depending on the developmental characteristics of the baby during infancy and supporting them with interactive features,
- Taking and implementing the necessary measures in order to deliver robotic coding for children in early childhood to disadvantaged children,
- Carrying out robotic coding and applications with children in early childhood,

- More applications related to augmented reality also take place in early childhood,
- Implementation of web-designed programs for children in childhood, by considering them in a broader perspective,
- Considering the developmental ages of children in all of these practices,
- It is recommended to offer and implement environments for adolescent children where they can combine their technological knowledge with creativity.

## Conflict of interest

The authors declare no conflict of interest.

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Chapter 9

# Developing Creativity via LEGO and AI Robotics

*Um Albaneen Jamali*

## Abstract

The chapter reports on a longitudinal study, which investigated the impacts of robotics programs on developing creativity among elementary school students. A mixed method of pre-post CAP test and observations was used for the purpose of this study, which was carried out over 2 years. A sample of 60, 10–12 year-old female students from middle socio-economic status participated in the study. They were randomly assigned into two treatment and control groups. In the first year of the study a LEGO robotics program was administered to the treatment group while 30 participants in the control group did not receive any robotics program. In the second year, an Arduino robotics program using AI was administered to the students in the treatment group while the students in the control group did not receive any robotics intervention. The results from pre-post tests indicated that the LEGO robotics intervention was significantly effective in developing creative thinking skills of fluency, flexibility and elaboration while had no significant impact upon developing originality. However, robotics programs using AI had significant impact upon developing all creativity thinking skills of fluency, flexibility, originality and elaboration. The chapter suggests implications for policymakers and educators while provides recommendations for future researchers in the field.

**Keywords:** creativity, robotics, LEGO, artificial intelligence AI, education, fluency, flexibility, elaboration

## 1. Introduction

Achieving long-term sustainability, has stimulated many countries to reach for solutions to address limitations to resources. This will require innovations and creativity in all fields. Sustainability and creativity are, hence, closely interconnected. Creativity is at the heart of sustainable development, rooted in sustainable economic, educational, social and environmental practices. In this respect, creativity includes imagination and ingenuity, while goes beyond to include new technologies, and new approaches of using existing technology. The Industrial Revolution 4.0 has opened up new avenues for creativity and innovation, which requires various fields, particularly, education to re-design its programs to meet new and changing demands. The current paper first defines creativity and its skills, and then attends to educational programs

fostering creativity, including robotics and artificial intelligence, AI. The paper, then, explores the present longitudinal study, which examined the effect of LEGO robotics and AI on developing creative thinking skills among female, primary-school students, and suggests implications for future.

## 2. Creativity

Creativity means generating or producing something useful, original and novel [1]. Different meanings, definitions and models were linked to creativity. These variations, however, do not indicate contradiction nor confusion, but denote how creativity was discussed and elaborated in detail in various settings [1].

### 2.1 Creative thinking

Creative thinking has been linked with a variety of thinking patters and thinking skills. Some researchers highlighted the importance of three patterns of divergent, convergent and emergent thinking in creativity [2, 3]. According to this perspective, creativity requires divergent thinking where original and novel ideas will be produces; convergent thinking where the novel ideas will be assessed for its usefulness; and finally emergent thinking, which translate the novel and useful ideas into creative products.

Furthermore, these patterns of creative thinking require adopting a number of creative thinking skills. Fluency refers to generating a number of ideas, flexibility denotes producing different thought, and originality refers to generating unusual and novel ideas, while elaboration denotes adding details or features to the final product [4].

## 3. Fostering creativity in education

A proliferation of educational programs has intended to develop creative thinking skills among students. These programs foster creativity through two major approaches. In direct approach, the creative thinking skills are being introduced independent from the curriculum and then relative activities being practiced. Indirect approach refers to when creative thinking skills are being integrated in curriculum and presented in subject-related activities, without necessarily introducing the specific thinking skill. The later approach is widely used in designing educational programs.

However, these programs are either outdated in the sense that the specified and detailed instructions are either too lengthy and de motiving or lacking innovation and creativity; while demonstrating little or no connection to 21 century's major improvement, technology. The current paper is an attempt to avoid these limitations, presenting the use of technologies in terms of LEGO robotics and Artificial Intelligence (AI). Providing such programs may well serve teachers and parents in their attempts to develop creativity. The chapter shed lights on LEGO robotics and AI robotics and related research in the field. It, then, emphasize on a research conducted in this regard, providing implications for educators and parents.

### 3.1 LEGO educational robotics

The educational robotics kit used in the current study is The LEGO® Education WeDo™ The kit sold by LEGO Group online and was contributed to schools by the Bahraini Ministry of Education. On the other hand, other LEGO robotics kits available in market are usually pre-built robots or are remote-control machines. Such robots are not technically considered as robots (i.e. they do not function on the basis of collecting input from the external contexts and environment). The LEGO® Education WeDo™ kit included 280 colorful bricks, a smart hub, a motor and two sensors. The sensors collect inputs and data from the outer settings, whereas the smart hub represents the robot's brain, therefore, organizing the sensors and motors to perform through coding. The WeDo 2.0 software uses Bluetooth technology and can be run through a computer or a tablet. The LEGO® Education WeDo™ Software provides an icon-based programming setting, which is used to create coding by dragging and dropping coding Blocks into a sequence on Canvas or the computer screen. Creating LEGO robots can involve a great deal of complexity. Researchers indicated that, for example, six colorful LEGO bricks can be joint in one billion different ways [5].

### 3.2 AI educational robotics

Robots and artificial intelligence (AI) have enabled innovative solutions to the challenges faced by humans in all fields including education. Nowadays, AI robots are used to bring technology and humans closer together, solve problems, and transform ideas to meet changing demands. AI robots such as Arduino-assisted robots used in this study, are augmented with a variety of sensors (including vision devices, accelerometers, proximity sensors, and other environmental sensors,) that feed them with sensing data they can analyze and act upon in real-time. Arduino consists of both a physical programmable circuit board and a piece of software, that runs on computers, and is used to write and upload a simplified version of C++ code to the physical board. Arduino kit provides building block for robot builders to create connected, intelligent, and reliable robotics solutions. AI enables Arduino robots to:

- Collect information through sensors
- Analyze the collected information
- Make inferences based on their environment and overall mission
- Act accordingly to deliver the best outcome

AI-driven robots are more competent than the ones without this technology, saving human effort and time while ensuring accuracy, validity, and minor errors.

### 3.3 AI robot and machine learning

To better understand what AI robots are, it's significant to understand what makes them intelligent. Artificial intelligence refers to a broad class of systems that enable machines to mimic human capabilities. To make a robot truly intelligent Machine

Learning is required. Machine learning uses algorithms that enables the robots to use real-time data and contextual information acquired to make predictions and decisions [6].

## 4. Research on LEGO robotics and AI robotics

A growing body of research studies have examined the impact of LEGO and AI robotics in fostering creativity. Some of these research show now be highlighted.

### 4.1 LEGO robotics & creativity

Zviel-Girshin and Luria [7] investigated the addition of robotics education in kindergarten and elementary school as a tool for raising confidence, enhancing technological thinking, developing twenty-first century skills including creativity. A quantitative survey of 197 children of both genders and a qualitative analysis of interviews were presented. Results showed that kindergarten and elementary school children fostered creativity and felt confident in building new robots, and indicated positive attitudes towards technology, science and robotics. Male participants demonstrated more positive results compared to their female counterparts.

Coxon, Dohrman and Nadler [8] in their study of 60 students aged 6–12, examined the impact of integrating robotics in curriculum on children's math achievement. The unit included an engineering design loop to help children create and code robots using LEGO WeDo 2.0. The mixed method analysis included pre- and post-assessment of students' understanding of fractions and the Cognitive Abilities Test Screening Form 7 (CogAT 7). The robotics intervention program resulted in significant achievements in math (Cohen's d = 0.72) consistent for children at multiple ability levels and those traditionally underrepresented in STEM fields (i.e. race, gender, and socioeconomic background). Also, students successfully demonstrated creative thinking skills of fluency and flexibility.

Hendrik, Ali and Nayan [9] study examined the use of Robotic Technology as a learning tool to develop students' Figural Creativity (FC). Forty elementary school students aged 10–11 years, participated in this study. Students' creativity skills were assessed using the Figural Creativity Test (TKF). The findings from pre-post assessment indicated 23% creativity improvement among students in K-13 Curriculum with sig. 2-tailed = .000, $p < .05$. students indicated development of creative thinking skills of fluency, flexibility and elaboration. They recommended that robotic technology to be applied in the educational sectors.

The effect of robotics on creativity was further investigated by Kim and Coxon [2]. A sample of 50 students aged 6–15 participated in a controlled intervention study following a First LEGO League for a period of 20 hours in 4 days. The results demonstrated significant gains in creative thinking skills, particularly flexibility and elaboration, in favor of male participants. Flexibility gains, however, were most meaningful as the two-tailed p value of less than.001 was indicated.

### 4.2 AI robotics & creativity

AI robotics have been the subject of many research studies in the last decade. Guven et al. [10] aimed to determine the effects of Arduino-assisted robotics coding applications on children's robotics attitude, scientific creativity and motivation. The

mixed research method was conducted with 11 (6 females and 5 males), 6th grade students in a STEM in 2018–2019 academic year. Quantitative data collection tools included scientific creativity scale, motivation scale and robotics attitude scale, while qualitative data was collected through semi-structured interviews. The results suggested that the levels of children's creativity, attitude and motivation increased with the robotics coding activities integrated into science curriculum. In addition, students demonstrated creative thinking skills of fluency, flexibility, originality and elaboration while showed solving many daily-life problems. The researchers called for implementing Arduino-assisted robotics coding applications in the teaching of 6th grade science curricula.

Kim and Lee [11] examined the impact of integrating Arduino in educational program on fostering creativity. The developed educational program was applied to 20 high school students for a period of 36 hours. The results, however, demonstrated no statistically significant change in participants' creative problem-solving ability. Upon exploring their views on Arduino-based education, the students noted that the Arduino-based program was interesting with some accomplishment. However, they felt overwhelmed by difficulties in designing and debugging. Researchers called for reconsideration of teaching materials, teaching-learning methods, and activities before integrating AI in education.

Chou [12] investigated students' learning performances in an Arduino-based educational robotics program. A learning setting was designed at a public elementary school in Taiwan. 30 grade five students participated in an after-school program for 16-week. They were randomly divided into two controlled and experimental groups. Children in the experimental group participated in a weekly educational AI robotics program, whereas those in the controlled group engaged in other activities like homework practice. A mixed method of observation and pre-posttest design of controlled and experimental groups was employed to assess the students' problem-solving skills, computer programming and electrical engineering. The quantitative findings indicated that AI robotics programs significantly developed their problem-solving skills, besides fostering the electrical engineering and computer programming content knowledge. The qualitative findings from observation indicated children's applying varieties of alternatives (flexibility), novel and original ideas (originality) in creating AI robots to solve real-life problems. In interpretation of the results, the researcher emphasized on ease of applying Arduino solutions in everyday life. She also noted the importance of providing students with support on software and hardware debugging.

On the other hand, the above studies had some limitations, which should be considered. Some studies were performed in controlled environments while students participated in an intense robotics curriculum over an abbreviated period. Furthermore, most of the mentioned studies used quantitative methods, while the selected sample were very small, and were not representative of female gender. Moreover, the mentioned studies did not examine four major creative thinking skills of fluency, flexibility, originality and elaboration and in some studies the skills development was determined during observation. Employing creativity standardized tests would provide a better opportunity to compare and contrast the results from previous, current and future research studies. In an attempt to avoid these limitations, the present study investigated changes in students' creativity prior to and after conducting robotics interventions in a classroom setting and over a course of 12 weeks and among a sample of 60 female students. The study hypothesis denoted that LEGO and AI robotics intervention positively affect developing creativity thinking skills of flexibility, fluency, elaboration and originality among students.

## 5. Methods

### 5.1 Research design & sample

A mixed method was used for the purpose of the current study. Qualitative approach included observation and interview. The researcher observed students' designing and coding robots and conducted 30 minutes of semi-structured interviews asking students to elaborate on their robots. The quantitative method consisted of a control treatment and pre-posttest design.

The study's random sample included 60 female students, who ranged in age from 9 to 12 (n = 60). They attended a local primary girls school in Bani Jamra and came from middle socio-economic backgrounds. The student participants were randomly allocated into controlled and treatment group. Were, mostly, from middle socio- economic status and attended a primary girls school in an inner area of Bani Jamra. They were randomly assigned into two groups of treatment and controlled group.

Furthermore, the homogeneity of variances were assessed by Levene's test and Independent Samples t-test. The participants' creativity was measured according to CAP [13] before performing the study. The results demonstrated that there was homogeneity of variances, as assessed by the Levene's test for equality of variances, for creative thinking skills, $p > .05$. The results indicated following $p$ values regarding over all creativity, and skills of fluency, flexibility, originality and elaboration respectively (.347, .380, .105, .584, .872), which were not significant. Similarly, the results from independent samples t-test yielded no significant gains at over all creativity, fluency, flexibility, originality and elaboration respectively (.680, .486, .840, .559, .779). It further indicated the equality and homogeneity of variances in terms of creative thinking skills (**Table 1**).

### 5.2 Procedures

The current longitudinal study was performed during two years. In the first year LEGO robotics intervention was executed for students in the treatment group, while

| Group | test | df | Mean | SD | Levene's test | | T test | |
|---|---|---|---|---|---|---|---|---|
| | | | | | F | *p* | (t) | (*p*) |
| Controlled | CAP general score | 30 | 38.633 | 6.965 | .899 | .347 | −.415 | .680 |
| Treatment | CAP general score | 30 | 39.333 | 6.064 | | | | |
| Controlled | Fluency | 30 | 11.133 | 1.432 | .781 | .380 | −.701 | .486 |
| Treatment | Fluency | 30 | 11.366 | 1.129 | | | | |
| Controlled | Flexibility | 30 | 6.433 | 1.406 | 2.709 | .105 | .202 | .840 |
| Treatment | Flexibility | 30 | 6.366 | 1.129 | | | | |
| Controlled | Originality | 30 | 2.000 | 1.286 | .303 | .584 | −.588 | .559 |
| Treatment | Originality | 30 | 2.200 | 1.349 | | | | |
| Controlled | Elaboration | 30 | 19.066 | 4.585 | 0.026 | .872 | −.281 | 0.779 |
| Treatment | Elaboration | 30 | 19.400 | 4.590 | | | | |

**Table 1.**
*The results of the Levene's test and independent samples t-test.*

their counterparts in the controlled group received no robotics intervention. The program was delivered on weekly session of two hours for a duration of 12 weeks. In year two of the study, the intervention included Arduino robotics program, using artificial intelligence AI technique. Similar to the year one of the study, the program was delivered to the treatment group on weekly session of two hours for a duration of 10 weeks. Students in the controlled group received no intervention. Students' creativity was measured using Frank Williams [13] Creativity Assessment Package (CAP) prior and after the LEGO robotics and AI interventions. Furthermore, the researcher observed participants" performance during the class activities of building and coding robots. The observations followed semi-structured interviews of 30 minutes long where students elaborated on their robots.. The quantitative data aimed at presenting an overall picture of the effects of robotics programs on participants' creativity thinking skills, whereas the qualitative data sought to provide further insight into such possible effect.

### 5.3 Data analysis

Mixed methods were used to ensure triangulation. The study design of study included a pre and posttest design. Quantitative data were collected from students' performance on CAP tests prior and after the robotics programs, CAP test included 12 square frames with a simple line inside each frame, which served as a stimulus. Students were required to complete as many as 12 drawings using these lines. Creative thinking skills of flexibility, fluency, elaboration and originality were measured via these drawings. The resulted data were analyzed using the t-test with repeated measure.

The qualitative data included observation of how participants' design and cod robots through adopting creativity thinking skills of flexibility, fluency, originality and elaboration. Students' interview transcripts were also used to inform the observation.

## 6. Results

The findings from both quantitative and qualitative data in two years of study yielded interesting results. The student participants achieved higher scores on creative thinking skills following the robotics interventions in the treatment group, when compared to their counterparts' scores in the controlled group, and these changes were significantly different. The results from each intervention shall now be discussed in more details.

### 6.1 LEGO robotics intervention

In regard to LEGO robotics intervention (**Table 2**), the results from t-test with repeated measures indicated significant gains at students' over all creativity scores in posttests compared to their scores in pretest, $t(29) = 2.963$, and $p = .006$ ($p < .05$). The findings were in favor of students' performance in the treatment group. Participants' over all creativity scores in the treatment group (M = 41.000, SD = 6.000) demonstrated a rise of an average 2.8 compared to students' in the controlled group (M = 38.200, SD = 6.758) as presented in **Table 3**. This suggested that LEGO robotics

| Group | test | N | Mean | SD | (t) | (p) |
|---|---|---|---|---|---|---|
| Controlled | CAP general score | 30 | 38.2 | 6.7589 | 2.963 | **0.006** |
| Treatment | CAP general score | 30 | 41 | 6 | | |
| Controlled | Fluency | 30 | 11.1333 | 1.4319 | 2.536 | **0.017** |
| Treatment | Fluency | 30 | 11.3667 | 1.129 | | |
| Controlled | Flexibility | 30 | 5.4667 | 1.5024 | 2.009 | **0.054** |
| Treatment | Flexibility | 30 | 6.2 | 1.4479 | | |
| Controlled | Originality | 30 | 1.9333 | 1.2847 | 0.744 | **0.463** |
| Treatment | Originality | 30 | 2.1333 | 1.0742 | | |
| Controlled | Elaboration | 30 | 18.7333 | 4.5328 | 1.868 | **0.072** |
| Treatment | Elaboration | 30 | 20 | 4.6683 | | |

**Table 2.**
*The results of the t-test with repeated measures comparing students' posttest scores after LEGO robotics intervention on subscales of creativity in the treatment & controlled group.*

programs resulted in developing overall students' creativity. The results provided support for earlier mentioned studies [2, 7–9].

Furthermore, the t-test comparing fluency scores of students in both treatment and controlled group demonstrated significant increases at the posttest, t (29) = 2.536, and p = .017 ($p < .05$) favoring the participants' scores in the treatment group. Fluency increases were the most statistically significant compared to other creativity thinking skills as the $p$ value of .017 was demonstrated, similar to the earlier mentioned study [2]. Similarly, students' performance on various activities and their interview subtracts supported the above findings. For instance, a group of students in the treatment group explained how their robotic fan performed numerous missions (i.e., fluency) of providing electricity to the building, water filtering, watering plants and so on and forth. In harmony with [2, 8, 9] studies, the results suggested that LEGO robotics programs resulted in developing fluency.

Moreover, in regard to flexibility subscale of creativity, students' scores on posttest in the treatment group demonstrated significant increases, (t (29) = 2.009, and $p$ = .054 (p < .05)) compared to their counterparts' scores in the controlled group. Likewise, the t-test comparing elaboration posttest scores in both treatment and controlled group showed significant increase at the posttest, t (29) = 1.868, and $p$ = .072 ($p < .05$) in favor of the students' scores in the treatment group. Students' performance on robotics tasks indicated the development of creative skills of elaboration and flexibility. For example, student participants were able to add details regarding a robotic butterfly in a polluted environment. The details included small bumps on the body, extra eye, colored spots on the wings and so on and so forth. The findings were in line with previously mentioned studies [2, 8, 9]. This suggested that LEGO robotics programs resulted in developing. Flexibility.

On the other hand, the results regarding the thinking skill of originality yielded no significant gain, t (29) = 0.744, $p$ = .463. Nevertheless, student participants in the treatment group (M = 2.133, SD = 1.074) obtained higher scores than their peers in the controlled group (M = 1.933, SD =1.284). The findings from the conducted interviews indicated limited signs of fostering originality skill among some participants. For example, a group of students produced a smart mask, featured robotic sensors and

Oregano leaves from school garden. Such novel creative product, where nature met technology achieved the first prize in Bahrain's fair of future scientists. The findings suggested that LEGO robotics programs did not result in developing originality.

### 6.2 AI robotics intervention

Likewise and in regard to AI robotics intervention, the paired samples t-test comparing creativity posttest scores after the intervention in the treatment and controlled groups demonstrated significant gains at posttest, t(29) = 3.439, and p = .002 ($p < .05$) in favor of students' scores in the treatment group, as presented in **Table 3**. Student scores after AI robotics program (M = 45.233, SD = 8.426) showed an increase of on average 6.533 points compared to their counterparts in the controlled group (M = 37.866, SD = 9.933). This suggested that AI robotics programs resulted in developing overall students' creativity. It supported earlier research studies [10, 12].

Furthermore, the t-test comparing fluency posttest scores in both treatment and controlled group indicated significant gains at the posttest, t (29) = 3.193, and $p = .003$ ($p < .05$) in favor of the students' scores in the treatment group. In the same way, students' performance on various activities and their interview subtracts supported the above findings. For instance, a student explained how she build and programmed an Arduino robot to do numerous missions (i.e., fluency) of providing data regarding the soil ph, soil moisture, soil temperature, air temperature, humidity, and so on and so forth. This suggested that AI robotics programs resulted in developing fluency.

Similarly, the p values regarding other skills of creativity in terms of flexibility and elaboration indicated following gains of .028 and .001 respectively, which were statistically meaningful. The t-test comparing flexibility posttest scores in both treatment and controlled group indicated significant gains at the posttest, t(29) = 2.305, and p = .028 ($p < .05$) in favor of the students' scores in the treatment group. Likewise, the t-test comparing elaboration posttest scores in both treatment and controlled group showed significant increase at the posttest, t (29) = 3.706, and p = .001 ($p < .05$) in favor of the students' scores in the treatment group. Students' Arduino robots indicated the development of creative skills of flexibility and elaboration. For example,

| Group | test | N | Mean | SD | (t) | (p) |
|---|---|---|---|---|---|---|
| Controlled | CAP general score | 30 | 37.8667 | 9.93334 | −3.439 | .002 |
| Treatment | CAP general score | 30 | 45.2333 | 8.42690 | | |
| Controlled | Fluency | 30 | 10.1000 | 2.61758 | −3.193 | .003 |
| Treatment | Fluency | 30 | 11.5333 | 1.22428 | | |
| Controlled | Flexibility | 30 | 6.2667 | 1.99885 | −2.305 | .028 |
| Treatment | Flexibility | 30 | 7.2333 | 1.25075 | | |
| Controlled | Originality | 30 | 1.5667 | 1.73570 | −1.975 | .058 |
| Treatment | Originality | 30 | 2.1000 | 2.00603 | | |
| Controlled | Elaboration | 30 | 19.1000 | 6.01922 | −3.706 | .001 |
| Treatment | Elaboration | 30 | 24.0667 | 4.47162 | | |

**Table 3.**
*The results of the t-test with repeated measures comparing students' posttest scores after AI robotics intervention on subscales of creativity in the treatment & controlled group.*

**Figure 1.**
*A cap developed by students consisted of 18 components doing four activities demonstrating the creativity skill of elaboration and fluency during a session with a focus on cooperative meaningful learning.*

student participants were able to create a cap, which consisted of 18 components and performed four activities using artificial intelligence, as presented in **Figure 1**. The findings supported the study hypothesis as AI robotics interventions resulted in developing fluency and elaboration. The findings were in line with previously mentioned studies [10, 12]. This suggested that AI robotics programs resulted in developing flexibility and elaboration.

Moreover, in contrary with the results indicated in the LEGO robotics intervention, students demonstrated significant increase on the subscale of originality following the AI intervention, t (29) = 1.975, $p$ = .058 ($p < .05$). The results from the qualitative method provided further support for the developed skill of originality. For instance, students in the treatment group created a smart garden where an Arduino robot was measuring ph soil, soil moisture and temperature and act accordingly to lower or higher ph soil by watering water and date or water and eggshells to prevent the growth of the unwanted cactus. Such unique and original idea at elementary levels was presented in the regional contest of challenging future science. This findings supported research studies that demonstrated the impact of AI robotics intervention on developing originality and unique ideas. A possible explanation of the developed skill, which was repeatedly mentioned by students in interviews, was their freedom to choose from variety of sensors and that developed originality. As a students stated "comparing to LEGO, Arduino robots are more real! Because of many sensors, they have. So it is much easier to think of unusual ideas." The findings suggested that AI robotics programs resulted in developing originality. The results provided support for earlier mentioned studies [10, 12] while contradicted [11] study.

## 7. Discussion

The findings from the current study provided insight into the impact of LEGO robotics and robotics applying artificial intelligence AI, on students' development of

creative thinking skills. The students' posttest scores in the treatment group who received robotics interventions (i.e. LEGO robotics or robotics programs using AI) indicated significant differences in creative thinking skills compared to students' posttest scores in the control group who received no robotics intervention. And this differences were in favor of students in treatment groups. The findings from qualitative data of task observation and students' interviews further supported the study's result, as students in the treatment groups repeatedly elaborated on their fostering fluency, flexibility, originality and elaboration. The findings suggested that both robotics interventions had positive impact upon developing students' creativity.

The results were consistent to earlier research studies [2, 7–9], which indicated positive impacts of robotics intervention on developing creativity. Furthermore, the findings in the first year of the study when LEGO robotics program was executed indicated significant gains in creative thinking skills of fluency, flexibility and elaboration. However, the findings in the second year of the study when the intervention program included robotics using AI, indicated significant gains in all creative thinking skills of fluency, flexibility, originality and elaboration. The results were consistent to earlier research studies [10, 12], which indicated positive impacts of AI robotics intervention on developing creativity. The reason behind this could be seen in terms of AI benefits. AI allows robots to perform activities faster and more accurately. The deep learning imbedded in AI enable robots to become smarter, enhancing their capabilities so they can perform more complex tasks. AI- powered robots are equipped with a variety of sensors (e.g. proximity, humidity and sound sensors, accelerometer and other environmental sensors), that enable them to sense data and, then analysis and act upon in real-time. These are what make them more "real" compared to LEGO robotics.

Moreover, the present longitudinal study was effective in developing a wider range of creative thinking skills in comparison with previous studies. I would like to take the view that the gains demonstrated in the current study could be due to the small sample, the length of robotics program, and the research context. The study was performed in participants' familiar surroundings of their classroom and the robotics program was delivered by their familiar teachers compared to some studies where stranger coach and researchers delivered robotics in an unfamiliar setting of an out-of-school clubs. In view of the students' age, a familiar classroom settings and a familiar coach might be advantageous in fostering creativity.

In addition, the study lasted for a prolonged period of 12 weeks. The aim was to ensure students' mastering of programs without being pressurized with the amount of information and difficulties of AI coding. The lengthy time might be effective in fostering creativity.

However, the current study had some limitations. The sample consisted of female primary school students from predominantly middle socio-economic status. Performing the studies with more diverse sample including both genders, from primary and secondary levels and from diverse socio-economic status may provide better insights into the impact of LEGO and AI robotics in future research studies.

Furthermore, the classroom context of the present study did not provide a controlled laboratory setting. However, the setting was sought to be advantageous in encouraging teachers to consider incorporating LEGO and AI robotics in curricula in their classroom contexts. Moreover, the current study applied quantitative and qualitative approaches. Adopting other mixed methods of data collection, such as case study may provide further information regarding how LEGO and AI robotics enhances creativity in children.

## 8. Conclusions

In summary, the chapter highlighted the impact of LEGO robotics and robotics using AI in developing creative thinking skills. The current study provided useful insights into the impact of robotics on developing creative thinking skills among Bahraini students. Executing LEGO robotics interventions was effective in fostering fluency, flexibility and elaboration while AI robotics suggested developing a wider range of creative thinking skills including fluency, flexibility, originality and elaboration. AI was considered advantageous in providing a realistic environment to develop creativity. As a result of the present study, policy makers and educators may consider various implications. Policy makers may consider providing training opportunities in LEGO and AI robotics as part of continual professional development programs; while fund large-scale and longitudinal studies in the field. School leaders and teachers may consider integrating LEGO and AI robotics in curricula. Worth noting that teaching AI robotics requires instructors who are well trained so the bugs in AI do not demotivate students. Likewise, manufactures may consider resolving the bugs with Arduino hardware and provide easy and applicable AI hardware for educational purposes. The present study demonstrated some attempts in enhancing sustainable development through fostering creativity. Further attempts are indeed, required to apply AI and robotics in education, and hence, foster creativity and enhance sustainable development in the near future.

## Conflict of interest

The authors declare no conflict of interest.

## Thanks

Special thanks to my students, princesses of creativity, who participated in my study.

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Chapter 10

# Digital Platforms in Teaching Arabic Dialects

*Asmaa Abdelbary, Livia Panascì and Cristina Solimando*

## Abstract

The use of teaching platforms and accessible online materials is a response to the increasing demand for distance training courses and, consequently, the need for innovation in the methodological, technical and strategical approaches to language teaching. In Teaching Arabic Language as Foreign Language (TAFL) the linguistic variation represents nowadays a central issue in the teaching practice. The Arabic linguistic world is usually described as diglossic speech communities. In the last decades, this representation of linguistic reality has been reviewed. The reconceptualisation of the diglossic theory leads to a deep reconsideration of the didactic material to use in teaching Arabic besides dialects as foreign language. Our proposal deals with the use of MOODLE in teaching Arabic colloquial varieties besides Modern Standard Arabic.

**Keywords:** Arabic dialects, digital platforms, Moodle, integrated approach, second language acquisition

## 1. Introduction

### 1.1 Teaching Arabic language in a post-pandemic academic context

In recent years, the teaching of foreign languages has faced challenges posed by the need to find pedagogical solutions in line with an unprecedented growth in digital resources in the e-learning environment. The Covid-19 pandemic accelerated the use of such resources and made online platforms indispensable in order to run language courses. Italy boasts a long tradition of in-class lectures and university-level instruction that is generally associated with face-to-face lessons [1–3]. Nevertheless, the need to find new methods of providing materials and online forms of interaction has, in fact, turned out to be an opportunity for rethinking methodologies and the renewal of content [4, 5]. The experience of Covid-19 provided the chance not only to discover new resources but also to use them in a more captivating format largely based on an interactive approach to learning [6, 7]. The use of online platforms and digital resources for teaching Arabic is very recent [8, 9]: the challenges of online language teaching coupled with Arabic teaching practice highlight a complex pre-existing situation. This complexity is due, firstly, to general backwardness in terms of methodology and practices and, secondly, to the objective difficulty of teaching a language characterised by such a sharp distinction between the oral and the written forms [10–12]. The coexistence of an official language—Modern Standard Arabic (MSA)—used in writing

and formal communication alongside different varieties of the colloquial language used in everyday speech creates difficulties in teaching the language. Indeed, language teaching practices and teacher education for Arabic have been questioned in recent decades spurred by ongoing processes such as the growing number of multicultural contexts and classrooms [13], the exposure of both learners and teachers to different varieties of Arabic through the media, as well as the shifting role of non-native teachers and teacher trainers in institutional contexts. These issues call for a rethinking of the directions that teaching practice should take, as well as a reconsideration of the curriculum and language policy regarding Arabic [14]. Moreover, one of the most hotly debated issues in recent years centres on how students should be exposed to language variation [15, 16], not only from a theoretical but also from a practical point of view. In this respect, research into the teaching of Arabic lags somewhat behind that of research into the teaching of many European languages. There are some practical and ideological reasons for this backwardness such as the delegitimisation of the teaching of dialects, the scarcity of materials and the dilemma of what variety of teachers should choose. Introducing students to the Arabic pluriglossia must tackle the major issue of the role of dialect in the curriculum. The introduction of spoken varieties allows students to have insights into the sociolinguistic reality of the language they intend to learn and to develop indispensable skills in order to communicate with native speakers in informal as well as formal contexts. Spoken Arabic is often stigmatised as a less prestigious variety of Arabic, even though it is the language of choice for day-to-day communication for native Arabic speakers. Knowledge of a spoken variety of Arabic is essential for students who hope to integrate with the Arabic-speaking world [17, 18].

Although a certain awareness of this need has arisen in recent years, the teaching practice still reflects a traditional method based only on the Standard variety with a focus on grammar.

The use of online resources, such as video and interactive activities, as well as a rethinking of traditional methodologies experimented during the Covid-19 pandemic, provided the chance to reconsider the role of Spoken Arabic in our curriculum and to set out new content and new approaches to teaching practices.

In this perspective, we adopted MOODLE (Modular Object-Oriented Dynamic Learning Environment) platform in order to show how online resources can be employed for 'non-conventional' content courses, such as the Arabic dialects. Both will have as a subject the construction of a Learning Unit (LU) of Colloquial Arabic (CA) about the same subject: 'the market'. One LU will exemplify lessons for an Egyptian Arabic (EA) course, the other one for a Tunisian Arabic (TA) course. The two case studies are designed to exemplify how the same topic, for a class of the same L2 proficiency level, can be treated differently and, above all, to show how MOODLE can be used to enhance different types of lessons. The two case studies illustrated in our contribution deal with Egyptian and Tunisian, but the methodology can be adopted for all other colloquial varieties.

### 1.2 MOODLE as a didactic instrument and its functions

The use of teaching platforms and accessible online materials is a response to the increasing demand for distance courses and, consequently, the need for innovation in the methodological, technical and strategic approaches to language teaching. Technologies can facilitate and transform the learning environment in three ways: adding flexibility and strengthening in-class teaching; organising and sharing resources and aiding the collaborative process in teacher-student relations [19].

As pointed out by [20], an online course should thus be carefully planned in advance. Each section of the online contents must be decided in terms of prerequisites and learning objectives according to a pre-established syllabus, having clearly ordered the learning content and added suitable activities to each unit of learning content. Moreover, it is desirable to provide at least one quiz at the end of each section of the course to allow students to evaluate their learning achievements and provide discussion forums and chat rooms. Setting up an online course requires time and a clear design in terms of the overall structure and contents within the syllabus. Moreover, in distance language courses input can be easily provided, but the output is less straightforward. For this reason, a platform such as MOODLE, which is able to assess the students' progress, was indispensable. MOODLE is one of the most popular programmes for the creation and organisation of online courses [21]. Its pedagogical basis and adaptiveness to the academic environment contributed to its popularity among teachers of different languages [22–24]. Its attractiveness lies in several advantages such as the interaction between learners and tutors, collaboration among learners, feedback on tasks and automatic backup.

The 'distance' modality has already created a potential element of change and innovation and aided the collaborative process in teacher-student relations. New technologies in the teaching field can create a dimension that is unlimited spatially and time-wise, with repeatability being a central feature that is generally missing in face-to-face teaching. Roma Tre University uses the MOODLE platform, an LMS (Learning Management System) open-source learning environment that provides software suitable for distance training. The use of MOODLE has become increasingly popular in foreign language teaching, and teachers are discovering that it has increased potential compared to other online learning environments. It can help language teachers and students, providing not only a place to share information but also a social environment where they can interact in a variety of settings. From a functional perspective, it has easily configurable features: the Activities function allows for a varied typology of learning activities and tests, such as glossaries and quizzes. There are also other instruments like Forum, Chat and Wiki that exploit the potential for exchange and interaction in a virtual environment. Such activities allow teachers to be involved in the students' learning processes at different stages, enhancing active and participative online learning for individuals and groups. Activities begin with online socialising and becoming familiar with the technology, then move through the stages of information exchange to higher order thinking and engagement. Moreover, quizzes and forums give the teacher the chance to evaluate the students' progress in terms of monitoring individuals as they complete the activities as well as the group's progress in acquiring skills. In particular, the Forum is a useful communication tool: as long as there is an internet connection, teachers and students can communicate with their group at any time and from anywhere. Because forums are asynchronous, students can take their time formulating their messages or reading those of others and writing their replies. They can draft and rewrite until they are happy with the result, rather than feel under pressure to respond immediately. It is also possible to upload materials, such as texts and media resources, although, unlike Activities, these do not allow for interaction between participants. Moreover, teachers can use the resources of other platforms such as video website makers (like Animaker, described in 3.1.1). This flexibility, together with the potential extendibility of the MOODLE platform, make this platform extremely performant when planning a language course.

## 2. How to enhance colloquial Arabic teaching using MOODLE: two case studies

This chapter aims to show the application of some MOODLE functions by presenting two case studies. Both focus on the construction of a Learning Unit (LU) of Colloquial Arabic (CA) for an undergraduate blended class (face-to-face and online) on the same subject: the marketplace. One LU will present lessons for a Tunisian Arabic (TA) course and the other for an Egyptian Arabic (EA) course. The two case studies demonstrate how the same topic, for students at the same L2 proficiency level, can be dealt with in different ways and, above all, how MOODLE can be used to enhance different types of lessons. First, we will provide the details common to the two case studies: the characteristics of the class and the course considered, the language proficiency level and the objectives of the LU, the prerequisites, the teaching materials and the type of interaction. We will then go into further detail when describing the two LUs.

### 2.1 The context and the class

Although in theory MOODLE can be used for teaching Arabic Language at any level and in any class or context, this chapter will refer to a specific class type. Our example of the LU is designed for an Italian university student, whose education level is the second year of an undergraduate degree course. The average proficiency level for Arabic is therefore approximately between A1 and A2 of the CEFR, both for Modern Standard Arabic (MSA) and CA[1]. The students are following a curriculum where the language is taught alongside Arabic culture, and where MSA is introduced alongside CA varieties, both from a practical point of view (learning to master a dialect and MSA) and a theoretical one (the main notions of Arabic dialectology having been introduced since the beginning of the course). Additionally, the course provides two teaching methods for the same educational program: face-to-face and e-learning. In fact, some students regularly attend face-to-face lessons, while others follow the course online using the MOODLE platform. The contents of each LU are summarised in shorter video lessons uploaded weekly to the online platform, so both students attending face-to-face lessons and those in e-learning can take advantage of the video lessons using their MOODLE login credentials.

### 2.2 Prerequisites

The two case studies regard students at an A2 (CEFR) level. At the lower A1 level[2], students are able to write and read a vocalised text and understand and use very simple everyday expressions and basic phrases aimed at satisfying concrete needs; they can introduce themselves and others and can ask and answer questions using personal details. They can, moreover, interact in a simple way provided their interlocutor talks slowly and clearly and is prepared to help. The variety chosen in the first year (pre-A1/A1) is MSA: any Arabic course planning also has to consider the objective difficulties related to very different alphabet, phonetic system and morphology. These difficulties take time to overcome, especially in the early learning phase: compared with European

[1] To establish the level of proficiency in Arabic, for which an official certification does not yet exist, reference is made to: [25–27].

[2] [25, pp.: 48, 49, 54, 62, 66].

languages, students need extra time to assimilate certain notions and to pass to active learning with continual guidance on the part of the instructor. The A1 level requires, besides the basic grammatical notions, listening sessions and targeted work on vocabulary: everyday lexis is privileged and, in particular, vocabulary is chosen that is largely common to both CA and MSA[3]. Besides these specific issues, learners need to be aware of the situation of diglossia present in any community of Arabic speakers, and they should build up their language skills by knowing such variants and registers. From this perspective, a phonological, morphological and syntactical shift model[4] between CA and MSA is introduced at the beginning of the undergraduate course. This offers a comparison between the characteristics of CA and MSA that can guide students in the study of Arabic variants so they can switch smoothly between CA and MSA. Moreover, an integrated approach [27] is adopted: CA and MSA are presented together, throughout the various stages of the learning process with the socio-communicative task (SCT) providing the main focus of the space dedicated to CA and MSA at each CEFR level. With this integrated approach, the requirements of the SCT are considered as the starting point for gradually introducing grammar and vocabulary as well as the framework within which any LU must be planned. From this perspective, the learning process must not only take into consideration developing the learners' linguistic competencies but also provide them with the necessary tools to be able to manage variation 'in ways that emulate native speakers' linguistic behaviour in authentic contexts' ([27], p. 69). This aspect requires a gradual introduction to how CA and MSA diverge: an awareness of CA and MSA differences must pass through an initial theoretical approach in which the teacher illustrates the basic phonetic and morphological differences between MSA and the major dialects. This introductory information will allow students to perceive the more delicate sociolinguistic issues regarding contexts of use, the mechanisms of code-mixing and, occasionally, the ideological import of colloquial variants in the Arab world. This introduction will give students a basis for acquiring the communicative skills needed in grasping the specific dialects presented in later LUs.

### 2.3 Aims

Hereafter, we will first outline the main objectives of the Arabic course and then describe the specific aims of the LUs analysed in two case studies.

#### *2.3.1 General aims*

The main objective of the 2nd year Arabic language course is to bring students to approximately an A2 level according to the CEFR. At this level, the student is supposed to be able to understand frequently used sentences and expressions relating to areas of the most immediate relevance (e.g., personal and family information, shopping, local geography), communicate in routine tasks requiring a simple and direct exchange of information on familiar and routine matters, and describe in simple terms their background, their environment and their immediate needs ([25], p. 48, 49, 54, 62, 66).

However, the Arabic language presents specific difficulties for the learner and precise correspondence with the CEFR levels is not always practicable. In addition,

[3] To give some examples, with *al-bariḥa* and *amsi* 'yesterday', *ṭāwila* and *mā'ida* 'table', *sana* and '*ām* 'year', the first term is preferred in the LU dialect in order to facilitate understanding.

[4] The "modello di slittamento diglottico fonetico, morfologico e sintattico" [28].

as stated in 2.2, learners need to be aware of the situation of diglossia present in any community of Arabic speakers. Therefore, among the long-term learning objectives is the student's ability to recognise the different conversational situations, linguistic contexts and registers adopted by native speakers as well as being able to adapt their own speech to the situation.

Furthermore, the pluriglossic reality of Arab countries requires that students not only understand and produce at least one variety of colloquial Arabic orally but also that they are able to read and write it. In fact, even though written production and comprehension focus mainly on the study of MSA, it is not enough for students merely to focus on mastering the Arabic alphabet. They must be able to read and write both in scientific transcription (necessary for gaining access to academic materials on Arabic dialectology) and in Arabizi[5], the spontaneous transcription system used by native speakers to communicate on social media and used for written communication on everyday and informal topics.

It is also important to remember that even though this is an Arabic language course, its objectives are not limited to the acquisition of strictly linguistic skills. Transversal competencies and skills such as multicultural competence, multilingualism, problem-solving and cultural awareness and expression[6] are central to the training of individuals who, in addition to abstract linguistic knowledge, will use the language with real people from different cultural backgrounds.

### *2.3.2 Specific learning objectives*

As previously stated, we are setting out to show the potential of MOODLE and how this tool can improve the teaching of CA by examining a specific LU, the main topic of which is the marketplace. In fact, considering the need to present learners with real-life tasks, we opted for a conversational situation that everyone has to face soon after they arrive in an Arab country. Shopping is a need that cannot be avoided, but it can pose considerable difficulties for beginners: previously unheard expressions of courtesy, shopkeepers reeling off prices (including complex numbers), a vast lexicon that changes from one country to another, etc. Therefore, short-term objectives have been established for this LU in the marketplace.

From the lexical point of view, by the end of the lessons, the students should have expanded their repertoire regarding the semantic field in question. In particular, we will focus on terminology relating to fruit and vegetables, the names of the different vendors and shops as well as the verbs used most frequently when shopping (buy, weigh, pay, etc.). It is important to note that marketplace vocabulary, which largely belongs to the basic lexicon of a language, is one of the semantic fields strongly affected by diglossia in Arabic. Words used to express meanings such as 'artichoke', 'courgette' or 'parsley' vary greatly from one Arab country to another (sometimes even within the same country) and their MSA names are rarely used by speakers[7].

Consequently, among the specific learning objectives of the LU, in addition to learning the vocabulary in the chosen dialect, we want to raise students' awareness that this semantic field is subject to diglossia. They will therefore have to learn to relate to speakers by choosing MSA or CA according to the communicative context: they will

[5] On Arabizi see: [29].

[6] These competences are among the "Key competences for life-long learning" [30].

[7] For an idea of the level of variation of words in these semantic fields, see [31].

probably read information about a product sold in a supermarket in MSA, but they will also have to be able to order the same product from the shopkeeper using the CA.

Another goal will be learning specific grammar rules, which we have chosen to introduce using a deductive method. Through listening and reading exercises, therefore, students will be introduced to morphological elements that they have never come across before.

Regarding multicultural competence, the goal is to broaden the students' knowledge of the culture and habits relating to food and shopping in Arab countries. The marketplace is an important setting for interpersonal relations and a place where foreigners can test their linguistic and cultural skills from the very early stages of L2 acquisition. However, they must learn that going grocery shopping in an Arab country is not the same as in their home country. For example, bargaining is key and certain expressions of courtesy are necessary. Knowing how to express yourself in CA also circumvents being scorned by native speakers.

Finally, the most important objective is the fact that at the end of the LU the students have to demonstrate that they are able to go shopping in a real-life situation.

### 2.4 Didactic materials

As mentioned in Section 1, the in-class lecture is generally the preferred teaching methodology in Italy. It involves a teacher explaining a topic to a large classroom of students who listen, take notes and then study the notions autonomously at home. However, any language class should aim for a more communicative and interactive approach. Among other things, this implies that the materials chosen by the teacher are not limited to the textbook or mere teacher explanation.

By now, many younger students are used to studying foreign languages, at school, attending private courses or studying abroad. In classes offering the main European languages (English in particular), teachers generally opt for a communicative, collaborative and task-oriented approach, so students have become used to this kind of L2 learning.

Furthermore, digital natives are much inclined to use didactic tools that go beyond the textbook: video, chat rooms, online tandems, various apps and quizzes are just some of the alternatives to the printed page when learning a language. In addition to this, the pandemic and social isolation, during which people could only escape to virtual reality, increased the trend in making more use of such spaces: indeed, they are now perceived as real as actual physical spaces.

Given these assumptions, we decided to structure the LUs exploiting various materials and not just the traditional printed texts of the classroom-taught lesson. The LUs will clearly, and initially, require the use of a textbook; additionally, finding manuals of Arabic dialects is not always easy, and very often students find themselves studying a foreign language (the Arabic dialect) via a second foreign language (usually French, English or German). Regarding TA, for example, most teaching materials are in French[8], which not every Italian student knows. It is therefore useful if the teacher's explanations and the textbook are accompanied by additional materials that use only the source language (e.g., Italian) and the target language (in this case TA). In teaching EA, we find similar problems as it is not easy to find textbooks suitable for Italian students. Recently in Italy, however, we can note that some textbooks for EA are being published in order to respond to Italian students' needs.[9]

[8] To mention just a few manuals: [32–34].

[9] We suggest a textbook like [35].

Other didactic materials used in the LUs make use of video, including PowerPoint with the key concepts of the topic summarised and a recording of the teacher explaining significant concepts. These video lessons, uploaded weekly to the MOODLE platform and in a password-protected space, are available for all students, whether they attend face-to-face classes or follow online. Furthermore, students can discuss the topics covered using the MOODLE Forum.

In addition to the textbook and video lessons, students can take advantage of all the different types of quizzes offered by MOODLE. Depending on their educational needs, and trying to vary as much as possible, the teacher can ask students to practise with quizzes based on multiple-choice or true/false questions, 'spot the odd one out', gap-filling exercises and cloze tests. We believe that these kinds of tests, in addition to being excellent drills, provide positive reinforcement for the student since they are not evaluative (they do not affect the student's final mark) but are a useful self-evaluative tool. By practising constantly, the students will see their scores improve and they will undoubtedly acquire self-confidence and interest in the subject. MOODLE also allows users to set up questions not only in written form but also by proposing an audio track with a question or answer. This makes the exercises more realistic as, especially at the initial levels (A1-A2), the language studied is mainly oral ([27], p. 47–70).

One of the many advantages of MOODLE is the Assignment function, which gives the teacher the opportunity to set up homework and to specify the type of file that students have to upload in order to complete a task required. In addition, when using the Forum function, the teacher can create a discussion topic focusing, for instance, on a cultural aspect related to the LU, so that students can exchange opinions and observations about the topic in question.

MOODLE also offers interesting possibilities regarding vocabulary. First of all, since it is possible to insert links to Internet websites on the main class page, students can receive suggestions about where to look for words they do not know using both online and printed resources. Thus, for example, a student searching for a new word in the studied dialect will have access to both paper dictionaries suggested in class, and online resources, for which the teacher has uploaded links to the main page of the course on MOODLE. Furthermore, MOODLE allows for the creation of a cooperative glossary. This is a tool that each teacher can decide to set up according to his/her needs and preferences. Basically, it is a series of forms with a title and a description (where it is also possible to upload files, such as images or audio tracks) and the system automatically records the words inserted in alphabetical order. Both students and the teachers can insert the vocabulary learned in any particular LU. Above all, the tool is collaborative since it is produced by the joint efforts of the entire class, recording the lexis encountered up to that moment. The method for inserting the lexical material is decided at the beginning of the course. Solimando [7] has recently discussed how the glossary was used for an MSA class, and modifications of this can be made for a CA class. First of all, the headwords can be inserted in Arabic graphemes in transcription and accompanied by a recorded audio track.

It is possible to insert a translation and an example of the use of the word in context, always employing the two alphabetic systems and placing them side by side accompanied by the recorded audio track (see **Figure 1**). It is also possible to insert synonyms and antonyms by creating intertextual links.

Finally, with MOODLE students can access a multitude of specialised apps and websites for computer-mediated teaching. In fact, as they think fit, teachers can program which tool to use to make a lesson more dynamic and then upload the finished product or link to the MOODLE class page. In these LUs, for example, we use software

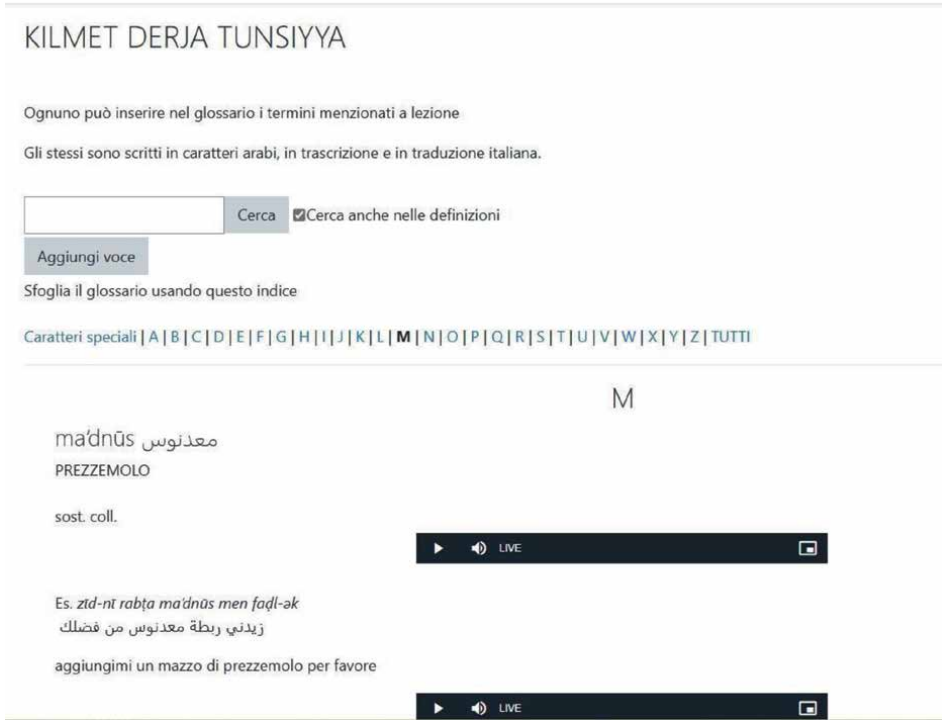


**Figure 1.**
*Example of a Moodle glossary entry: "Persil" (ma'dnūs).*

such as Animaker (that allows users to create animated videos using pre-given characters and templates), Quizlet (that provides tools for studying and learning, such as digital flashcards, matching games and live quizzes) and Lingt Editor (that specialises in creating speaking assignments and assessment for students).

### 2.5 Interaction

Interaction in these LUs should be as varied as possible: sometimes the teacher will speak alone to the class, sometimes he/she will address the whole class, sometimes an individual student will be asked to answer questions, while at other times the students will work in pairs or in groups. Furthermore, as the course is divided into students who attend face-to-face lessons and others who follow online, the interaction of some learners is only mediated by MOODLE, by watching and listening to video lessons and practising by completing various kinds of quizzes.

We believe that keeping interaction as varied as possible helps to maintain students' interest and focus. We also believe that moving away from the traditional in-class lecture can help to develop skills associated with active participation by students, especially oral comprehension and production skills.

Furthermore, in the traditional type of lesson, in which little time is given over to orality and where the focus is on writing (often adopting the grammar-translation method), many students feel extremely shy when speaking a language they have not yet mastered. In this scenario, students only compare themselves with their teacher, whether he/she is a native Arabic speaker or not, and this increases insecurity. Varying this interaction and allowing students to compare themselves with their peers

can help them to overcome shyness and acquire self-confidence. It is for this reason that teacher-student interaction should occasionally change to student–student interaction (i.e., working in pairs or in groups).

Furthermore, the interaction between students takes place both in the physical space of the university classroom and in the virtual space of MOODLE. In fact, having the Forum and a large number of non-evaluative exercises available certainly helps students to build up confidence in the L2. It also helps to mechanise some linguistic processes, which, without this chance to practise, would be very difficult to apply in a real communicative situation.

## 3. Case study: a learning unit for Tunisian Arabic

### 3.1 Structure: the PPP

The LU for TA will follow a Presentation, Practice, Production (PPP) structure ([36], p. 64–68). Originating from structural-situational teaching, the main objective of PPP is to place language in a clear situational context. It is one of the most common ways to structure a teaching activity, and is mainly used to teach the linguistic system (i.e., phonology, vocabulary, morphology, etc.) and linguistic functions (i.e., to actively put the L2 into practice for a specific purpose, such as ordering something, apologising for something or introducing someone).

We opted for this structure for the LU about the marketplace in TA, but, of course, it would be opportune to change the structure from time to time. Among others, it is possible to use the Flipped Classroom, ESA or Task-Based Learning methods[10]. In order to stimulate students' interest and to keep their level of attention high, it is important not to choose the same didactic approach at all times.

The PPP structure comprises three phases. The first is Presentation, where the LU topic is introduced and students are provided with a context for the topic. The second is Practice, when the students put into practice the linguistic forms introduced earlier. Generally, this phase involves a limited degree of arbitrariness with the students first practising with simple mechanical exercises; only later do they deal with more difficult exercises with a greater degree of freedom in the linguistic choices available. For example, simple drills or gap-filling exercises are recommended at the start before progressing to more complex cloze-type quizzes. Finally, the third phase is Production, i.e., free practice, when the students autonomously apply the language to real-life tasks.

Speaking more specifically about the marketplace topic, the Presentation involves the introduction of new vocabulary relating to the semantic field of fruit and vegetables, while the grammar input relates to the imperative verb tense. The Practice includes various lexical, phonological and morphological exercises, which, by exploiting the many tools offered by MOODLE, allow students to put the L2 into practice. Finally, the Production phase involves students being able to simulate going shopping, interacting with vendors, negotiating prices and ordering things using the imperative.

[10] For an overview of the most popular teaching methodologies, see [36, p. 62–78].

### *3.1.1 Presentation*

At the beginning of any LU, regardless of the learning strategy adopted, it is necessary to introduce the topic. The proposal for the LU of the marketplace in TA starts with a warm-up exercise and the presentation of the lexicon.

The teacher first shows the students a video supported by the Animaker software[11], introducing the LU lexis and related morphology. The video is created by the teacher him/herself to bridge any gaps in teaching materials. As stated in Section 2.4, in fact, it is not always possible to find pre-packaged products, particularly audio-visual materials for teaching Arabic dialects. In order to provide support for parts of the lesson for which the textbook is not sufficient, it is important for the teacher to know about, and learn how to use, alternative tools. In this respect, MOODLE is extremely useful as it allows users to upload various kinds of links and files. In this specific case, the teacher created a short educational video using Animaker to explore a marketplace. By having two fictitious characters interact (**Figures 2** and **3**), students can see the best-selling products as well as the names of the most common stalls.

The video, previously uploaded on MOODLE, gives the teacher the chance to start a little conversation with the students. Firstly, the teacher drills students in pronunciation and vocabulary, asking them to repeat the names of the objects they have just seen in the video. Then he/she can start asking more complex questions, perhaps about the students' favourite fruit and vegetables or asking them to describe their favourite dishes and their ingredients. Students in e-learning can carry out this task using Forum. This is the first part of the lesson, so the primary goals are to activate students' schemata to provide a context for the topic and introduce the lexicon.

The Presentation then continues with vocabulary building. In this part of the LU, teacher-student interaction (when the teacher speaks to the whole class or questions


**Figure 2.**
*Example of didactic video created with Animaker "At the marketplace" (fi-l-māršī).*

[11] On this software, see Section 2.3 and, for an example, see [37].


**Figure 3.**
*Example of didactic video created with Animaker: "Greengrocer" (ḫaḍḍār).*

an individual student) develops alongside the student's autonomous production. In fact, the oral conversation exercise that takes place in the physical class is supported by a series of virtual exercises previously uploaded on MOODLE. The platform also allows the users to set up various word games, such as matching recorded audio to the correct word and translating it (see **Figure 4**)[12] or moving the name of an object (a vegetable, for example) to the correct blank space in a picture (see **Figure 5**).[13]

Multiple-choice quizzes can also be created using an audio track instead of written prompts, providing students with slightly more complex exercises such as listening to sentences and matching the correct unit of measurement to each product (see **Figure 6**)[14].

In this way, the teacher also drills students in phonetics using an alternative method to traditional dictation.

From time to time, this kind of exercise can be carried out by every student on his/her own device with time limits set by the teacher; it can also be done collectively and orally using the teacher's device and projected in the classroom or used at home for independent study.

As mentioned in 2.4, students have access to reference materials, both printed and online, for the entire course and this is particularly important when studying vocabulary. For this LU, for example, we propose two online dictionaries (Derja. Ninja [38], an English-Tunisian Arabic dictionary in which entries can be looked up

[12] MOODLE: activity > quiz > matching question type.

[13] MOODLE: activity > quiz > drag and drop onto image.

[14] MOODLE: activity > quiz > multiple choice.


**Figure 4.**
*Example of Moodle activity: Listen to the audio and choose the correct answer.*

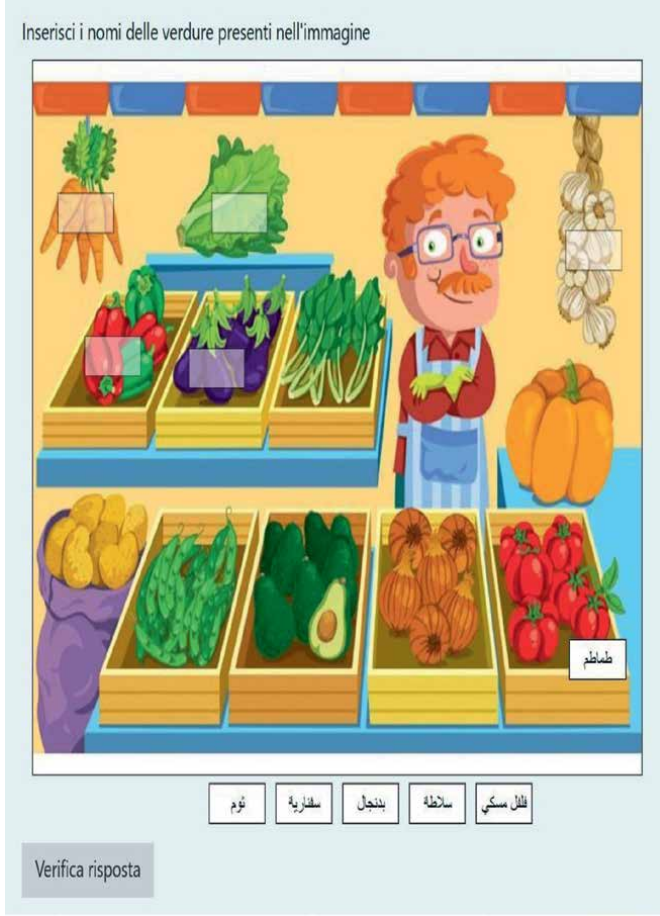


**Figure 5.**
*Example of Moodle activity: Drag the word into the correct blank space.*


**Figure 6.**
*Example of Moodle activity: Choose the correct answer (multiple choice quiz).*

both in Arabic characters and in Arabizi; and TuniCo [39], a product of an important University of Vienna project, in which entries can be looked up in scientific transcription) in addition to printed dictionaries (an English-Tunisian dictionary written for the Peace Corps [40]; an old French-Tunisian dictionary with a large number of headwords [41] and a modern general Maghrebi Arabic to French dictionary [42]).

After introducing and practising the vocabulary, the Presentation part of the LU introduces the grammar. Here, students are offered sentences (heard and perhaps spoken during the lesson) that include both verbs in the imperative tense (*ʿamr*) and present tense (*muḍāriʿ*). Focussing on the imperative verbs, the teacher elicits from the students why they are different, thus introducing grammar in a real-life situation and making the students deduce the grammar rule for themselves. Moreover, the teacher can encourage learners to compare the rules for imperatives in MSA with those just encountered in TA. We believe that this comparative approach helps to develop students' metalinguistic analytical skills and encourages the memorisation of corresponding structures in both language varieties.

Once the theory is understood, students can put the learned rules into practice using drills. For example, we propose a multiple choice test in which the student has to select the correct imperative form of the corresponding verbs in the past tense (*māḍī*).

Finally, in order to focus on lexis and grammar structures, the textbook is a fundamental tool: a text read out loud with textual comprehension questions is a useful way of revising new words, grammar and syntax, alongside examples of a well-structured dialogue that the student can also imitate in oral production.

As stated above, classroom lessons are always accompanied by a PowerPoint summary on the MOODLE platform. At any time, students can find the main concepts

of the LU explained with diagrams, and with the recorded voice of the teacher. As independent work to be done at home, the students must then complete the collaborative glossary, inserting any new words encountered accompanied by all the additional information they can find (sentences exemplifying how the word is used, morphological characteristics, the correct spelling in all the required systems of writing etc.).

### *3.1.2 Practice*

In this part of the LU, students have to put into practice the topics studied using the L2, first through controlled practice, i.e., with mechanical exercises and a low level of arbitrariness, then with a 'semi-controlled practice', i.e., with greater freedom.

Various drills and word-games have already been presented in the previous section, all of which provide excellent examples of how MOODLE can assist in putting the L2 into practice. Another extremely interesting way to learn and revise vocabulary is provided by the Quizlet software [43][15]. This gives teachers the chance to create flashcards on any topic: you only need to find a suitable image on the Internet or on your device and associate it with the required word. The word can be written clearly in whatever graphemes the user prefers and it can also be linked to an audio version. In addition, Quizlet allows for the creation of word games, such as 'match the pairs'.

As **Figure 7** illustrates, you have many pictures of objects and the words for them scattered across the screen; there is a timed challenge to make all the pairs disappear by matching them correctly. These are always extremely dynamic stimulating exercises that help to train the memory. Of course, the link to the online resource can be uploaded to MOODLE.

As to other resources already available on MOODLE, the platform also offers the chance to create tests of greater complexity than those seen so far.

Therefore, for semi-controlled practice, we propose (see **Figure 8**) an exercise in which the student has to understand a written text, choose the right meaning to insert in the empty space from the five options offered and insert it in the correct


**Figure 7.**
*Example of Quizlet activity: Match the pairs.*

[15] For further information on the use of Quizlet in Arabic language teaching, see [8].


**Figure 8.**
*Example of Moodle activity: Choose the correct word (multiple choice quiz).*

grammatical form[16]. It turns out that in this exercise the degree of freedom in the linguistic choices available is higher than in the previous exercise, and consequently the difficulty increases. This type of practice is usually left to individual study: again, the individual is always at the centre of interaction in a process of self-evaluation and absorbing the concepts presented.

### *3.1.3 Production*

After the topic has been introduced and after the students have understood and learned the vocabulary and grammar and put it into practice with supervised exercises, they are ready for free practice. This is the final part of the LU, which tests the learner and shows if the topic covered has been mastered. It is also a fundamental part of the teaching-learning process since it allows the language studied in theory to be applied to a real-life situation, i.e., through a real-life task. At this stage, it is, in fact, the students who have to produce the L2 to complete a task, and they have to do so by interacting with others, whether they are native speakers or classmates.

The interaction therefore changes completely compared to that adopted in the early stages of learning: from vertical interaction where it is mainly the teacher who addresses the students, we now move to horizontal interaction where the students interact with each other. Pair and group work are privileged in the Production stage; this is a good way to increase the time that the students spend talking in the L2, such output is necessary for language acquisition.

In this LU, in particular, the task that the students have to complete takes place through group work within a role-playing framework, i.e., one of the preferred means

[16] MOODLE: activity > quiz > multiple choice.

acknowledged by Constructivism for teaching the L2. Indeed, it is believed that knowledge arises through a process of active construction and that learning occurs when the students interact with the world around them. Moreover, according to the Communicative approach, it is important to put the emphasis on task-oriented activities where the students play an active role in order to develop their communicative abilities.

For this part of the LU, therefore, the teacher creates groups of 5–6 people, trying to mix the students appropriately (that is, creating balanced groups both from the point of view of their pre-existing knowledge and their behaviour in class). In each group, one student will be identified as a customer that goes shopping to the market.

The remaining students in the group will play the role of shopkeepers. Once the groups have been created and the roles have been assigned, the teacher will give the student-customer a pre-prepared shopping list. To complete the task, the student will have to pretend to go to the market, interact with all the merchants from whom he/she has to buy products, negotiate the price, ask for the right quantities and pay correctly.

In addition to being fun and dynamic, an exercise of this type facilitates the simulation of a possible interaction in a real linguistic context. Furthermore, knowing how to carry out this task indicates that the student is actually capable of putting into practice all the linguistic data (phonetic, morphological, lexical, syntactic) introduced in the previous lessons.

## 4. Case study: a learning unit for Egyptian Arabic

### 4.1 Structure: the flipped classroom

Studying EA in a Western country means little or no exposure to the language outside the classroom. It is to implement the number of hours dedicated to the L2 that some of the teaching materials will be assigned as homework before the lesson, in line with the Flipped Classroom structure[17]. In fact, we stress the importance of providing a weekly lesson plan, uploaded to the MOODLE platform, that sets out what the student should prepare autonomously before attending the class.

The materials presented follow the Communicative Approach that puts the student at the heart of the learning process, the teacher's role revolving around organising a varied linguistic input according to the learners' needs [45]. The materials are also chosen with the aim of giving the student a more effective and independent role within the learning process. Therefore, the class is divided into small groups, so that students can interact with each other, while the teacher acts as a facilitator. In line with this methodology, grammar rules are presented starting from a real context of use and through a process of exploration, although without going into unnecessary detail.

The case study is divided into three parts, each part preparatory to the next one: students start building basic vocabulary in EA (e.g., fruit and vegetable lexicon) and end up carrying out more complex skills, such as having a whole conversation in a food market. The materials presented do not overlook the cultural aspect: the student will thus be introduced to Egyptian cuisine and its distinctive dishes.

[17] The Flipped Classroom is a lesson structure becoming more and more used in teaching L2: "Basically the concept of a flipped class is this: that which is traditionally done in class is now done at home, and that which is traditionally done as homework is now completed in class" [44, p. 13].

### *4.1.1 Expand vocabulary*

The first LU activity consists in expanding the vocabulary through the MOODLE Glossary. In line with the Flipped Classroom structure, this activity is carried out independently by the students: it consists of an initial vocabulary list given by the teacher that they have to study before class. The words are entered in the Glossary in Arabic alphabet alongside an image and a recording of the pronunciation, without the need to add a translation or transcription (**Figure 9**).

Leaving the lexicon of fruit and vegetables to self-study is a choice due to various reasons. First of all, it allows the teacher to focus, during the face-to-face lesson, on communicative exercises that use the same lexicon. Furthermore, given the lexical and phonetic similarity between the words in EA and MSA, the student can easily and independently develop a metalinguistic reflection. During the lesson, students' attention can thus be drawn to phonetic differences between EA and MSA that they have already heard, for example, the regular pronunciation of the letter *qāf* ([q] in MSA) as [ʔ] in EA.

Among the advantages of the Glossary is that synonyms can be inserted: in **Figure 9** the two alternatives *ṭamāṭim* and *ʿūṭa* (typical of Cairo) are proposed for the meaning of 'tomato'.

After drilling the students on pronunciation, the teacher can evaluate what the students were able to assimilate when working on their own before class through MOODLE's Quiz function.

Students who are following the class remotely can access Quiz from the MOODLE platform, while face-to-face students can use their own electronic devices. For a smoother experience, it is highly recommended to carry out these activities in a language lab where 'Communication happens in pairs or in groups using objective language. Students try innovative things in a lab than in a classroom. Audio, video, multimedia, and the internet collectively provide resources with which the students respond. For students, attending lab sessions is a retreat from the traditional classroom sessions. They find it an effective and versatile tool


**Figure 9.**
*Examples of Moodle glossary entries: "Tomato" (طماطم); "Rocket" (جرجير); "Orange" (برتقان).*

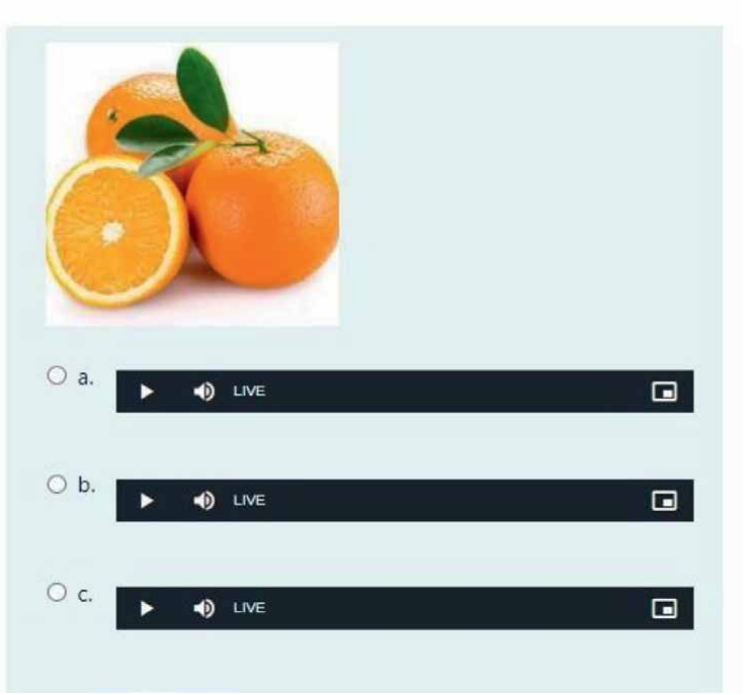


**Figure 10.**
*Example of Moodle activity: Listen to the audio and choose the correct answer.*

in providing interactive sessions to the students to learn the language or swiftly undergo any activity' ([46], p. 2).

We will now show some examples of exercises, from the simplest to the most complex. We started with quizzes based on listening and identifying, as it is sufficient at this stage for the student to recognise the meaning without needing to read. We, therefore, use mainly multiple-choice questions[18] allowing the teacher to insert pictures and voice recordings: students must look at the picture, listen to different recordings, and match the picture with the appropriate name of the fruit while repeating it various times (**Figure 10**); or they must listen to the name of a fruit or vegetable and match it with the right picture while repeating the correct word.

We then move to a more challenging exercise where students are asked to work in small groups to discuss and read words, so they can finally drag each type of fruit or vegetable and put it in the correct place[19] (**Figure 11**) or choose the correct word for each picture from many types of fruit and vegetable[20].

MOODLE Assignment can now be used to set up homework exercises so that students can apply and practise what they have learned in this part of the LU. In the assignment we suggest, students are asked to write down the types of fruit and vegetables they would like to add to a salad and then record what they have written. They can upload this to Assignment so that the teacher can listen to their recordings and provide feedback on their pronunciation.

[18] MOODLE: activity > quiz > multiple choice.

[19] MOODLE: activity > quiz > drag and drop onto image.

[20] MOODLE: activity > quiz > matching question type.


**Figure 11.**
*Example of Moodle Activity: Look at the picture and choose the correct word (Multiple choice quiz).*

### *4.1.2 Oral comprehension and production*

The second part of the LU focuses on providing students with the language and communication skills they need to start a conversation with a vendor at the marketplace.

It begins with presenting the key phrases that will help students to express their needs at the market. The expressions, written, translated, illustrated and recorded, are listed in the Glossary. To make sure that the meaning is clear, the word is placed in a frequently used sentence context. In this way, we expand the vocabulary necessary for exchanges in the marketplace. Later, the students will study at home the mentioned expressions by listening to the recordings, re-reading the expressions in the given contexts, and trying to create simple dialogues.

In addition, students further practise new expressions through quizzes similar to those proposed in paragraph 4.1.1, which prepare them for simple listening about the subject.

Teachers of EA sometimes face the challenges posed by finding authentic audio and visual materials. Scenes from Egyptian films and TV series can be used to simulate authentic communicative situations, but these types of audio-visual resources are sometimes unsuitable for beginners as they require more highly developed language skills. It is therefore inevitable to resort to pre-made materials: we made use of an existing YouTube video created by an EA teacher [47] to simulate real everyday life situations. Students watch part of the video in class—relating specifically to the LU topic—talking about it in small groups using the guidelines and questions prepared by the teacher on Assignment (**Figure 12**), before they discuss it with the teacher.

For homework, we propose a multiple-choice exercise[21] using Quiz. Here students must watch and listen to the part of the video that they have already worked on during class to complete the missing parts of the text by choosing the right answer from the

[21] MOODLE: activity > quiz > gap fill.


**Figure 12.**
*Example of Moodle Activity: First part: Watch the video and answer the questions (in Italian); Part Two: Watch the video and answer the questions (in Arabic); Part Three: Guess the meaning.*

various options available. This requires paying greater attention and listening carefully to each word in the video.

We preferred to avoid detailed explanations of grammar rules, which are presented only in restricted contexts in this phase, but which will gradually be introduced by the teacher according to each SCT.

The MOODLE platform also allows teachers to upload links to educational sites that can simulate real communicative situations. For example, a tool like Lingt Editor [48] can be used with Assignments for speaking exercises and to assess student progress. This site allows the teacher to record the role of the vendor but leaves the role of the buyer blank for the student to record it themselves (**Figure 13**). Consequently, students practise what they have learned, and the teacher can listen to and evaluate each student separately.

### *4.1.3 Culture*

This part of the LU focuses on cultural aspects and can be integrated using Forum, where the teacher adds instructions guiding students through two video clips [49, 50], one of a popular Egyptian market and the other about the fruit and vegetable section in a famous supermarket in Egypt. Both are authentic videos showing Egyptian citizens on a market/supermarket tour.

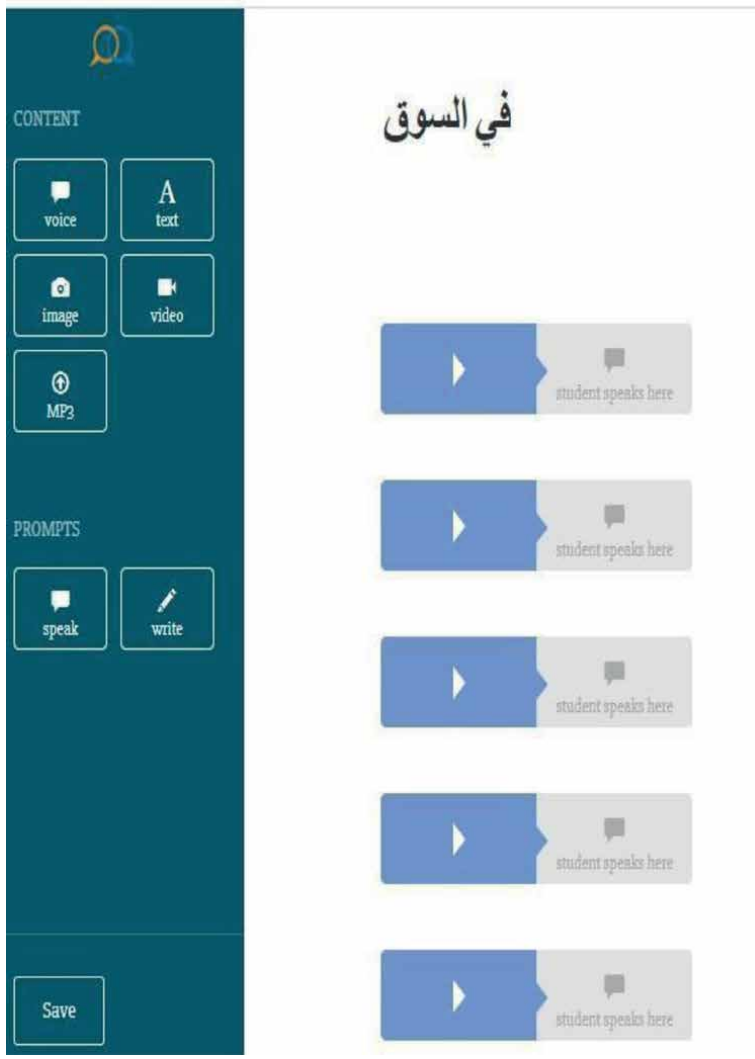


**Figure 13.**
*Example of speaking activity supported by Lingt editor.*

Students autonomously watch the two videos and lead a discussion on Forum: what they heard and saw about fruit and vegetables, their observations about the differences between the popular market and the famous supermarket or the discussion on prices. In their discussions on Forum, students can use EA, MSA or their mother tongue, given that the main purpose of this activity is cultural rather than linguistic. The teacher follows up on what the students discussed and during class watches the videos with the students, exchanges opinions and observations with them, and discusses any of the points that they have shared on the Forum.

To extend the cultural dimension, we can also use Forum to create a new discussion topic about Egyptian food. In this activity, the students are divided into small groups: each group is responsible for a famous Egyptian recipe, and they have to discover what its ingredients are and how it is made. To achieve this goal, the students communicate through social media with students studying Italian

at Egyptian universities to obtain information about the dishes. The communication between the students and their Egyptian counterparts must be in EA using Italian only when necessary: indeed, at this stage, it is important to indicate to the Egyptian students the level of EA they should use and to try not to go beyond it. Our own students thus come back with information about Egyptian recipes and post it on Forum, preparing an oral presentation in EA. The purpose of this activity is to expose students to EA outside the classroom, i.e., to hear it and to practise it authentically with Egyptians, as well as to expand their cultural awareness of Egyptian society. Activities involving communication with Egyptian students can be repeated throughout the academic year as necessary, based on the various cultural topics that are raised.

## 5. Conclusion

The two case studies examined to demonstrate how an online platform like MOODLE can provide captivating strategies for learning about linguistic variation, a field that is still largely unexplored. There is a certain aversion to the teaching of spoken varieties in TAFL (Teaching Arabic as Foreign Language) linked to an ideological reluctance to teach dialects, compounded by a lack of appropriate teaching materials. In an academic context, dialects are mostly taught according to dialectological methods and the role reserved for them is minor compared to MSA. Although the CEFR is also a point of reference for the teaching practices of non-European languages, Arabic instructors do not appear to give sufficient importance to the communicative approach emphasised in the CEFR descriptors, even though learning Arabic also requires competence in one or more dialects.

Creative use of MOODLE's functions allows for a potentially limitless range of materials—audio extracts, quizzes and videos—that can meet and satisfy students' needs in their search for motivating and enjoyable language practice. The PPP structure (Presentation–Practice–Production) is very efficient: in Presentation the LU topic is introduced and students are provided with a context for the topic (vocabulary and morphology); in Practice, the students put into practice the linguistic forms introduced earlier through the different degree of freedom in the linguistic choices available. Only in the third phase, the Production, the students autonomously apply the language to real-life tasks. The choice of the same topic for Tunisian and Egyptian dialect, allows to show how this methodology can be easily adapted to other colloquial varieties and how flexible the MOODLE platform is. The interactive activities should be seen within the framework of a collaborative relationship between student and teacher. This stimulating approach can easily be applied to the teaching of one or more colloquial varieties. From this perspective, the two case studies presented here show how complementary the activities can be when MOODLE is exploited to the full. Here the teacher's role is more active since s/he has to manage the platform appropriately in order to cover all educational requirements – whether lexical, audio-visual or, more generally, grammatical – using a deductive approach. The content and the methodology adopted demonstrate the need to design an Arabic Second Language syllabus using an integrated approach, in which Arabic is presented in its oral as well as in its written varieties. This allows students to be aware of the linguistic reality of Arabic and to be confident in using the opportune form in different SCTs.

## Author's contribution

The Teaching Dialect in Arabic Language Courses project is coordinated by C. Solimando and is taught at Roma Tre University by A. Abdelbary and L. Panascì. This paper is the result of the project. All three authors collaborated on the article: for academic purposes, C. Solimando is responsible for sections 1.1, 1.2, 2.2, 5, L. Panascì for 2.1, 2.3, 2.3.1, 2.3.1, 2.3.2, 2.4, 2.5, 3.1, 3.1.1, 3.1.2, 3.1.3 and A. Abdelbary for 4.1, 4.1.1, 4.1.2, 4.1.3.

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