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Active Learning

Beyond the Future

Edited by Sílvio Manuel Brito

ACTIVE LEARNING - BEYOND THE FUTURE

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Meet the editor

Sílvio Brito holds a degree in Human Resource Management and Work Psychology from ISLA (current European University); a Master's degree in Management, in the area of Organizational Behavior, from the Universidade Lusíada; and a PhD in Psychology from the University of Extremadura, Spain. He collaborates as a scientific editor with the IntechOpen publishing house and is a member of the Portuguese Society of Psychology, INFAD (International Association of Educational Psychology of Childhood, Adolescent Majority and Disability) in Spain, and a researcher of the Psyche-EX Research Center of the University of Extremadura. He was a member of the Scientific Committee of the First International Congress of Entrepreneurs of the University of Salamanca and is a collaborator of its Summer School in the Chair of Entrepreneurs, as well as a member of its Scientific Committee. He is also Secretary General of the Association for Training, Research and Development of Entrepreneurship. He is a lecturer in the Department of Human Resource Management and Organizational Behavior of the School of Management of the Polytechnic Institute of Tomar, and was a DoinGlobal collaborator in the area of entrepreneurship. He has been a member of doctoral and master jury commissions in Portugal (IPL, IPS, IPT, and ISLA) and abroad (USAL and UNEX) and has supervised various research projects and internships. He has several scientific publications, both national and foreign, in the area of human resources and psychology, namely entrepreneurship, being a collaborating member of the Current and Personal Psychology Journals. He collaborated in a project to read the scientific blog "Empreender." He was an adviser to the Directorate of the Cooperativa de Ensino Universidade Lusíada, CRL (current Minerva Foundation), trainer at the CNAF/GUÈRIN Training Center, and human resource technician at the Central Mutual Agricultural Credit Fund.

Contents

Preface

Active learning is a powerful tool that consists of a way to dominate many aspects of knowledge and has become an incredible strategy that transverses to different areas of life. We can see some examples such as teaching students to develop attitudes and build tools to achieve a successful score, filling a gap in the signature school curriculum by addressing new kinds of thinking and new learning contexts, motivating and training to obtain research behavior, developing curiosity, and contributing to competencies to be more successful (Cooper, 2019). Promoting active learning is a way of improving the competitiveness of people to discover employment opportunities (Spolter et al., 2019).

In front of such reality active learning must have a necessity to be divulgated The reality-opportunity conjugation represents a reflection for future research on techniques, helping researchers to find new active ways to work in several areas to achieve further success with active work, namely during student times .

As a transversal discipline, active learning points to many advances that are more interactive than ever before. Making a research approach to artificial intelligence challenges the need to empower people and increase learning through new techniques such as e-learning, uncertainty and information, lateral thinking, improvisation and argumentation, social motivations, and open mind incentives. This offers starting points and insights for active learning work (Gubaev et al., 2019) and provides the necessary impetus and intellectual techniques for human tasks (Nikolakis et al., 2019).

Therefore, active learning can be a future model for new students and researchers, increasing dynamism in schools, innovating pedagogical and experiential learning procedures, and approaching generations, organizations, and communities for change (Han et al., 2019).

Turning from classic learning to active learning opens new opportunities for universities. Teaching models become more strategic and more effective for students' activities and entice other types of researchers to redesign learning and teaching systems and create joining tools for transfer knowledge (Vlajecic et al., 2018, 2019).

Active learning enhances the opportunities and qualities of students for global challenges (Wu et al., 2019). It expands in an explosive global manner the fact that learners involved in innovative techniques are more adaptable to growth expectations, with subjective values playing a direct and indirect role in academic expectations in organizations' growth (Brand et al., 2019). This promotes investment and technological growth, increasing mobility and academic alliances and enhancing all kinds of knowledge (Gone, 2019).

Active learning has also been a motive for people who have either learning difficulties or are excellent learners because it brings together in equal opportunities positioning and social

justice throughout "World Education" through value to the people. It also encourages them to help each other, to find out how to develop society, and acquire competencies by discouraging laziness (Handayani et al., 2019).

Also, active learning has become increasingly technological. Many organizations use artificial intelligence databases, strongly supported on knowledge capital, for become growth through innovation and creativity processes often evaluated in a competencies and talents (Eris & Kimiçoglu, 2019).

So, active learning is an active mind.

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Section 1

Active Learning

Chapter 1

Introductory Chapter: Active Learning—Beyond the Future

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Additional information is available at the end of the chapter

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1. Introduction

1.1. Objectives and preoccupations

More than a new knowledge form, active learning is a tool that opens us the future doors of scientific research appointing for the increment of the potential intelligent machines [1]. The active learning permits us to get research competencies, namely problem-solving, and uses several types of strategies [2], very useful for the one who wants to be creative and be more acumen in using teaching techniques like data visualization [3], and at the same time, test them according to an established task path such as: active comprehension and active production [4]. On the other hand, active learning empowers our relationship with the technology and gives us more understanding and domination with our relationship with data [5] and with the active learning algorithmic practice [6]. This relationship extends to the organizational practice, where active learning develops environments conducive to business practice [7] and reinforced by the online context [8], reducing the time of treatment and data interpretation and translating into a significant improvement in the review and design of financial, social and commercial scenarios, and strategies. Therefore, we are dealing with a very practical and very motivational way of knowledge transmission [9] and to increase interest in various subjects [10] namely in practicing medicine [11] and to choose collected data about informal nonhuman aspects for human condition explanation [12] combining soft and technical skills with physical activity to improve the performance [13] and using technology kits to increase experiences and increase the subjective knowledge [14].

In addition, in classrooms in Tomar, Portugal, we set active learning team, tasks representing their self-mastery of knowledge being inside the indoor and outdoor work contexts. Following that, we tried to define and explore the concept of active learning through references about

active learning increasing self-confidence and problem-solving in strategic scenery, and to measure active learning with development tasks and presentations. The above studies have the dual purpose of investigating the issues and extending them to different types of populations.

1.2. Research methods

There are many forms and techniques to apply active learning and increase the students which increase students' ability to systematize and consolidate knowledge. So, we use the following active learning techniques for case study active learning strategy [15]:

1. preparation for the debate [16]
2. teamwork [17]
3. exposition and communication [18]
4. preparation for improvisation [19]
5. ability to argue [20]
6. involvement in the activity [21]
7. problem-solving [22].

Meanwhile, these techniques have been reinforced with Organizational Development techniques practice, during the discipline development [23] as it follows:

1. Training-group (an interactive technique where people learn from each other, the best-known technique is the psychodrama) [24].
2. Team-building (use of intervention different types that enhance social relationships and clarify the roles of group members, one of the known techniques is outdoor) [25].
3. Delphi technique (use of an experts group to compare unstructured or individual groups) [26].
4. Technique of help interview/consultation (consultation process—technique of psychological interview) [27].
5. Force-field analysis technique (the technique of events diagnosis for results optimization) [28].
6. Confrontation group technique (a technique that means having the courage to tell a person what they have seen or heard, to show that they are worried about them and to suggest that they are willing to help) [29].
7. Data feedback technique (data feedback—ability to give and receive opinions, criticisms and suggestions about our attitudes, behaviors, and/or performances, with the purpose of reorienting and/or stimulating a particular individual or group action) [30].
8. Third-party technique (the third party—is a procedure for the resolution of controversies—is one of the alternative methods to classic judiciary litigation), [31].

9. "All at the same time in the same room" technique (getting the whole system in the room—streamlining communication for the whole organization) [32].
10. Grid organization development technique (detection of personality styles in relation to task and relationship) [33].
11. "Transactional analysis" technique (studies and analyzes the exchanges of stimuli and responses, or transactions between individuals) [34].
12. World café technique (flexible, sensitive, and powerful process for generating collaborative dialogs between individuals, in which they can share their knowledge and discover new opportunities for joint action) [35].
13. Open space technology technique (how to gather people in a conference, retreat, or meeting) [36].
14. Sensitivity laboratory technique (temporary residential community, structured according to participants' learning requirements) [37].
15. E-learning technique (formation in O.D. from distance) [38].
16. Consulting techniques in O.D. (assumed forms of paper by the consultant), [39].

1.3. Preliminary results

Based on active learning techniques, we proposed those that justified the link between revealed autonomy and the ability to solve problems in a strategic scenario, in our theme, case study resolution, and the results achieved with tasks execution and presentations. Several contributions try to explain advantages, constraints, and active learning utility, on this book that we divide in to three sections:

1. Active learning properly: where we talk about the concept humanization, namely the relation with learners and the active learning practice implementation focusing cases.
2. Technologies and active learning: where we talk about the use of technology in the active learning, its boundary between technology and learners, with the inherent advantages and some constraints provoked by what the change brought about the challenges of this new knowledge approach.
3. Related trends: where we talk about the future of active learning in an ethical-pedagogical approach, ending in its entrepreneurial character.

In the first section, we begin with an excellent article from PdD Radwan Akran, about active machine learning use where, in a clear explanation, he conveys to us this technique knowledge, taking, in particular, into account, increasing in teaching and learning. At the same time, he showed us how the humans learn faster with better performance when they can actively select the informative instances from a pool of unlabeled data instead of random sampling, and discuss the challenges that this technique has to win.

Following, we have another interesting article from the Dr. Sewagegn Abatihun Alehegn and Dr. Boitumelo M. Diale, who presents us a learners' role empowerment scenario, where they achieve competencies using active learning, a focus on student-centered teaching and skills.

On the path of what we deal with in this section, we have a fabulous article form Prof. Yamada Reiko that offers an overview of an introduction case about the use of active learning methodologies in higher education program, in Japan, revealing the achieved success factors.

We complete this section with a great article from prof. David Johnson about cooperative learning, which reveal us the adaptability of this methodology in adaptation by small groups, achieving effective results. Thus, he reveals us the focus on cooperative learning theories, types and behaviors, implicit in this technique he offers us an extraordinary practice to master and apply the knowledge.

In the second section, we have a set of investigations that present us with an extraordinary dynamics in the practical active learning approach in the future direction based on information and communication technologies.

According with that, Dr. Abdolrezapour Pariza shows us a computer mediation active learning activities with good results in students' performance, an excellent experimental work that translates very satisfactory results to face this type of learning as the future dynamics in the knowledge acquisition and application.

Continuing with this section, we have another good example with the contribution of Dr. Aouag Sofiane regarding an innovative approach for renewing instructional design focus with a precision microinstructional engineering design, in an innovative way, that transports us into a new world.

The section concludes with an excellent and visionary article by Dr. Mario Barajas that points us to the future orientation of active learning, and it also points out that creativity in conjunction with digital technologies contributes to students' enrichment competencies, in particular, creative competencies.

The third section addresses issues related to active learning namely social dilemmas, coaching strategies and entrepreneurship. In the first article, Dr. Bishara Saied gives us a strong and appellative work about the form that the teaching counselors must deal with students with disabilities, researching for an active way to solve several dilemmas.

Drs. Enisa Mede and Kıvılcım Vermez present an excellent case study on a coaching process to enrich the skills of new teachers in order to be able to teach actively.

We end the section and the book with a spectacular chapter by Dr. Emete Toros about female entrepreneurship that, through active factors and personality traits, develops active learning to create their own businesses and professions.

2. Body

2.1. How to apply and measure the active learning into the classroom

The active learning strategy put into practice is the case study in the use of in organizational change and intervention techniques [24–39, 40]. The students organize in groups and begin

to investigate a given case study with the teacher supervision, when applied a set of O.D. methods and techniques in a change process follow-up participation [41] and organizational intervention [42], for presenting in a short space of time, in the classroom. The students, doing the investigation consult several sources (books, videos, HRM consulting sites, technical and scientific articles, and other documents), being that the final result is intended to illustrate the knowledge obtained by the student through this process.

The case study strategy has the following structure:

1. Theoretical foundation
2. Technique nature and objective
3. When and to whom the technique is directed.
4. Consultant role.

3. Technique development and process

The students must represent O.D. consultant roles [43], in practical presentation examples, which can be real or created, presenting the situation that leads to the intervention, also justifying the technique utility for the presented situation and how it should be applied.

The work is measured in a way inspired by a case base learning Blooms Taxonomy [44] where students are evaluated according to a punctuation of 0 to 20 points in each technique with weighted scale in each executed techniques either, that we mention again:

1. Preparation for the debate [16]. Student's efforts in the sense to obtain relevant consistent data for their fundamental speech in order to confront other speeches from other students, about some case or cases, for getting a solid argumentation to confront doubts, facts, and tendencies revealed (10% weight).
2. Teamwork [17]. Means students organization capacity support themselves, helping each other by motivating, cooperating and communicating, addressing risk scenarios, and taking decisions about their resources in competition according to their own means, where they synergistically take attitudes to win the challenges (20% weight).
3. Exposition and communication [18]. Students draw a proposal about their investigations, questioning critically, arguing, and seeing beyond the future, and own interests or ideologies, giving and asking for feedbacks, creating a positive and constructive speech, changing experiences, and potentiating the speech (20%weight).
4. Preparation for improvisation [19] and ability to argue [20]. Students search additional opportunities to speak and write in ways that convey the essence and significance of their research clearly and accurately. They search networking possibilities that could help in their guidelines to speak in an associative way the several and different subjects, and use a strategy for defending subjective constraints to what the others consider appropriate, who is mistaken for sense and the ability to demonstrate the existing differences and diversity (30%weight).

5. Involvement in the activity [21]. Students do a transformational form involve them on practice, searching references, and doing experiences and categorize data samples, discussions, results, and conclusions, during the investigation timeline, complying with all determinations made between everybody compromised (10%weight).
6. Problem solving [22]. Students develop a wide range of ideas with flexibility and resources, according to a well-defined problem, to solve in a creative form (10%weight).

Considering the highest score of each technique, we obtain a profile according to the respective techniques, therefore:

1. Organizer [45]: a student that can obtain communication planning competencies to meet the interlocutor's needs and expectations, namely student colleagues in the classroom social dynamics. The students receive highest punctuation in preparation for debate.
2. Collaborator [46]: a student who improves the study questions, brings experimental knowledge, establishes trust among the colleagues, helps you search for data and interpret it laterally, assists colleagues in collective learning processes, from various perspectives, and to check that the analysis seems appropriate. The students receive highest punctuation in teamwork.
3. Communicator [47]: a student who delivers dialogs with logic conducting the others to generate communicational attitudes, which discloses information on change, in an appropriate manner, seeks to learn from peers and to help those improve their ability to provide answers, and helps them to be able to confront the criticism and manipulation, indicating clues for searching solutions to improve the dialog. The students receive highest punctuation in exposition and communication.
4. Improviser [48] and arguer [49]: a student who uses spontaneously and creatively his talent to explore unusual issues and makes unplanned decisions, helping her colleagues to solve problems, taking critiquing decisions. The students receive highest punctuation in preparation for improvisation, and use rhetoric and other modes of argumentation and discursive strategies helping others to develop empathy characteristics with their dialogues and provide transparent forms of explanation regarding the issues. The students receive highest punctuation in preparation for improvisation and ability to argue.
5. Committed to work [50]: a student makes inquiries and uses independent and creative thinking skills helping others in the same way to get more results from the workflow and never gives up the flow. The students receive highest punctuation in involvement in the activity.
6. Problem solver [51]: a student who shares interests, resilience, immersions, with other colleagues in team activities toward a solution, a strategy, and an objective, to solve a problem and overcome challenges. The students receive highest punctuation in problem solving.

   Other scores (maximum score) are intended to differentiate from each other independently of the obtained profile.

This profile is not inflexible, depends from many human factors in a task development, and from previously acquired competences, but it will not have a restrictive character since active learning, at least as far as organizational development is concerned, is a continuum for the future, for the change, and evolution.

3.1. Research sample to applicate active learning

Our research sample translates a finalist group, composed of 22 students (17 females and 5 males), with the age average of 22 years, from a higher education course of a higher institution published during the frequency of an Organizational Development signature from a HRM graduation on which active learning and O.D. techniques were applied. We also use communication instruments, such as e-mail and the social net "whatsapp", for doing the work anytime and everywhere for the necessities, interests, and needs, and databases about O.D. techniques. For consultation and evaluation, consulting works and presentations, and measure, we used Excel and SPSS as instruments.

3.2. Results, discussion, and contributions in the field of higher education

According to what we observed, the active learning techniques with an average punctuation by the students are as follows:

1st: preparation for improvisation and ability to argue (42, 22)

2nd: teamwork (37)

3rd: exposition and communication (34)

4rd: preparation for the debate (22, 3)

5th: involvement in the activity (22)

6th: problem solver (21).

In a certain way, the students obtained good achievements with this, where we can say that the active learning is better than the classical techniques (expositive learning), they work in an interactive way, they prepare the studies, the meetings, and the presentations, working together, and made excellent projects. Nevertheless, we still continue to develop the techniques, because the students are not so good in argumentations and either in the commitment to the action or in the problem solving, where this last aspect concerns us since they are creative, and as we did not measure their creative profile, we cannot know what type are they. Supposedly, they seem as disseminators because they disseminate activities around the case ideas, and get things done adapting it to work discarding theories but not fitting the facts. They also try things out than thinking and try too many approaches till one is completely acceptable, but taking action is more difficult. So, maybe these are the truth, cause them main active learning profile is improvisators and wranglers, and together are team workers and communicators. The correlation with the main techniques is significative by applying the Pearson correlation as follows:

1st: preparation for improvisation and ability to argue:

- correlation with teamwork (, 867) and with exposition and communication (, 911).

2nd: team work:

- correlation with preparation for improvisation and ability to argue (, 867) and with exposition and communication (, 992).

3rd: exposition and communication:

- correlation with teamwork (, 992) and with preparation and ability to argue (, 911).

We had the privilege to verify, through the direct experience with the students, that the use of active learning is very useful to the students because this helps them to grow up their knowledge, and apply it in several determinated areas for their future, but more allows to increase their curiosity, essential competencies for the progress of personal knowledge, and increase the relationship between students and teachers, and working together with teams that provides live experiences in an interactive way evolving with the technology and creating it.

4. Conclusions and future trends

We think that active learning improves, essentially, the student's communication competencies and the mutual trust with each other. By another way, it establishes bridges between them to develop collective and individual attitudes to study, create, and offer solutions for work in better sharing utilities and facilities to win the challenges of tomorrow frontiers.

In future, active learning will give us more active students and teachers and models increasingly for online learning [52], gives us new devices for health and well-being [53], and provides feasible paths to obtain data resources through artificial intelligence [54] strategies for students to learn, study, and live with their own resources like service learning, metacognition, e-portfolios, open space dynamics, and e-team working [55]. This transition to the technology will help to extract more information that will be used as based for another type of learning it is an evolution process [56] that which climax is codification, by the subjects, critical thinking aspects, social and academic skills [57]. A good example of this is that the active learning will spread motivation, more and more, dealing and managing difficulties before the problems [58] increase in the way that people can develop the attitudes of curiosity and research to aim new answers from new questions [59]. In higher education, we will see active learning becoming an everyday life practice, where students exchange experiences, research approaches, and visit more degree programs [60], working and knowing better than ever, but each case is a case, and the knowledge world is very diverse, so what we know about the future? What we are waiting for? We hope this book may tell you!

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Chapter 2

Human Active Learning

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Additional information is available at the end of the chapter

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Abstract

Active machine learning (AML) is a popular research area in machine learning. It allows selection of the most informative instances in training data of the domain for manual labeling. AML aims to produce a highly accurate classifier using as few labeled instances as possible, thereby minimizing the cost of obtaining labeled data. As machines can learn from experience like humans do, using AML for human category learning may help human learning become more efficient and hence reduce the cost of teaching. This chapter is a review of recent research literature concerning the use of AML technique to enhance human learning and teaching. There are a few studies on the applications of AML to the human category learning domain. The most interesting study was by Castro et al., which showed that humans learn faster with better performance when they can actively select the informative instances from a pool of unlabeled data instead of random sampling. Although AML can facilitate object categorization for humans, there are still many challenges and questions that need to be addressed in the use of AML for modeling human categorization. In this chapter, we will discuss some of these challenges.

Keywords: active learning, machine learning, human learning, cognitive science, categorization

1. Introduction

With the growing amount of data produced daily, the need of techniques to handle these data has been increased. Machine learning (ML) is a prominent area of computer science that evolved from the study of pattern recognition and computational learning theory in artificial intelligence (AI) [1]. ML is algorithms that are able to learn from data, identify patterns in observed data, and build models that make predictions about unseen data. Algorithm or model enables

computer (machine) to learn from data. Over the past decades, learning algorithms have found widespread applications in numerous areas such as computer vision, object recognition, web search, natural language processing, emotion recognition, etc. The performance of different ML algorithms strongly depends on the size and structure of dataset of the domain.

Supervised machine learning learns from the available data (experience), which is given in the form of training data (instances). The knowledge induced from the data can then be used for descriptive or predictive purposes. Supervised learning problems can be categorized as either classification or regression, depending on the output label of the data [2]. Classification problems assign a discrete class label to input instance, while regression problems have continuous numeric values. Classification is a function that assigns a new object (or instance) as belonging to one of the predefined classes [1]. The goal of classification is to accurately predict the target class for each instance in the data.

Figure 1 shows the workflow in supervised learning. We can see that there are two different steps: training and prediction. During training, a feature extractor is used to convert each input (training data instance) to a feature set. These feature sets with labels are fed into the learning algorithm to generate a classifier model. During prediction, the same feature extractor is used to convert unseen inputs to feature sets that are then fed into the model, which generates predicted labels [3, 4].

ML with many other disciplines of AI are gaining popularity, and they have been used in numerous fields and industries, including finance, healthcare, education, and psychology. Since learning is an important aspect of intelligent behavior, ML can be used commonly for data analysis in psychology and cognitive science. Recently, ML methods have been investigated in experimental psychology and human categorization.

In ML, active learning refers to an approach that selects the queries (instances) for labeling from a large pool of unlabeled data [5, 6]. In most cases, an active learning algorithm outperformed random sampling method and reduced number of instances that necessary to achieve similar performance. Active learning is often used for problems where it is difficult (expensive and/or time-consuming) to obtain labeled training data [7, 8].

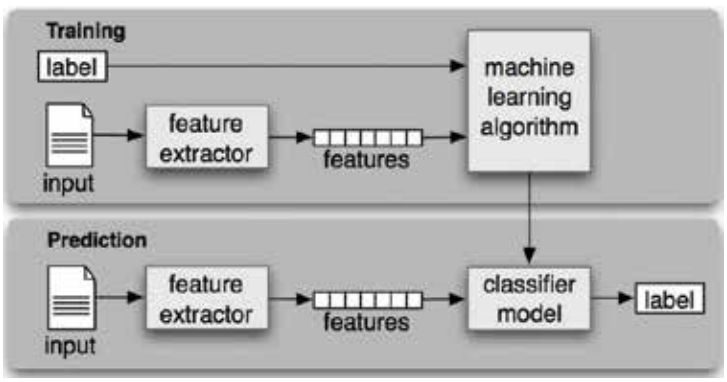

Figure 1. The architecture of a supervised classification.

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Researchers have shown that active learning is beneficial in many domains [9], including education [10], machine learning [5], remote sensing [11], and cognitive science [12].

2. Active machine learning

Semi-supervised learning (or SSL) has attracted a highly considerable amount of interest in ML. SSL techniques allow classifiers or learners to learn from labeled and unlabeled data at the same time [13, 14]. Typically, they are used when we have a small-size labeled dataset with a large-size unlabeled dataset. **Figure 2** intuitively shows the difference between supervised and semi-supervised learning. Actually most real-world learning scenarios are SSL. During the last two decades, SSL methods such as active learning, co-training, and co-testing have significantly improved learning performance in various applications.

When a machine learning model is trained, learning is performed on a random subset of all the available sets of labeled training data. We will refer to this mode of learning as passive learning (PL). In PL mode of learning, the classifier (learner) does not participate interactively with the

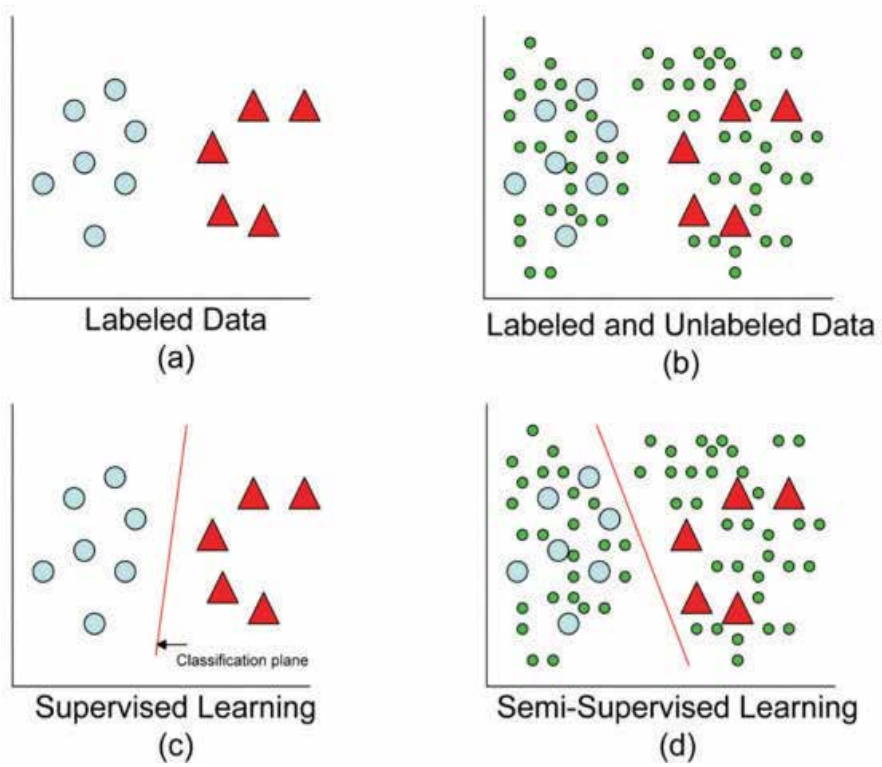

Figure 2. Supervised vs. semi-supervised learning.

teacher [13]. A passive learner receives a random dataset from the world and then produces a classifier or model. Thus, PL is more straightforward and easier to implement.

Active machine learning (AML) is a popular research area in ML [5, 8, 13]. It allows selection of the most informative instances in training dataset of the domain for manual labeling. AML aims to produce a highly accurate classifier using as few labeled instances as possible, thereby minimizing the cost of obtaining labeled data [5]. With this assumption, AML is a specialized version of SSL, and they aim to reduce manual labeling workload. We provide a comparison of AML and PL in **Table 1** [5, 13]. Although most research in AL has tended to focus on binary classification problems and achieve high classification accuracy, some studies have addressed multicategory classification [15]. In AML, the classifier is initially trained on a small set of instances (labeled pool L), and it chooses informative instances from an unlabeled pool U of data to request labels from the expert or oracle (e.g., a human annotator) that can upon request provide a label for any instance in this pool [16], and this is repeated till convergence. This way, only a small quantity of unlabeled instances needs to be labeled to get very good performance. **Figure 3** illustrates the AML cycle.

AML is an important technique in machine learning, because labeled data is often more difficult and expensive to obtain than unlabeled data [17]. For example, if one is classifying web pages into categories based on the content, labeled data would likely be collected by hand, while unlabeled data could be found from the Internet automatically. Multiple studies proposed several AML algorithms and applied them to many applications. They have shown that when AML is used, ML models require significantly less training data and can still perform well without loss of accuracy [4, 8].

Typically, AML approaches select a single unlabeled instance, which is the most informative at that iteration, and then retrain the classifier. The training process in this case is hard and time-consuming; further, repeated retraining is inefficient. Thus, a batch mode AML strategy [9, 10] that selects multiple instances each time is more appropriate under these circumstances.

Pool-based method is the most prominent technique used in AML, and most research work of AML is pool based in recent years as unlabeled data has become easier to collect [5]. Pool-based AML assumes that the model has access to the entire set of unlabeled data at selection time.

PL	AML
No control over training instances	Selects training instances from a pool of unlabeled data (queries)
Large number of required training instances	Relatively small
Examine the entire training data before inducing a classifier (batch process)	Learner sees one or a subset instances at a time (iterative process)
One classifier induced	Many
Simple stopping criteria	Complex

Table 1. Comparison of active machine learning and passive learning.

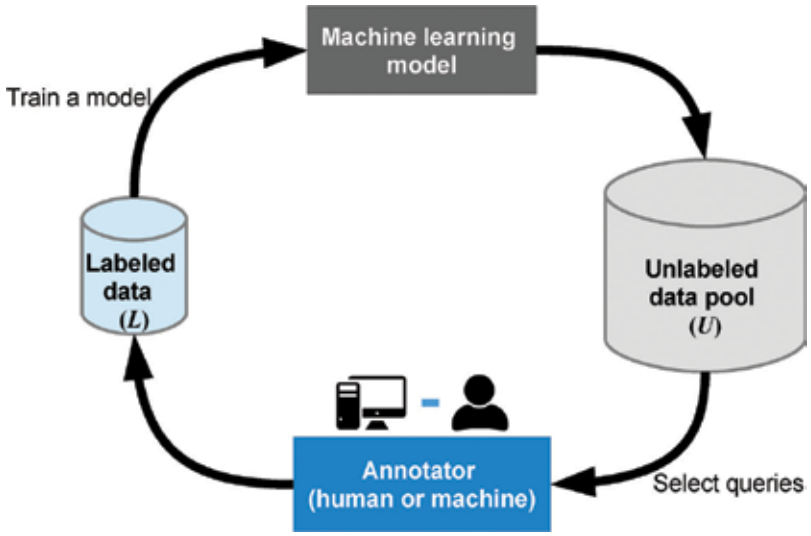

Figure 3. Pool-based AML cycle.

3. AML selection strategies

There are a number of AML query selection strategies, which have been presented by Settles [5]: (1) Uncertainty sampling is the simplest and the most commonly used strategy. Uncertainty sampling focuses on selecting the instance that the classifier is most uncertain about to label. This strategy can be divided into two categories: maximum entropy of the estimated label and minimum margin (distance of an instance to the decision boundary). (2) Expected error reduction, which aims to query instance that minimizes the expected error of the classifier. (3) Query by Committee (QBC) in which the most informative instance is the one that a committee of classifiers finds most disagreement. Bagging and boosting are used to generate committees of classifiers from the same dataset. They aim to combine a set of weak classifiers to create a single strong classifier. While bagging creates each base classifier independently, boosting allows these classifiers to influence each other during training process [18]. Boosting is an iterative process that initially assigns equal weight to each of the training samples; then the weights are modified based on the error rate of individual classifier.

4. Human AML

Actually human learns concepts in similar way of SSL, from a limited number of labeled data (e.g., parental labeling of objects) to a large amount of unlabeled data (e.g., observation of objects without naming in real life) [14]. In the ML scenario, it is easy to obtain the predictions of the classifier, and it is usually expensive to obtain the actual labels for instances.

In the real world, learners are not provided with labeled category information with every object they encounter (like in supervised category learning tasks), nor do they receive only unlabeled

information (like in unsupervised category learning tasks). People use labeled (with feedback) and unlabeled (no feedback) information when learning categories. In supervised learning, individuals learn the categories by correcting their performance based on the feedback they receive. The feedback people receive about categories may be either true or false. However, unsupervised learning category gives no feedback (information) about the category of an object. The individual learns from his/her experiences with different category objects, without receiving any feedback. Actually, humans categorize real-world categories most similarly to an SSL technique.

Gibson et al. [19] have used the equivalences between models found in human categorization and machine learning research to explain how the SSL techniques can be applied to human learning. In human AML, participants are usually first shown a small number of labeled instances, followed by a large set of unlabeled instances [20]. A set of experiments conducted by Gibson et al.[19] showed that SSL models are useful for explaining human behavior when they used both labeled and unlabeled data.

Unlike machines, a human learner gets tired as she/he answers questions, so finding out whether she/he knows a concept or not (i.e., getting the labels) is usually an expensive task. Therefore, using AML for human learning may help it become more efficient and effective and hence reduce the cost of teaching [21]. It might be costlier to teach an example to a human than it is to teach a computer program.

Although AML has been studied in different domains, such as video annotation and web page classification, its applications to human learning have been studied very little. There are a few empirical studies on the applications of AML to the human learning domain. The first such study was by [22], which showed that humans can use unlabeled data in addition to labeled data in categorization tasks. The authors in [23] proved by empirical evidence that human category learning is influenced by unlabeled data in a supervised categorization task, but they did not explain how individual can select these unlabeled examples.

There are a few studies on the applications of AML to the human category learning domain. Castro et al. [12] investigated what they refer to as "human active learning." They tried to answer a research question "Can machine learning be used to enhance human learning?" in the context of human category learning. We consider [16] as the most interesting study in human AML field. Castro et al. showed that humans learn faster with greater performance when they can actively select the instances from a pool of unlabeled data instead of random sampling and their performance is nearly optimal. However, they did not address how humans choose the next best instance. Moreover, they conducted their experiments by humans in a simple binary classification task, not in a real-life situation. Participants were presented with artificial novel 3D shapes (stimuli) that varied along a single, continuous dimension (spiky to smooth) and were given feedback as to which category the stimulus belonged to (see **Figure 4**). The task for each participant was to find out the precise egg shape (category boundary) for which eggs that were any spikier would hatch into snakes, while eggs that were any smoother would hatch into birds. Authors compared the performance of three distinct conditions for each participant. In the active learning condition, the participant could choose specific observations to test their beliefs based on her previous queries and their noisy labels, whereas, in

Figure 4. Example stimuli used in the experiment, with corresponding values.

the PL condition, the sequence of data was generated randomly by the experiment. They also included a "Machine-Yoked" condition where participants saw sequences of observations created by active learners but did not have control over the sequence.

The closest research to investigation by Castro et al. is [24] and [25] using a slightly modified procedure. They have successfully shown that learners benefit from the selection in category learning. Gureckis and Markant [25] concluded that AML can be superior because it allows humans to use their prior experience and current hypotheses to select the most helpful instances (e.g., asking a question about something that is especially confusing).

The work [24] by the same authors examined the interaction of self-directed information selection and category learning. Self-directed learning in humans can be inspired by "active learning" research in the ML literature [25, 26]. In this study, participants learned about two categories of "antennas" that varied along two dimensions (circles that differed in size and the orientation of a central line segment) and received one of the two television stations (CH1 or CH2). They compared active learning (or self-directed learning) condition, in which participants designed stimuli to learn about, with passive condition in which instances were generated from predefined distributions. Their results showed that for simple one-dimensional rules, active learners acquired the correct category rule faster than passive learners. Also, the AML advantage only held for the less complex, rule-based category.

Sim et al. [27] showed that school-age children learn more effectively when they are allowed to make decisions about what information they wish to gather than others who could only observe samples that were randomly generated for them. This results lead to the conclusion that children are capable of learning from the data they generate by themselves even at an early age. This result also suggests that the children's information gathering was informed by uncertainty and previous feedback, leading them to sample items that were near the true category boundary. This result was successfully replicated in [24]. Adams and Kachergis proved the effectiveness of AML for preschoolers, and they use an informative sampling strategy in an active category learning task. The authors suggest that children's performance in the AML task is related to their early math and preliteracy skills.

Kachergis et al. [28] in their paper investigated whether AML is better than PL in a cross-situational word learning context. They also investigated the strategies and found that most learners use immediate repetition to disambiguate pairings.

Researches in computer science on computationally efficient AML have inspired new theoretical approaches to inquiry behavior in humans.

5. Challenges of using AML for human categorization

5.1. High dimensionality

Most of the empirical studies, which addressed human HAML, focus on learning two-class problems on a one-dimensional input space [15, 29], but there are obstacles to generalize the model to multiclass classification problems [19]. The same is true for a single-modality (visual) object recognition. It is important to investigate the generalization of human AML to multi-dimensional objects (stimuli), such as auditory stimuli, high-dimensional stimuli, real-world stimuli, other demographic groups, etc.

5.2. Sensitivity to noise

Experimental studies on the human AML show that it is sensitive to noise and humans are not as good as machines in selecting queries from an unlabeled dataset of artificial visual stimuli [21]. Thus, human AML performance declines with higher noise levels. Humans perform relatively well in at least some noise settings, suggesting that they took the experiment seriously [30].

5.3. Distribution and ordering of unlabeled data

Zhu et al. [22] showed that humans are sensitive to the distributional structure of the subsequent unlabeled experience. Gibson et al. [19] investigated the effects of the distributions of unlabeled instances (stimuli) to human learner in two experiments, and they also investigated the effect of the order of the unlabeled items that participants encountered in an experiment. They concluded that human categorization is sensitive to both the distribution and ordering of unlabeled instances [19].

5.4. Small number of participants and objects

The small number of participants limits the generalization of the findings to other humans. In many studies that investigated human AML, small group of people participated in the experiments. In addition, a small number of objects used in the investigations lead to a similar limitation, because a limited number of teaching and test instances reduce the reliability of the results.

5.5. Category or concept structure

People are sensitive to the value of both labeled and unlabeled stimuli, and this depends on the structure of the concept being learned [24]. Markant and Gureckis [31] showed that the effectiveness of AML might interact with the particular structure of the target categories. Two types of category structures were used in that study: rule-based (RB), in which the decision rule is defined as a criterion along a single dimension, and information integration, in which the decision rule is a function of at least two dimensions.

5.6. Prediction of the next question

In human learning, people often learn by asking rich and interesting questions, which more directly target the concepts in a learning task. For example, a child might ask "Do all dogs have long tails?" or "What is the difference between cats and dogs?" [32]. The main challenge for AML method is to predict which question a human will ask from the given context. A number of recent studies have discussed this challenge [33–35]. Rothe et al. in [33] proposed a model that predicts what questions human learners will ask and can creatively generate novel questions that did not exist in the training data. Their work in [34] showed that human can accurately evaluate question quality by using the Bayesian ideal observers. In the most recent review [35], authors highlight and discuss nine challenges about the psychology of human inquiry.

6. Human AML for autism students

One goal of recent researches is to incorporate ML models with behavioral models to teach students and to investigate whether they can benefit from ML techniques to learn better.

Radwan et al. [21] were the first to attempt to use AML for teaching students with autism spectrum disorders (ASD). Students with ASD cannot learn in the same way as most people, and they need special treatment to learn a concept or an object. One of the difficulties faced by people with ASD is the recognition of categories. Radwan et al. [21] proposed a novel batch-mode pool-based AML framework for teaching students with ASD and compare the effectiveness of PL vs. AML on teaching object recognition for those students. AML approach presented to the student the most informative teaching set of objects based on the uncertainty sampling strategy. In this framework, a student plays the role of the classifier and does not have a probabilistic model. So, the uncertainty is computed in the context of the child's responses to measure informativeness for all objects. If an object's uncertainty is high, it implies that the student does not have sufficient knowledge to classify the object, and then adding this object into the training set can improve the child's recognition ability.

For this purpose, a web- and touch-based application was developed and presented on a tablet PC. Objects from everyday lives of children were grouped based on their categories and four difficulty levels L1–L4; see **Figure 5**. Picture stimuli of target objects were colored images, and they were collected using image search engines, in particular Google and Bing. The teaching procedure was based on applied behavioral analysis (ABA) principles. Five students with mild to moderate levels of ASD participated in the experiment. An alternating treatment design of single subject research methods was used to compare the effects of AML and PL.

The results indicate that AML was more effective than PL for four out of the five students. Consequently, students can learn faster and are able to reach a learning criterion with fewer teaching trials [21]. AML approach was generally more effective in terms of accuracy. The statistical results demonstrated that there was a statistically significant difference in accuracy level between the means of PL and AML. The AML approach and procedures provide two

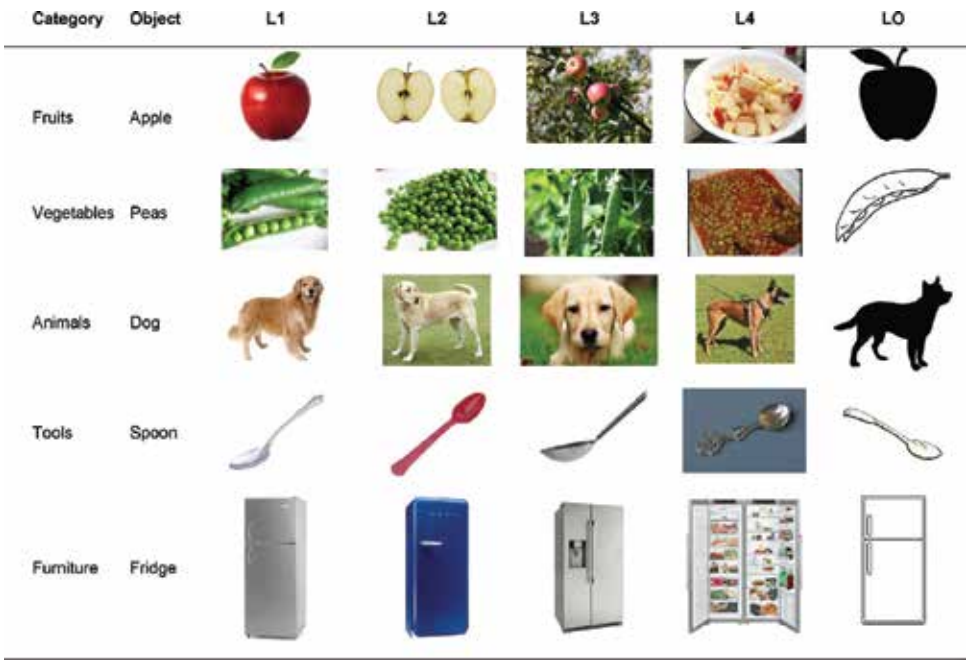

Figure 5. A sample of images from the dataset used for teaching and test. Columns L1–L4 show different difficulty levels.

features that helped to reduce repetition in learning environment: (1) minimizing the number of teaching trials required for training and (2) determining mastery criterion for levels. When a participant reached mastery criterion, the application no longer assesses this level in the following phases.

7. Conclusion

The applications of AML in human categorization have become increasingly common in recent years. Humans and machines seem to benefit from AML in similar ways [24, 30, 36]. In AML setting, a learning machine is able to query an oracle in order to obtain the most informative instances that are expected to improve performance [37]. However, humans ask far richer and more sophisticated questions. In this review, we present and discuss benefits and challenges of using AML for human categorization and concept learning. More research is needed to address several limitations of human AL.

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Chapter 3

Empowering Learners Using Active Learning in Higher Education Institutions

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Additional information is available at the end of the chapter

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Abstract

Higher education institutions are expected to produce skillful, problem solver, and competent graduates. This becomes possible when the instructors are using the appropriate teaching methodology and the learners are active and empowered in the teaching-learning process. In relation to this, constructivism theory emphasized that the learner is the center of the learning and the instructors playing an advising and facilitating role. In the teaching-learning process, when the learners are empowered using the appropriate teaching methodology, they feel a sense of confidence, capability, competence, and self-esteem, enabling them to meet life's challenges more effectively. Therefore, a shift in theory (education theory) to a more student-centered approach using active learning is recommended because this approach has its own role to make the students creative and competent in their study. Thus, this chapter of a book tried to address the contribution of active learning in the empowerment of learners in higher education institutions.

Keywords: active learning, empowerment, higher education institution, learners

1. Introduction

It is clear that students in higher learning institution are expected to be creative, proficient, and problem solver in their field of study. For these to be happen, the teaching-learning process in higher learning institutions should be implemented properly and use the right teaching methodology in relation to the nature and content of the course or subject. In different countries of the world, education is now moving toward new practices in teaching and learning to make the learners creative and competent which is active learning (student-centered method)

because the traditional teaching method (lecture) is not adequately preparing students for the real world of work. The new practices of teaching that active learning is focused on are creativity and problem solving if it is properly implemented [1]. In higher education institutions and other education levels (i.e., primary and secondary schools), student-centered methodology specifically active learning is recommended [2, 3] to make the learners creative and proficient in their learning. Active learning is an innovative model for the provision of high-quality, collaborative, engaging, and motivating education [4]. It engages learners in the process of learning through activities and/or discussion in class, and it increases learners' higher order thinking as compared to passively listening to a lecturer [5].

In active learning, students' activity and commitment in the teaching-learning process are key elements [6]. Active learning involves students in their learning using different activities such as reading, writing, discussion, or problem solving, which promote analysis, synthesis, and evaluation of class content and engages students in two aspects, i.e., doing things and thinking about the things they are doing ([7], p. 2). In addition, the students can also engage in the assessment and feedback process.

The assessment and feedback which are implemented in the active learning classroom have also its own contribution for the empowerment of students. If the instructors are using authentic assessment methods and provide effective feedback and if the students participated in the assessment and feedback process, it is possible to increase their performance and confidence in their learning.

Currently, higher education institutions face challenges with skill for learning, skill for life, and skill for work. Many higher education institutions are responding to this challenge by implementing strategies designed to empower learners, i.e., giving them more autonomy, ownership, and responsibility for their learning. Using active learning in the classrooms, laboratories, and fields (practical sites), it is possible to empower students in their learning. In the teaching-learning process, when the learners are empowered using the appropriate teaching methodology, they feel a sense of confidence, competence, and self-esteem, enabling them to meet life's challenges more effectively. Therefore, a shift in theory (education theory) to a more student-centered approach using active learning is recommended [8] because this approach has its own contribution to make the students creative and proficient in their study.

Thus, this chapter tried to address the contribution of active learning to empower learners in higher education institutions. In addition to this introduction section, the following is the list of possible topics which will be treated in the chapter.

2. Method

This manuscript is a review of different sources. Articles in active learning and assessment are collected, identified, and reviewed from online databases and library catalogs from the University of Johannesburg to access electronic collection of journals and research studies. The majority of the reviewed documents were journal articles. But there are also books,

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book chapters, conference proceedings, and thesis. The analysis and discussion reviews are presented together based on the different topics which are related to the issue, and finally conclusions are given.

3. Active learning and active learning strategies

3.1. Active learning

A Chinese philosopher Confucius from 551 to 479 BC (in the fifth century BC) wrote the following quotation: "I hear and I forget; I see and I remember; I do and I understand," and this quote is highly related to active learning. As to Hativa [9] this quotation indicated that students learn meaningfully only when they are doing something either physically or mentally with the information and learning materials. In active learning the learners are the main agents in the learning process not the instructors. Hativa added that it is through involvement and doing that learners truly contribute in the learning process. So, for learning to be active, students do more than listening; they have to read, write, discus, or be involved in problem-solving activities [10].

The fundamental concept of active learning is to advance the learning experience of learners and the teaching experience of instructors. When learners are active in the classroom, they are engaged in higher-order thinking (analysis, synthesis, evaluation) and in a variety of activities such as reading, discussing, writing, and problem solving [7]. Such classroom activities put the student at the center of the learning process enabling them to improve their critical thinking skills [10]. Active learning can be realized by any method of teaching which actively involves students in the real learning process of [6].

Studies indicated that active learning has a greater impact on student mastery of higher and lower level cognitive skills. It increases students' performance across the different disciplines. On average, students who learn in conventional lecture courses are 1.5 times more likely to fail than students who learn in courses with only active learning [5]. Mickelson et al. [8] also indicated that active learning shows that student involvement in the learning process leads to deep learning.

3.2. Active learning strategies

In the teaching-learning process, instructors in higher institutions are required to use different active learning techniques or strategies to empower students in their learning. The selection of the techniques depends on the nature and content of the subject they are teaching. The active learning strategies comprise different activities that share the common elements of involving learners in doing things and thinking about the things they are doing [7]. The use of different active learning strategies can significantly improve the teaching-learning process.

Different authors, Mocinic [11] and Oliveira et al. [12], proposed the following list of active learning methods to be used by instructors in higher learning institutions to make the students creative and proficient in their learning:

a. Collaborative learning

b. Discussion methods: discussion, case study, and brainstorming

c. Role play

d. Games involving simulation of imaginary situations

e. Problem-based teaching

f. Projects (individual or group)

g. Peer teaching

h. Debates

i. Short demonstrations followed by class discussion, etc.

Integrating the above-listed active learning methods in the instructional process based on the nature and contents of the course will make the student's learning successful and competent. For example, collaborative learning is one of the best methods of active learning which can facilitate learner's critical thinking. Peer interactions during collaborative learning can be helpful for the learner's development of critical thinking [13]. Therefore, as Eison [14] stated, the above-listed active learning strategies increase students:

- Creativity
- Critical thinking
- Discussion or speaking with other students, in a small group, or with the whole class
- Exploring personal attitudes and values
- Providing and receiving feedback
- Expressing ideas through writing

Hence, to have the above-listed benefits, using different active learning strategies properly inside and outside the classroom is very important specifically for the learners. Eison [14] suggested that instructors have used larger proportion of time in helping students to develop their understanding and skills and a lesser proportion of time in transmitting information when they use active learning strategies appropriately. In this strategy (active learning), instructors provide opportunities for learners to apply and demonstrate what they are learning. In addition, they provide opportunities for learners to receive feedback from peers and/or the instructors themselves. In general, the active learning strategies have the following characteristics in promoting students' learning in the classroom [7]:

- Students are actively involved in the instructional process more than just listening.
- More emphasis is given on advancing students' skills, and less is given on transmitting information.

- Students are involved to develop their higher order thinking skills.
- Students are actively involved in different activities (e.g., writing, discussing, and reading).
- Emphasis is placed on the learners' investigation of their attitudes and values.

4. Psychological theories of active learning

It is clear that students have different areas of interest and learning styles in the instructional process. However, the traditional way (lecture method) of teaching assumes that all students learn the same, and they cognitively process information the same way at the same rate [1]. This is in fact impossible. Currently, there is a shift in education theory to a more student-centered approach specifically active learning methodology [8], because this approach has its own contribution for the learners' better understanding of the issue/lesson presented to them. Student-centered teaching method emerged from constructivist learning theory [15]. This theory was frequently described as student-centered teaching method because it emphasized on student's active role in the teaching-learning process [16].

According to Walsh and Inala [17], this approach seeks to engage students in their own learning and for them to actively take part in the learning process themselves rather than being simply fed information by their instructors. From the different theories, constructivism theory emphasized that the learner is the center of the learning process, while the instructors playing an advising and facilitating role. Here in constructivism theory, the learner is active rather than passive. Constructivist believes that knowledge is experienced-based activities rather than directed by instructors [18] and it is not received from the outside environment; rather, the student interprets and process what is received through the senses to create knowledge.

According to Hativa [9], the theory of constructivism entails that students learn well only when they are active in the teaching-learning process rather than passive, when they use what they are taught to alter their prior knowledge, and when they construct their own understanding. In addition, learners develop their own interpretation of the issue presented to create a theory that makes sense to them. They then connect the new knowledge with the personal knowledge structure that they construct.

Hativa [9] added that in the constructivist learning theory, "meaningful learning takes place only when students actively process the new information, interpret it, and link it to their present knowledge." This theory has an implication for effective classroom teaching in a way that instructors should encourage students' active involvement in the learning process and learners gain valuable information for their creativity and competency.

In active learning, learners construct and formulate knowledge based on previously acquired beliefs and experiences. This theory has huge contribution in empowering learners using active learning methodology. The process followed to empower learners using active learning requires a dynamic interaction between the learners and their experience. The theoretical foundation of critical thinking and higher-order thinking skills is the constructivist principle

of learning through experience [8]. Mickelson et al. [8] added that, during active learning as to constructivist theory, the students take control of their learning.

5. Learner empowerment

Empowerment in the academic setting is the approach and practice of supporting learners to become able to shape their learning and study for a sustainable future. So, learner empowerment is giving more autonomy and ownership for the learners in their learning in the instructional process and ultimately produces an intrinsic desire to learn [19]. Learners become effective in their learning when they are empowered. Learners should be empowered for every activity in the instructional process. When learners are empowered, they become motivated, work harder, and strive for a better performance [20]. For this to happen, the role of the instructors involves guiding and facilitating rather than transmitting information to the learners. This means the instructor has to make the teaching-learning process more active to empower the learners.

Furthermore, as to Schrodtet al. ([19], p. 184), empowered learners should:

i. Be more likely to see the meaningfulness of the course content and activities.

ii. Feel a greater sense of self-efficacy in performing classroom tasks.

iii. Be more likely to perceive that learning course content can have an impact.

In relation to this, Kirk et al. ([21], p. 589) found out "that highly empowered students reported better grades, fewer behavioral incidents, increased extracurricular participation and higher educational aspirations than students who were less empowered."

Therefore, empowerment is a process enabling the learner to think, believe, and carry out an activity and criticize his/her own work and made decisions autonomously. Thomas and Velthos as cited in Frymier and Houser [22], empowerment consists of four dimensions:

- **Meaningfulness**—considers the value of tasks in relation to one's own beliefs, ideas, and standards. If the work is not meaningful, the students will not be motivated to generate high-quality work (Glasser as cited in [22]).
- **Competence**—means that the person feels qualified and capable to perform the necessary activities to achieve the goal. The feelings of empowerment are decreased when the individual lack self-confidence in their skills and feel intimidated by the task or goal.
- **Impact**—means that the accomplishment of a task is perceived to make a difference in the scheme of things. The more impact individuals believe they have, the more internal motivation they should feel.
- **Choice**—refers to the degree to which persons self-determine their task goals or methods for accomplishing them. This model predicted that great choice contributes to feelings of increased empowerment (Thomas and Velthouse as cited in [22]).

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Therefore, empowerment can be seen as a goal aimed at cooperation, based on mutual respect, discovery of perspectives, development of vision, and provision of options for reaching creative solutions [23]. Angela [20] mentions that learner empowerment is both a means and an end. As a means, it helps learners to attain and enjoy quality learning. As an end, student empowerment is a desirable goal that all teachers should pursue because, when students feel that they can do something and do not feel powerless in their learning environment, the quality learning begins.

Angela [20] further explains the important components of student empowerment: empowerment through involvement and empowerment through partnership. Firstly, student empowerment is possible only through active involvement in their learning, and the best ways to empower students are to allow them prearranged and to let them make their own decisions. Secondly, student empowerment is not a one-party activity. It requires genuine understanding and acceptance on the part of the school authority, including teachers and the school administration. Without partnership, student empowerment in the school setting is impossible. To this effect, empowering students are essential, and the students should have confidence in the knowledge and skill they possess. This happens when they are empowered through a range of assessment methods.

6. Contribution of active learning for empowerment

The active learning methods that the instructors are using in the classroom have huge contribution to the empowerment of learners. To empower students in their learning, instructors should apply multiple strategies in the classroom and in the field (practical sites). If the instructors use different strategies of active learning, the involvement of students in their learning becomes high, and there is a chance for the students to be proficient in their learning and real world of work. As to Bonwell and Eison [7], students' involvement in their learning can be further improved by the instructor's use of different active learning strategies. If the students are actively involved in active learning process using different strategies, they develop higher order thinking tasks as analysis, synthesis, and evaluation. Therefore, these higher order thinking tasks increase the learner's creativity and make them empowered in their learning.

It is clear that learning can be empowering and active learners know this. They are used to succeed and praise for their accomplishments. However, there are a few students in every classroom who tend to learn differently than their most successful classmates [24]. In the instructional process, the instructors should give chance for learners to cooperate with each other using different strategies. The learner's cooperation in the learning process helps them to share their experiences and improve their learning. Active learning is contributed for the active participation of students in class discussions and to improve their understanding of class contents. In general, if active learning is properly implemented in the instructional process in higher learning institution and other education levels, it develops student's skills for critical thinking and increases their competency. Critical thinking is one of the skills in which student-centered learning promotes and this learning approach shifts the focus of power, in terms of what is learnt and how it is learnt, from the instructor to the student [25]. Therefore, the development of higher order thinking skills, critical thinking skills, creativity, and competency is the result of proper implementation of active learning, and this empowers student's learning and study.

7. Assessment and feedback in active learning and empowerment

Assessment and feedback are the fundamental tools in active learning and a base to the empowerment of learners if they are properly implemented. The assessment methods which are developed in relation to any teaching mode should be aligned with the learning outcomes which will be measured. As to Sluijsmans et al. [26], assessment as a tool for learning has a great impact on the students' learning and development into reflective practitioners.

Empowering learners in the assessment process encourages or engages them in real-life situations. Empowering learners with different assessment methods has a major impact on their results, and learners should be empowered for every activity in the teaching and learning process [27]. Angela as cited in [27] noted that learner empowerment is possible only through active involvement in their learning.

In active learning, the two forms of assessment, that is, formative and summative assessments, can be used and play a valuable role. According to Gibson and Shaw [28], formative assessment can be achieved through the observation of classroom activities such as discussions, student presentations, self- and peer assessments, and group work. Obviously, formative assessment does not often occur in lecture-based teaching where communication is one way, with little or no input from the learners. Active learning techniques, however, provide more opportunities for formative assessment to take place as the instructor observes student performance and modifies the learning experience accordingly. However, unlike formative assessment, summative assessments are not used to adjust instruction during learning; instead, they are more likely to be used to determine student scores and grades [28].

The active learning process invites learners to assess their own and others' work, which means self- and peer assessments are the dominant assessment methods in the empowerment of students. Amo and Jareno [29] noted that self- and peer assessments are being increasingly used in higher education to help students learn more efficiently. Assessment can provide feedback to the instructor themselves to improve their instructional process and to check how the learning is going on. Recent research results showed that for student-centered teaching (active learning), alternative assessment strategies such as authentic assessment can be used to evaluate both student's active learning process and their learning outcome [30]. Authentic assessment is a form of assessment in which learners are asked to perform and establish meaningful application of essential knowledge, attitudes, and skills to the real-life situations. The following are samples of the common assessment methods used in active learning methods.

7.1. Peer assessment

Peer assessment refers to the assessment of students by other students, and it is a mode of assessment associated with the use of active learning [31]. It encourages learners to be more responsible in their learning and performance [32]. Peer assessments are based on the behaviors of others and use some type of recording tool like a checklist, rating scale, or rubric developed from the learning objectives to guide the assessment [28].

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7.2. Self-assessment

Self-assessment is an assessment which allows students to assess their own performance [27], and it is a main tool to empower students in the assessment process [33]. It encourages students' self-regulation of their learning and setting of goals for self-improvement. It is most effective when it is embedded into the learning in the unit, and students are provided with the opportunity to learn from their mistakes.

7.3. Observation

Observation is the main tool to gather ongoing information of students' performance. It can take place in a variety of settings, across many activities, and employ a number of different tools to record information including checklists, anecdotal records, frequency count tables, and rubrics [28]. Observational assessments empower measurement of students' behavior, skills, and abilities in ways not possible via traditional assessment (quiz, test, or exam). When planning to observe students, instructors should consider whom they want to observe, what to observe, and how to evaluate and document what they see.

7.4. Presentations and demonstrations

Presentations and demonstrations are both authentic assessment techniques that are important in active learning classrooms [28]. When learners are required to present and demonstrate their work to an audience inside and outside the classroom, there is a chance to get feedback from the audiences and learn from it to improve their performance. These two assessment methods provide students with the opportunity to make the connection between their learning and real-world learning environments.

In relation to each of the abovementioned assessment methods, there should be appropriate and timely feedback. Feedback is an information provided by an agent (e.g., teacher, peer, self, book, experience) regarding aspects of one's performance or understanding [34]. Sadler [35] noted that giving detailed feedback for students to their work, with suggestions for improvement, should become a common practice in higher education. Hattie and Timperley [34] also added that effective feedback is characterized by its clarity, purposefulness, meaningfulness, and compatibility with students' prior knowledge. Therefore, if the assessment is supported by the provision of effective and appropriate feedback in the active learning process, it enhances the students learning and makes them competent in their field of study.

8. Conclusion

From different studies and literatures, it is indicated that empowering learner using active learning in higher education institutions and other education levels has its own contribution to make the learners creative and competent in their learning and study area. Instructors in the classrooms and outside (laboratory and practical sites) of higher learning institutions are

advised to use different active learning strategies based on the nature of the course with the support of appropriate assessment methods and feedback. If the learners are not properly assessed and given appropriate and timely feedback, they will not be effective in their learning, and their motivation to learn will decline. Therefore, the active learning strategies, assessment methods, and feedback (appropriate and timely) should be aligned together to empower learners in their learning. This learning strategy is supported and linked to the theory of constructivism. Therefore, using active learning in the instructional process is vital to empower learners and make them knowledgeable and competent in their study area.

Conflict of interest

There is no conflict of interest between the authors of this book chapter.

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Chapter 4

The New Movement of Active Learning in Japanese Higher Education: The Analysis of Active Learning Case in Japanese Graduate Programs

Aki Yamada and Reiko Yamada

Additional information is available at the end of the chapter

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Abstract

Currently, active learning becomes the major concern for Japanese higher education institutions. In this chapter, active learning is defined that students study with clear purposes and are engaged in learning proactively. As a result, active learning brings some learning outcomes. Many previous studies have shown that the learning outcomes of students are strongly associated with the quality of pedagogy and student experience. Such pedagogy often includes active learning methods, and it is often expected that active learning methods are strongly associated with proactive learning of students. Such active learning methods have been introduced in the Japanese graduate programs so called leading graduate programs. In this chapter, after examining the theory and effectiveness of active learning, we will examine the practice of active learning methods introduced in leading graduate program of University of Tsukuba. That program is unique and interdisciplinary programs, which will lead to learning outcomes sought in the new knowledge-based society.

Keywords: active learning, teaching-centered, learning-centered, interdisciplinary approach, STEAM

1. Introduction

In recent years, many Japanese universities and colleges have introduced the active learning method. The survey[1] conducted by the MEXT (Ministry of Education, Culture, Sports, Science, and Technology) in 2015 shows that 41.6% of four-year universities and colleges provide the faculty development workshops for promoting active learning methods in a class as compared with that of 26.9% in 2013. At the same time, 70% of four-year universities and colleges responded that they examined to incorporate active learning method effectively into curriculum and also 66% responded that they endeavored to increase classes to introduce active learning methods [1].

There are two factors of rapid spread of active learning in Japanese higher education institutions. First factor is the paradigm transformation from teaching-centered to learning-centered. In the knowledge-based society today, the transition from knowledge attainment-based to new teaching and learning-based educational methods is a worldwide trend. Traditional knowledge transmission-based teaching is effective method for obtaining basic skills, standardized skills, a certain amount of knowledge, and adaptability. However, there is a shared recognition that knowledge transmission-based and memorization-based learning face limitations when it comes to traits such as diversity, creativity, sense of challenge, individuality, proactiveness, and leadership. It is pointed out that the acquisition of practical knowledge and adaptive knowledge has affinity with active learning [2].

Second factor is keenly associated with the higher education policy shift of the MEXT to more learning outcome oriented. Such higher education policy is also applicable to the educational reform in graduate programs. Thus, not only undergraduate education but also the more learning outcomes for the knowledge-based society are sought through the graduate education.

The purposes of this chapter are to examine the MEXT higher education policy in recent years to accelerate the active learning and to show the relationship between active learning methods and learning outcomes in undergraduate education. Then, this chapter explores the case study of graduate education program, which introduces the active learning methods in order to deal with the MEXT policy to accelerate the educational reform of graduate program.

2. The learning-centered higher education policy in Japan

The learning-centered policy shift of the MEXT can be traced to the Central Council for Education (CCE) Report (2005), titled "The Future of Japanese Higher Education." This report confirmed that the twenty-first century as the age of the knowledge-based society, wherein higher education becomes indispensable for both individual and the nation [3].

[1]The MEXT conducts the survey so called "Survey for Educational Reform Situation in Japanese Universities" every year. The survey was conducted for 776 four-year universities and colleges between December of 2015 and February of 2016. The response rate was 99%. http://www.mext.go.jp/a_menu/koutou/daigaku/04052801/__icsFiles/afieldfile/2017/12/13/1398426_1.pdf Accessed on June 27, 2018

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The CCE report, published in 2008, was revolutionary in the sense that it confirmed this policy shift. Titled "Toward the Construction of Undergraduate Education," the report urged Japanese universities to set common learning outcomes for students of each institution as one method for quality assurance under globalization. In the same report, graduate attributes were utilized as a point of reference to recommend a common standard for learning outcomes. Also, universities are expected to integrate the life experiences of their students together with knowledge obtained from their classes in their undergraduate education [4].

The CCE Report of 2008 is recognized as the starting point for a higher education policy shift from emphasizing diversification and flexibility to one of quality assurance—the latter of which includes outcome assessments and a comprehensive reform plan. Such "quality assurance" has rushed higher education into establishing curricular programs, as well as pedagogical reforms, that have forced universities to adapt to the demands of universalization and the emergence of something resembling a global educational standard. In effect, the report demonstrates the need to clarify three policies in higher education for the sake of quality: namely, those relating to diplomas, curricula, and admissions [5].

The Central Education Council's 2012 [6] report "Toward the Qualitative Transformation of Undergraduate Education for the Future" recognized that reforms in university education to robustly equip students with the ability to face unpredictable times and remain viable form the foundation for solidifying students' lives and the future of Japan. Toward this end, the report stated that advancing qualitative changes in university undergraduate degree programs is essential. The conclusion of the Central Council for Education, released ahead of the report, recognized that proactive learning, meaning "the ability to proactively continue lifelong learning," is fostered through sufficient learning time. In other words, the starting point of establishing proactive learning by students is to secure sufficient learning time. In order to accomplish this, the report clarifies that universities have the responsibility to improve undergraduate degree programs, a new point in educational policy [2].

3. Active learning as the pedagogy

The concept of active learning can be reflected in the learning theory developed by Bonwell and Eison in 1990s. They examined characteristics of active learning at the higher education level and clarified the nature of active learning based on the empirical research. In "Active Learning: Creating Excitement in the Classroom" [7], they defined that active learning as (1) students are more actively involved in class than listening lectures, (2) put more emphasis on the development of students' abilities and skills than delivering information, (3) students are involved in higher thought including analysis, integration and evaluation, (4) students are involved in activities such as reading, discussion, and writing, and (5) students can explore phenomena based on their own judgments and values.

Mizokami delineates that the concept of active learning is associated with learning paradigm [8]. Learning paradigm is often compared with teaching paradigm. While teaching paradigm is based on the concept that knowledge should be delivered from the faculty, learning paradigm is regarded as that learning is conducted on student-centered, and knowledge is

not delivered, but is constructed, created, and acquired. Then, he defines that active learning includes all active types of learning, which surmounts passive type of learning. Then, he explains passive type of learning implies that listening to unidirectional knowledge transfer type of lecture and active type of learning indicates that students are engaged in activities such as writing, speaking as well as presenting and the externalization of cognitive process through such activities [8].

Chickering and Gamson indicate that the behaviors of speaking, writing, connection drawing, and applying learning are learning outcomes, and these outcomes are regarded as universal skills, integrative learning experiences, and creative thinking skills in postmodern as well as a knowledge-based society. Therefore, various active learning pedagogies are shared as effective methods to acquire such outcomes. Students often form a group and develop a group study, which has an element of peer learning in such active learning model [9].

Prince argued that active learning functions to take its place of the other pedagogies [10]. One of the characteristics of active learning methods is to use small-group work. Kenney and Suzuki describe that "placing students into small cooperative groups gives them a chance to work toward a common goal while building interpersonal and problem-solving skills" [11]. There are several relevant literatures showing that small-group work functions as a practice of active learning [12–15]. These relevant literatures indicate that many practitioners of active learning introduce small-group work in their classes as a method of active learning [12].

4. First-year experience and active learning

Japanese universities, first-year students, after entering the universities, experience the active learning through first-year experience class. First-year experience has been expanded rapidly in Japan, with developments taking place over the past 20 years being particularly remarkable.

Aforementioned the 2008 Central Council for Education report indicates "graduate attributes" as a barometer for "learning outcomes" shared within undergraduate programs. Graduate attributes include the following elements: (1) knowledge/understanding, (2) general skills, (3) attitude/intentionality, and (4) comprehensive learning experiences and creative thinking ability. Among these, the element of general skills is positioned as a necessary attribute—whether it is with respect to intellectual, professional, or social pursuits—that includes the components of (1) communication skills, (2) quantitative skills, (3) information literacy, (4) logical thinking capacity, and (5) problem solving ability.

Such skills are expected to be learned via undergraduate education curricula, wherein new educational types and methods such as first-year education and service learning are given high priority in additional to traditional classroom-style lectures [16]. Active learning in particular is becoming a fixed pedagogical method within first-year experience.

Recently, more than 90% of four-year universities and colleges introduce the first-year experience in the curriculum. Those four-year universities and colleges structure FYE as the transitional function to university study, rather than simply attempting to increase the level of knowledge. This function of FYE helps students to become proactively involved with various

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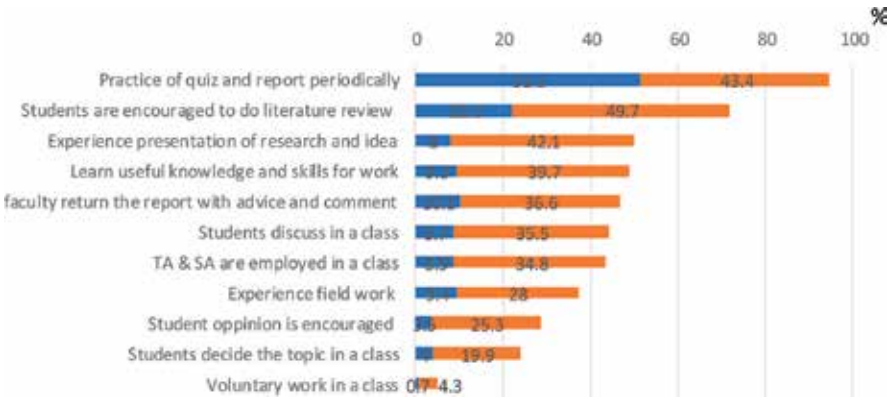

Figure 1. Experience of active learning at FYE.

elements that they would never have an opportunity to experience within strictly knowledge-based classroom lectures. Hence, active learning methods are frequently employed in the FYE in Japanese four-year universities and colleges. Those active learning methods frequently used in the FYE are discussion, writing, ICT, collaborative learning, debate, and peer teaching.

Figure 1 shows the frequency of active learning style at FYE classes through the responses of first-year students from four universities in 2010. We conducted the survey for the first-year students in four universities and 4723 first-year students responded for this survey in 2010. As shown in **Figure 1**, when we consider the responses marking both "frequently" and "often," the rate of students who experience the active learning such as presentation, learn applied skills, and discussion reaches around 50%.

5. Active learning and student learning

Although MEXT report of 2008 [4] and 2012 [6] encourages the active learning methods into undergraduate education, there is a question whether or not active learning actually leads to learning outcomes of students. In this section, we will examine the relationship between experiences of active learning and learning outcomes through the student self-reported survey[2]. Here, we will show the results of students' perception regarding the increase or decrease in analytic and problem-solving skills and critical thinking skills, oral presentation skills, and so on through the JCSS 2010. About 8300 students from national, public, and private four-year higher education institutions participated in this survey. Participating students' academic disciplines consists of humanities, social sciences, STEM, medical and nursing, and other fields.

For example, the percentage of students in both public/national universities and private universities who answered that their analytic and problem solving skills improved through the experience of "expressing my own thinking or research results in class" exceeded 70%

[2]Yamada continually conducted a set of student surveys called Japanese cooperative Institutional Research Program (JCIRP) since 2004. JCRIP has three different student self-reported surveys including Japanese Freshman survey (JFS), Japanese College Student Survey (JCSS) and Japanese Junior college Student Survey (JJCSS).

(the rate of students of national and public universities is 70.5%, and the rate of students of private universities is 75.9%). On the other hand, students who reported an improvement in analytic and problem-solving skills without having such experiences were less than 30% (the rate of students of national and public universities is 28.5%, and the rate of students of private universities is 24.2%).

The percentage of students who reported an improvement in "critical-thinking skills" through the experience of "finding literature and materials by oneself" was similarly high with a value around 80%. In concrete, 84.4% of students of public/nation universities and 78.9% of students of private universities showed the improvement in these skills. "presentation skills," and "acquisition of specialized or subject-specific knowledge" through the experience of "expressing my own thinking or research results in class" exceeded 70%. The methodologies of active learning can be seen to be an educational method that leads of students' proactive learning and to have a relationship to a certain extent with acquisition of learning outcomes related to skills belonging to university undergraduate academic abilities [2].

Is there any difference in teaching methods used between the disciplines? We compare the frequency of active learning methods used in a class between humanities and social sciences and STEM and medical sciences as shown in **Figure 2**.

The results reveal that students in the humanities and social sciences have more opportunities to "experience presentation of research and idea," "discuss in a class," and "decide the topic in a class" than students in STEM and medical sciences. It is assumed that the curriculum of STEM and medical sciences is more structured, and students are required to obtain large amount of knowledge through the curriculum than those of humanities and social sciences. However, it is pointed out that recently in order to promote active learning, flipped teaching style is encouraged to introduce in STEM and medical science classes.

In addition to introducing active learning methods, it is important to establish environments so students can learn proactively and independently outside of classes. Such representative environmental design to support student active learning is spaces called "Learning Commons." The MEXT encourages universities to establish learning commons, and thus, many Japanese universities came to install learning commons, which are artificially designed environments, have the effect of encouraging engagement toward proactive learning.

Yamada points out that there are great expectations toward learning commons. However, we must not forget that there are limits to their effects through just design and facilities. We can expect synergy through their interactive use by faculty members and students. Furthermore, it is critical that faculty who are in charge of classes understand the significance of learning commons and design courses that combine learning both inside and outside the classroom by, giving assignments so students use learning commons [2].

So far, we delineated that Japanese higher education policy to promote the active learning in a class and examined active learning as teaching methods for students to lead to leaning outcomes in undergraduate education. However, not only undergraduate education but also graduate education is required to make educational reform, which leads to learning outcomes required in society through the active learning.

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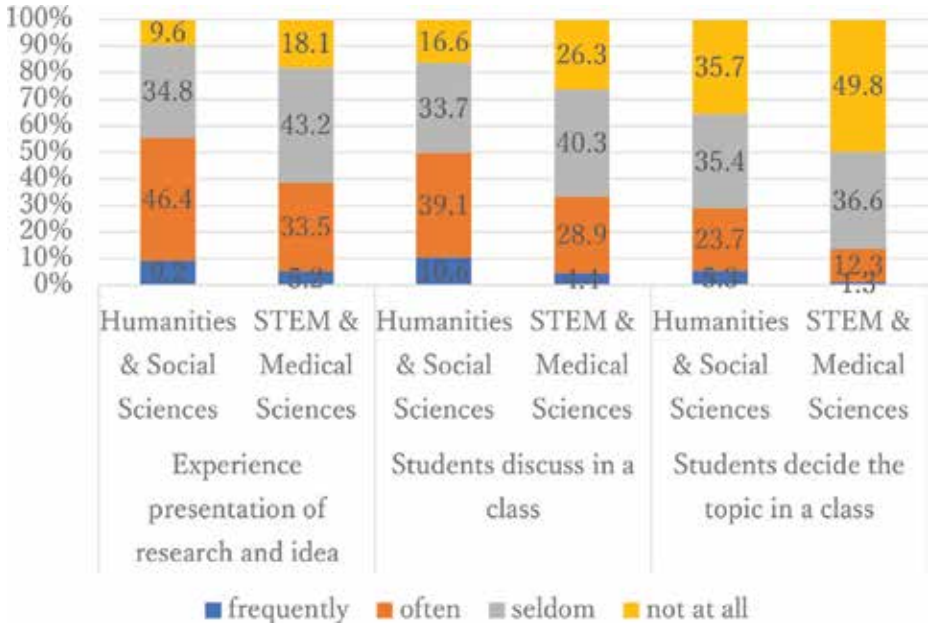

Figure 2. Frequency of active learning between academic disciplines.

Following the next section, the case study of graduate education program, which introduces the active learning methods in order to deal with the MEXT policy to accelerate the educational reform of graduate program will be explored.

6. Active learning and its outcomes: case study of a Japanese graduate program class

In this section, we will present a case study focusing on active learning methods utilized in the University of Tsukuba's Empowerment Informatics graduate program in Japan. This program belongs to the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) Program for Leading Graduate Schools, which promotes educational reform and improvement to make Japanese Universities competitive at the top levels of education internationally. In particular for this study, we will examine the "Advanced Tutorial Studies: Debate class," a mandatory course utilizing an active learning instruction method. The following three points will be explained:

1. The importance and value of active learning in the context of Japan and this program's curriculum.
2. Details and characteristics of the specific course the leading graduate program it belongs to.
3. The learning outcomes of this particular active learning case study.

6.1. Relationship between Japanese higher education and passive as well as active learning

In the previous section, we examined the concept of active learning and showed the data of introduction of active learning in Japanese higher education. In this section, the comparison of passive and active learning will be explored in order to develop the case study of active learning in Japanese graduate program.

Looking at the typical methods of teaching and evaluation, it is common to see academic learning environments toward passive learning methods. For example, large lectures where instructors present and students take notes, followed by testing to determine how well students learned the material. These methods tend to focus on student evaluation using simplistic question and answers, which can be reduced simply as correct or incorrect. Dósa and Russ succinctly state, "Learning in higher education today is measured overwhelmingly on the basis of "correctness," that is, whether students sufficiently approached the preset "expert" answer to a test question" [17]. In this nonactive style of learning, outcomes end up being evaluated on the basis of true or false, or multiple-choice questions, where there is a single correct answer. Even in more complex passive learning, there may be open-ended evaluations, such as essays or hands-on projects, but correctness is still boils down to a measurement of how close a student demonstrates an expected answer, in other words, there may be a scale of correctness. One flaw in this approach is a lack of dimensionality required in real world problem solving. To take an example, in design, it would be naive to suggest that there is a single correct outcome. Instead, in real world projects, there are tradeoffs between form, scale, esthetics, utility, reliability and durability, cost effectiveness, and so on. Yet, how can teaching methods help account for these complexities?

In contrast to passive learning, active learning refers to methods where students play an active role in their learning process. Historically, active learning has found most traction in the social sciences, which focus on human subjects and qualitative experiences. These fields and the nature of their study lend themselves well to active learning in the form of small discussion groups, which allow for voicing and recognition of a variety of perspectives and opinions on subject matter [18]. For instance, in the Socratic style of learning, students exercise critical thinking in open ended discussions seeking the answer to a given question. As a discussion, it is understood that there is no one single correct answer. As students in the group discuss and logically share their thoughts, their peers simultaneously evaluate the persuasiveness and the speaker's approach in order to judge the value of their answer and provide critique. Salemi argues that one benefit of active learning is that it forces students to demonstrate competency with existing knowledge and demonstrates their ability to use those concepts in critical problem solving or analysis [19]. This process of analyzing issues and applying critical thinking of existing and new knowledge requires practice and is often missing from passive learning environments. Furthermore, because active learning demonstrates student thought process and reasoning on a frequent basis, instructors receive more in-depth and frequent points of data to evaluate both student learning and the effectiveness of their teaching. Research conducted by Becker has shown that students learn more comprehensively and are more committed to their studies when instructors use active learning in their teaching [20].

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Previous active learning studies indicated the challenge of introducing it was not only for the students, but also for the instructors. Michael argued that "faculty perceptions about possible pedagogical barriers to active learning are more the result of lack of experience with or knowledge of this approach than a reflection of the realities of the classroom" [21]. College instructors often are lacking formal training in pedagogy, rarely study teaching and learning methodologies, and are hesitant to diverge from the standardized lecture/test driven learning pattern. Additionally, certain fields of studies do not lend as well to discussion type formats. Lab work or extremely technical knowledge transmission found in the Science Technology Engineering and Math (STEM) fields can be problematic to introduce in an active learning style [18]. Thus, even in more liberal Western higher education, there is a divide between social sciences and STEM fields, where active learning is largely omitted from STEM field classrooms. However, Springer et al. showed that STEM students engaging in small-group of work demonstrated the significant higher levels of learning outcomes [22].

Despite the benefits associative with active learning classrooms, it is not widely used, especially in East Asian education. Traditionally, the Japanese higher education learning style has predominately focused on the passive learning style of knowledge memorization and recall, following what is known as the "Confucian model" [23]. Hawkins explains the defining characteristic of the Confucius model as, "traits of self-denial, frugality, fortitude, patience, self-discipline, rote learning, memorization and delayed gratification" [23]. As the world is becoming increasingly globalized and internationally interconnected and Japanese higher education seeks to compete in world rankings, its education style is gradually shifting from a Confucian model to the more Western Socratic model that favors group discussion and active learning classrooms. This change aligns with more modern higher education global academic trends that are beginning to focus on solving problems with diverse answers, finding new approaches and solutions, and incorporating multidisciplinary and practical collaboration. The introduction of active learning presents a pedagogical method, which satisfies these needs. In Japan, as aforementioned earlier, MEXT further sees the introduction of active learning as a way to strengthen the links between education and knowledge and the ability to apply that knowledge in real-world scenarios for the benefit of society. In this regard, MEXT states, "it is important to utilize such knowledge and skills in actual society and actual life while discovering issues for oneself, seek solutions to those issues independently and cooperatively, and to express and practically apply the fruits of learning" [24].

6.2. Learning in STEAM graduate program

The purpose in this work is to provide a case study of one Science Technology Engineering Arts and Math (STEAM) graduate program in Japan and to explain how active learning is introduced in the curriculum and the learning outcomes. Examining the University of Tsukuba's Empowerment Informatics "Advanced Tutorial Studies: Debate Class," this chapter will explore how the active learning pedagogical style influenced learning outcomes. The addition of an active learning debate class in the curriculum lends itself two of the programs goals: (1) interdisciplinary ability—allowing students to examine problems from broader perspectives and to see the "big picture. (2) Frontline ability—giving students the skills they need as entrepreneurs and leaders, presenting their ideas logically and convincingly. Additionally,

this course expands upon internationalization goals, by offering a setting where domestic and international students collaborate and communicate closely together to solve problems. In the Empowerment Informatics graduate program, this course belongs to is both highly international and multidisciplinary, as it focuses on the integration of technology and humanistic goals. Thus, the academic backgrounds of students in this course are comprised of a variety of the STEAM fields. In this regard, it is important to understand how this active learning style class functions amidst diversity of culture, language, and academic background, affecting the interactions between students, and how instructors position themselves. For instance, in the cohort this study looks at, enrolled students consisted of three international students, one from the United States, two from Europe, and six Japanese students. Two of the international students came from a Media and Art design background, and the other remaining students' academic backgrounds heavily focused on robotics, medical robotics, AI, and other STEM fields.

This course consists of nine debate sessions, each with different topics based on general educational knowledge and topics linking student's academic work to society. **Table 1** shows the high-level debate questions used in this session of the course.

6.3. Preparation before the debate class

For the purpose of this class, students had to prepare to argue their group's position, thinking critically, challenging, defending, and improvising to build unique and persuasive arguments. Importantly, this class developed team building and Japanese students were challenged to participate in these debates all in English. Before the actual debate class session, students had one week to prepare their arguments, whether in favor or against the proposed question. Students rotated per debate to take on the role of a facilitator. For a given week, the facilitator's job was to provide the debate topic and coordinate between the two groups

Class no	Debate title topic
1	In contemporary education, has marketing become more important than research production in fostering international recognition?
2	Should workplaces encourage the application of Artificial Intelligence (AI)?
3	Should the retirement age be increased?
4	Should we make a limitation around technologies that enhance body functions of healthy people?
5	Higher education should be conducted in English or in each country's native languages?
6	Do companies and universities need special regulation or strategies to increase the percentage of women in technical and high-level management positions?
7	Is the research of military technologies necessary for technical development?
8	Should personal mobility devices (such as Segway, UNI-CUB, Hoverboard, etc.) be regulated on public roads?
9	In our contemporary society, should universities focus more on STEM education?

Table 1. Nine example session debate titles.

taking on roles as supporting and nonsupporting sides for the debate. The instructor and the student facilitator also helped to prepare students by researching and providing a narrative and introduction to the topic. For example, given the debate topic, "In our contemporary society, should universities focus more on STEM education," the following points were raised by the facilitator:

By focus we mean:

- Increasing research funding for disciplines like engineering and applied sciences at the expenses of more theoretical faculties.
- Reducing the number of faculty in humanities (literature, history, and philosophy) and social sciences (anthropology and sociology).
- Providing more degrees related to engineering and science.
- Discourage students from undertaking a humanistic education.

Suggested points and reading:

- From an interview with Paola Antonelli (curator of the design section of MoMa, New York):

> *"I went to architecture school. And in Italy at that time, it was highly theoretical. When you emerged, you could become an architect, but not necessarily. You could become a graphic designer, or a furniture designer. Fashion designer Gianfranco Ferré was an architect. You could become a chef. When taught in this philosophical, abstract way, design is a universal donor to any field that is about making and constructing, whether in the digital world or in the physical world."*

- An excerpt of "A Personal Chronology," from "The Language of New Media" by Lev Manovich.

6.4. How faculty as an instructor evaluated each nine individuals

Through the nine debating classes, there were five points of focus: (1) how much each individual prepared for the debate, (2) how well they worked in a team with students of diverse cultural backgrounds and fields of study, (3) how well students communicated with each other in English, (4) through preparation and improvisation, how well did they argue their points during the debate, and (5) how each individual was actively involved. Clearly, the evaluation of students in this active learning environment extended well beyond the content of their participation, but also considered how they were able to apply their knowledge, work in diverse teams, and give consideration on real-world problems from multiple perspectives.

To evidence how students were evaluated along these guidelines, we provide a sample excerpt from instructor comments on an individual student in this course:

> *… always contributed his knowledge enthusiastically in the debating class. Since he is from abroad, his cultural, historical, and educational background provided different points of view and perspectives from the other students, who were mostly Japanese. What made this debating class unique was that many of the debate topics came from strong historical, political or philosophical points of view that varied from country to country. Despite the fact that the students study in the EMP program while*

specializing in different fields of social robotics, AI, and art, there was great chemistry and it stimulated Japanese students to think from a different point of view. … presented his arguments and opinions by providing his own cultural and historical experiences associated with his home country, which led Japanese students to reconsider from their own point of view. Sometimes the topic varied; however, it was clear that he and the other two international students tried to connect and find the similarities in the topic, when the debate was not going back and forth. Some Japanese students were not trained in a spontaneous discussion style classroom; however, the foreign students just like … were more active and provided many strong points, which led to a great discussion. I think at the same time, it was also a great opportunity for … who comes from abroad to learn and understand the unique perspectives that Japanese students provided from their own cultural, historical, and educational backgrounds. Overall, his class participation was perfect = A

6.5. Findings of the active learning debate class

Throughout this class, the cultural, academic, educational, and social background of each of the nine students had a significant role and impact. Students who were trained and educated in Western countries such as the United States and Europe had completely different set of values, mindset, and understanding of the different debate topics. Their dissimilar culture, societal values, and concerns affected a range of topics, such as how they perceive AI, the role and importance of robotics, how each country's education should be and perceived, and so on. More importantly, what stood out the most was how language, each student's cultural background and style of sharing their knowledge had a significant impact on their participation. For instance, the majority of students who were educated in Western countries were trained to approach their arguments philosophically, providing examples to build their opinions logically. Notable, all of the international students seemed to be very confident to share their opinion without hesitation in comparison to the Japanese students.

Through observation, the Japanese students faced difficulty in sharing their opinions on the basis of philosophy, and the majority of them indicated that they never had the chance to study Western philosophy in depth. Since this class was structured while considering the international backgrounds of students, most cited examples from their cultural backgrounds, relaying how topics are perceived in their home country and the rationales behind this thinking. Initially, Japanese students were reluctant to speak and did not engage as actively in sharing their opinions. However, through this bidirectional communication, as the class went on they shared more and became familiar with the class style, atmosphere, and communicating with each classmate. By the end of the class, the Japanese graduate students in particular became more active in terms of speaking and sharing their thoughts, though still behind their international peers. Nine weeks spent in this active learning style debating class provided a new approach of teaching and learning and changed the way students approached classroom learning and development.

6.6. Student development and outcomes

Through the nine class sessions, students reached and developed deeper understanding of course concepts. Share their opinions, but also hearing the other students and then changing, adjusting, or think critically, and beginning to consider problems from multiple

perspectives. They also gained more confidence and started to feel more open to frankly share their thoughts and opinions with their classmates, whether they were international or domestic Japanese students, the atmosphere of the class changed drastically compared to the first introductory class. This same pattern was found among other students being introduced to active learning discussions, Salemi found, "the more the students participate and get used to the class, students prepare better for active learning classes because they know that they will be asked to contribute, and students will like to talk about class material with their peers using familiar language" [19]. Likewise, in our class, the more the students participated in the class, they were speaking to their peers more in familiar language and sharing terminologies with each other. Discussion among a diverse group of peers revealed the differing approaches individuals take based on their own background and perspective and sharing these in discussion benefited the entire group. Additionally, students benefit from variety in the class atmosphere, learn through each other, and realize that they aid in teaching other students, becoming reflective learners. Students learn from their peers, and they try harder to make them understand more, think in-depth, and explain their arguments in a more logical and persuasive way. This class introduced a new engaging learning atmosphere compared to the typical passive learning style Japanese student experience. Students gain confidence, feel more comfortable in sharing their knowledge and opinions, gain satisfaction from hearing and being involved in the class with their peers, and share their opinions in a more real-world exercise. Students started to be more active in class participation, obtaining the sense of awareness that they played an important role in their learning and had a responsibility for what they said and shared.

7. Conclusion

In the environment where the MEXT has shifted the learning-centered policy in recent years, this chapter shows how active learning becomes the major concern for Japanese higher education institutions, and active learning methods have been encouraged to utilize in the undergraduate education in order to develop the proactive learning. Many previous studies have shown that the learning outcomes of students are strongly associated with the quality of pedagogy and student experience. Such pedagogy often includes active learning methods and it is often expected that active learning methods are strongly associated with proactive learning of students. In terms of graduate education, there are small number of studies spotlighted the active learning methods. However, in a knowledge-based society, more active learning and the Socratic model are important to be introduced in Japanese graduate programs in order for students to obtain more interdisciplinary and frontline learning skills.

In the case of debate class shown, using active learning to examine queries allowed us to view questions from a broader perspective and take into account multiple perspectives. Active learning discussions allow each participant to be introspective, share his or her knowledge, and then reconsider their points of view by hearing from others. One clear benefit is that the critical application and extension of knowledge happen naturally in the Socratic style of active learning. Most traditional Japanese style classes severely limit or disregard the value of active learning.

Furthermore, even in Western education, there is a divide where the Socratic style of learning is more commonly used in the social sciences and humanities. On the other hand, due to the nature of STEM classes where lab exercises and experimental style of learning happens, simplistic and quantitative teaching and learning assessment has become ingrained.

As Japanese higher education aims to introduce Western style active learning, one point of concern is proper training for both students and faculty. In order to mix students coming from these two distinct academic backgrounds into one debate/discussion style of active learning class, instructors need to pay careful attention to understand each student's characteristics, each individual's personality, and how students will express themselves and react in a group made of diverse backgrounds. As this study found, Japanese students had little foundational experience in this model of learning and initially found it quite difficult compared to their international peers. Similarly, because active learning is not commonly adopted in Japanese academic traditions, faculty would benefit from training, or first-hand experience with this type of instruction. Michael explains to improve the quality of active learning style classes, faculty development programming, conducted locally or at national meetings of academic disciplines are important [21]. Additionally, it is important for faculty development to learn and take courses to understand the outcomes of active learning compared to lecture style classes. These sessions give teachers opportunities to see the techniques in action and practice to them eventually.

Despite these challenges, we feel that there is real potential for active learning in Japan's ongoing educational reform strategy. MEXT policy papers frequently suggest the need to further internationalization, interdisciplinary approaches, and an ability to link academic knowledge to real world problem solving for the benefit of society. The class of this case study focuses on providing a great example of how reflective discussion can bridge these boundaries. Internationalization efforts are often critiqued as being superficial, for example, even where there are significant numbers of international students, studies have found that they are not as well integrated within their Japanese universities, dampening the beneficial aspects of internationalization [25]. Yet classes like the one this case study examines create an environment where both international and domestic points of view are examined in depth and widen the perspective of all students involved. In addition to the instructor teaching and sharing their own learnings and understandings on an academic topic, in an active learning pedagogical style, students also share their thoughts by discussing topics together. In this manner, students are able to communicate ideas with a deeper and philosophical understanding by sharing the perspectives and beliefs that underlay their opinions.

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Chapter 5

Cooperative Learning: The Foundation for Active Learning

David W. Johnson and Roger T. Johnson

Additional information is available at the end of the chapter

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Abstract

The role of instructors is evolving from the presenter of information to the designer of active learning processes, environments, and experiences that maximize student engagement. The more active a lesson, the more students tend to engage intellectually and emotionally in the learning activities. Cooperative learning is the foundation on which many of the active learning procedures are based. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Most of the active learning procedures, such as problem-based learning, team-learning, collaborative learning, and PALS, require that students work cooperatively in small groups to achieve joint learning goals. Cooperative learning is based on two theories: Structure-Process-Outcome theory and Social Interdependence theory. Four types of cooperative learning have been derived: formal cooperative learning, informal cooperative learning, cooperative base groups, and constructive controversy. There is considerable research confirming the effectiveness of cooperative learning. To be cooperative, however, five basic elements must be structured into the situation: positive interdependence, individual accountability, promotive interaction, social skills, and group processing.

Keywords: active learning, cooperative learning, collaborative learning, student engagement, student involvement

1. Introduction

The role of instructor is evolving from the presenter of information to the designer of learning experiences that maximize student active engagement [1]. The influences behind this change include (a) the growing awareness that learning experiences should be active in ways that maximize student engagement and (b) the evidence that careful design of instructional

experiences makes students' acquisition of knowledge and competencies more efficient, effective, and appealing. One of the most useful methods of ensuring that students are actively engaged in learning experiences is cooperative learning. In addition, it is the foundation on which many of the active learning and student engagement procedures are built. First, we will explain the relationship between cooperative learning and active learning and student engagement. Second, we will explain the nature of cooperative learning.

1.1. Active learning and student engagement

The first requirement for designing a learning experience is to ensure students are active rather than passive. Passive to active is a continuum, as no learning experience is entirely passive (even sleep has active components) or entirely active. The question is the degree to which a learning experience is structured to make students passive or active. Near the passive end of the continuum, learning is typically listening to the instructor or individually reading information with or without taking notes and highlighting key passages. Characteristics of passive learning are that the student is silent, isolated (working separately from others), and under the direction of others. Near the active end of the continuum, learning occurs when students construct, discover, and transform their own knowledge. Active learning requires students to engage meaningfully cognitively and emotionally with other students, the task assigned, and the materials or resources used to complete the task. Characteristics of active learning are that students are talking with others (i.e., engaged in dialogs), interacting with others (i.e., member of a pair, triad, or group of four), generating new ideas and cognitive structures (discovering their own insights and meaning from the learning activities), and determining their own direction (i.e., coordinating with groupmates as to the direction and speed of the work). Active learning typically requires students working in pairs or small group to conceptualize, analyze, synthesize, and evaluate during discussions the information, procedures, strategies, and conceptual frameworks being learned.

Active learning subsumes students engaging intellectually and emotionally in the learning activities. The continuum of student engagement (both intellectually and emotionally) has disengagement at one end and engagement at the other. Student *disengagement* is defined as off-task behaviors, negative emotions, and the absence of focus, interest, effort, curiosity, persistence, the use of cognitive strategies, and other indicators of learning. Student *engagement* is students' exerting effort to complete the learning task, reflecting interest in completing the task successfully, focus on the task, curiosity about the task and its content, persistence, and the use of cognitive strategies. Engagement may be differentiated into three types: behavioral engagement (attending class, doing homework), cognitive engagement (effort to understand information and master complex skills), and emotional engagement (positive reactions to classmates, academic task and materials, teachers, and so forth).

Well-designed lessons require students to be active and engaged. These two aspects of lessons overlap, so that often if you get one, you get the other. The easiest way to ensure that students are active and engaged in learning may be to use cooperative learning. In addition, many of the forms of active learning being implemented in schools and universities are based on the foundation of cooperative learning. Some of the most common are discussed below. This is by no means an exhaustive list.

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1.2. Problem-based learning

Problem-based learning may be defined as assigning students to small groups and giving the groups a problem to understand and solve, with the goal of having students learn relevant information and procedures [2–4]. While students work in small groups the instructor facilitates and guides their work. Problem-based learning requires students to work in small groups to ensure that the relevant information and procedures are discovered and mastered by all members of the group, thus making cooperative learning the foundation on which problem-based learning is built. When this connection between cooperative learning and problem-based learning is explicit, it is known as Cooperative Problem-Based Learning or Problem-Based Cooperative Learning.

1.3. Team-based learning

In *team-based learning* instructors assign students with diverse skill sets and backgrounds to permanent groups of five to seven members to enhance the quality of student learning [5]. Students are individually accountable for homework assignments and for contributing to team efforts in class. Significant credit is given for inclass team activities and application exercises aimed at increasing both academic learning and team development. The activities are structured to give students frequent and timely feedback on their efforts. Since students work in teams to increase their own and teammates' learning, team-based learning is in effect another form of cooperative learning.

1.4. Collaborative learning

In the 1970s, Sir James Britton and others in England [6] created an active learning procedure known as Collaborative Learning based on the theorizing of Vygotsky [7]. Britton believed that a student's learning is derived from the community of learners made up of other students. Britton was opposed to providing specific definitions of the teacher's and students' roles, which he considered to be *training* (the application of explanations, instructions, or recipes for action). Instead, he recommended placing students in groups and letting them generate their own culture, community, and procedures for learning, which he considered to be *natural learning* (learning by making intuitive responses to whatever one's efforts produce). Britton believed the source of learning is dialogs and interactions with other students (and sometimes the teacher resulting from the positive interdependence among students' learning goals. The heart of collaborative learning, therefore, is the cooperative foundation of students working together to maximize their own and each other's learning.

1.5. Peer-assisted learning

Peer-assisted learning (PALS) involves classmates of equal status actively helping each other to acquire knowledge and skills [8]. It subsumes *Reciprocal Peer Tutoring*, which places same-age students into pairs of comparable ability and gives them the responsibility is to keep each other engaged academically [9]. Peer-assisted learning is based on cooperation, as assistance and encouragement tends not to take place in competitive interaction.

1.6. Conclusion

Almost all forms of active learning assume that students will work cooperatively in small groups. Cooperative learning is, therefore, the foundation on which most active learning strategies are built.

2. Cooperative learning

Most methods of active learning require the use of cooperative learning as an essential part of their method. Cooperative learning is the foundation on which most active learning methods are built. *Cooperation* is working together to accomplish shared goals [10, 11]. When cooperating, individuals work to achieve outcomes that benefit themselves and all other group members. *Cooperative learning* exists when small groups of students work to enhance their own and their groupmates' learning [1]. It is often compared to *competitive learning* (students working to accomplish academic goals that only one or a few participants can attain) and *individualistic learning* (each student working by him- or herself to complete assignments). Student efforts are evaluated on a criteria-referenced basis in cooperative and individualistic learning, while in competitive learning students are evaluated on a norm-referenced basis. Any learning task in any subject area with any curriculum may be structured cooperatively, but there are limitations on when and where competitive and individualistic learning may be used appropriately.

Cooperative learning is largely based on two theories: Structure-Process-Outcome theory and Social Interdependence theory.

2.1. Structure-process-outcome theory

Watson and Johnson [12] theorized that the way a situation is structured determines the process individuals engage in to complete the task, which determines the outcomes of the situation. The processes of interaction, in other words, determine outcomes, not the structure of the situation directly. This theory focuses instructors on structuring learning goals to create desired processes of interaction among students and between the students and the instructor. Once the desired processes of interaction occur, outcomes will tend to automatically result [10, 13].

2.2. Social interdependence theory

A second theory underlying cooperative learning is social interdependence theory [10]. In the early 1900s Kurt Koffka, proposed that groups were dynamic wholes in which the interdependence among members could vary. In the 1930s Kurt Lewin stated that the interdependence among members created by common goals is the essence of a group. The goal interdependence unites members into a "dynamic whole," so that changes in the state of a member or subgroup modify the state of other members or subgroups. In addition, motivation to accomplish the common goals results from an intrinsic state of tension within each group member. For interdependence to exist, there must be more than one person or entity involved, and the persons

or entities must have dynamic impact on each other. In the late 1940s, Morton Deutsch, one of Lewin's graduate students, extended Lewin's reasoning about interdependence and formulated a theory of cooperation and competition [14, 15]. The authors of this chapter, David (who was a doctoral student of Deutsch) and Roger Johnson, extended and expanded Deutsch's theory [10, 13, 16–19]. It should be noted that the authors of this chapter (David and Roger Johnson) coined the term social interdependence theory to describe their expanded version of the theory of cooperative, competitive, and individualistic efforts. Deutsch believed that social interdependence theory included more than cooperative, competitive, and individualistic processes, so he reserved the term for a future yet undefined theory.

In his theory of cooperation and competition, Deutsch posits that cooperation is created by *positive goal interdependence*, which exists when group members perceive that they can reach their goals if and only if the other group members also reach their goals [14, 15]. Competition is created by *negative goal interdependence*, which exists when group members perceive that they can obtain their goals if and only if the other group members fail to obtain their goals. Individualistic efforts are creative by *no goal interdependence*, which exists when individuals perceive that reaching their goal is independent from other individuals attaining their goals.

Positive goal interdependence tends to result in promotive interaction, negative goal interdependence tends to result in oppositional interaction, and no goal interdependence results in an absence of interaction. The relationship between the cooperation and competition and the interaction pattern each elicits tends to be bidirectional. Each may cause the other.

3. Types of cooperative learning

Four types of cooperative learning have been derived from cooperation and competition theory [1]. Formal cooperative learning may be implemented to teach specific content, informal cooperative learning may be implemented to ensure active cognitive processing of information during direct teaching, cooperative base groups may be implemented to provide long-term support and assistance, and constructive controversy may be implemented to create academic, intellectual conflicts to enhance achievement and creative problem solving.

3.1. Formal cooperative learning

Ref. [1] define *formal cooperative learning* as students working together, for one class period to several weeks, to achieve mutual learning goals and complete jointly specific tasks and assignments. Instructors can structure any course requirement or assignment in any curriculum or subject area for any age student cooperatively. To structure formal cooperative learning the instructor:

1. Makes a series of decisions about how to structure the learning groups (what size groups, how students are assigned to groups, what roles to assign, how to arrange materials, and how to arrange the room). The instructor also specifies the objectives for the lesson (one academic and one social skills).

2. Teaches the academic content students are expected to master and apply. The instructor then explains the (a) academic task to be completed, (b) the criteria used to determine the degree of students' success, (c) positive interdependence, (d) individual accountability, and (e) expected student behaviors.
3. Monitors the functioning of the learning groups and intervenes to (a) teach needed social skills and (b) provide needed academic assistance.
4. Uses the preset criteria for excellent to evaluate student performance. The instructor then ensures that groups process how effectively members worked together.

3.2. Informal cooperative learning

Ref. [1] define *informal cooperative learning* as students working together to achieve a joint learning goal in temporary, ad-hoc groups that last from a few minutes to one class period. During direct teaching, such as a lecture, demonstration, or video, the teacher structures informal cooperative learning groups. Students engage in three-to-five minute focused discussions before and after the direct teaching and three-to-five minute turn-to-your-partner discussions interspersed throughout the direct teaching. Informal cooperative learning can create a mood conducive to learning, focus student attention on the material to be learned, set expectations as to what will be covered in a class session, ensure that students cognitively process the material being taught, and provide closure to an instructional session. During direct teaching the instructor needs to ensure that students do the intellectual work of explaining what they are learning, conceptually organizing the material, summarizing it, and integrating it into existing conceptual frameworks.

3.3. Cooperative base groups

Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership in which students provide one another with support, encouragement, and assistance to make academic progress by attending class, completing assignments, learning assigned material) [1]. The use of base groups tends to improve attendance, personalizes the work required and the school experience, and improves the quality and quantity of learning. Base groups have permanent membership and provide the long-term caring peer relationships necessary to help students developed in healthy ways cognitively and socially as well as influence members to exert effort in striving to achieve. Base groups formally meet to provide help and assistance to each other, verify that each member is completing assignments and progressing satisfactory through the academic program, and discuss the academic progress of each member. It is especially important to have base groups in large classes or schools and when the subject matter is complex and difficult.

3.4. Constructive controversy

Johnson and Johnson [20] define *constructive controversy* as one person's ideas, information, conclusions, theories, and opinions being incompatible with those of another, and the two seek to reach an agreement that reflects their best reasoned judgment. Constructive controversy

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involves the discussion of the advantages and disadvantages of proposed actions aimed at synthesizing novel and creative solutions. It also involves dissent and argumentation [20]. *Dissent* may be defined as differing in opinion or conclusion, especially from the majority. *Argumentation* is a social process in which two or more individuals engage in a dialog where arguments are constructed, presented, and critiqued. The theory underlying constructive controversy states that the way conflict is structured within situations determines how individuals interact with each other, which in turn determines the quality of the outcomes [12, 19]. Intellectual conflict maybe structured along a continuum, with concurrence seeking at one end and constructive controversy at the other. The process of concurrence seeking involves avoiding open disagreement to conform to the majority opinion and reach a public consensus. The process of controversy involves utilizing the conflict among positions to achieve a synthesis or a creative integration of the various positions. The outcomes generated by the process of controversy tend to include higher quality decision making and achievement, greater creativity, higher cognitive and moral reasoning, greater motivation to improve understanding, more positive relationships and social support, and more democratic values. The conditions mediating the effects of the controversy process include a cooperative context, heterogeneity among members, skilled disagreement, and rational argument.

When used in combination, cooperative formal, informal, base groups, and constructive controversy provide an overall structure for school learning.

4. Outcomes of cooperative learning

Cooperative efforts result in numerous outcomes that may be subsumed into three broad categories: effort to achieve, positive interpersonal relationships, and psychological adjustment. The social interdependence research has considerable generalizability as (a) research participants have varied as to economic class, age, gender, and culture, (b) research tasks and measures of the dependent variables have varied widely, and (c) many different researchers with markedly different orientations working in different settings and in different decades have conducted the studies. We now have over 1200 studies on cooperative, competitive, and individualistic efforts from which we can derive effect sizes. This is far more evidence than exists for most other aspects of human interaction.

Cooperating to achieve a common goal results in higher achievement and greater productivity compared to competitive or individualistic efforts [10, 13, 19]. There is so much research that confirms this finding that it stands as one of the strongest principles of social and organizational psychology. Cooperation also resulted in more frequent generation of new ideas and solutions (i.e., *process gain*), more higher-level reasoning, and greater transfer of what is learned (i.e., *group to individual transfer*) than competitive or individualistic efforts. The superiority of cooperative efforts (as compared to competitive and individualistic efforts) increased as the task became more conceptual, the more higher-level reasoning and critical thinking was required, the more desired was problem solving, the more creativity was desired, the more long-term retention was required, and the greater the need for application of what was learned.

More positive and committed relationships develop in cooperative than in competitive or individualistic situations [10, 13, 19]. This is true when individuals are homogeneous. It is also true when individuals differ in ethnic membership, intellectual ability, handicapping conditions, culture, social class, and gender. Cooperative learning tends to be essential for classes with diverse students from different ethnic groups and handicapping conditions [10]. The more positive relationships that result from cooperative learning tends to reduce absenteeism and turnover, increase member commitment to academic goals, increase feelings of personal responsibility to the group and school, increase willingness to take on difficult tasks, increase motivation to achieve and persistence in working toward goal achievement, increase morale, increase readiness to endure pain and frustration on behalf of the group, increase readiness to defend the group against external criticism or attack, increase readiness to listen to and be influenced by classmates, increase commitment to each other's academic success, and increases academic productivity. Cooperating on a task, compared to competing or working individualistically, also results in more task-oriented and personal social support.

Working cooperatively with peers, and valuing cooperation, results in greater psychological health and higher self-esteem than does competing with peers or working independently [10, 13]. Personal ego-strength, self-confidence, independence, and autonomy are all promoted by being involved in cooperative efforts with caring people, who are committed to each other's success and well-being. When individuals work together to complete assignments, through their interaction they master needed social skills and competencies, promote each other's success (gaining self-worth), and form both academic and personal relationships (creating the basis for healthy social development).

When schools are dominated by cooperative efforts, students' psychological adjustment and health tend to increase. The more students cooperate with each other, the higher tends to be their self-esteem, productivity, acceptance and support of classmates, and autonomy and independence. Working cooperatively with peers is not a luxury. It is an absolute necessity for students' healthy development and ability to function independently.

5. Basic elements of cooperative learning lessons

Five basic elements for designing cooperative learning lessons have been derived from Social Interdependence theory and Structure-Process-Outcome theory and the research on social interdependence. The five basic elements that are required in any cooperative learning lesson are: positive interdependence, individual accountability, promotive interaction, social skills, and group processing.

Positive interdependence is the heart of cooperative efforts. Students must perceive that (a) they are linked with groupmates in a way so that they cannot succeed unless their groupmates do (and vice versa) and (b) groupmates' work benefits them and their work benefits their groupmates [10]. Positive interdependence among students must be structured into the lesson for it to be cooperative. While every lesson must contain positive goal interdependence, positive interdependence may also be structured through mutual rewards, distributed resources, complementary roles, a mutual identity, and other methods of structuring positive interdependence.

Each group member is individually accountable to contribute his or her fair share of the group's work. Individual accountability exists when the performance of each individual student is assessed and the results are given back as feedback to the group and the individual [10]. Individual accountability includes completing one's share of the work and facilitating the work of other group members. A purpose of cooperative learning is to make each group member a stronger individual. There is considerable group-to-individual transfer. Students learn together so that they can subsequently perform higher as individuals. Individual accountability may be structured by (a) observing students as they work together and documenting the contributions of each member, (b) having each student explain what they have learned to a classmate, or (c) giving an individual test to each student.

Students promote each other's success by helping, assisting, praising, encouraging, and supporting each other's efforts to learn [10]. Doing so results in such cognitive processes as discussing the nature of the concepts being learned, orally explaining to others how to solve problems, teaching one's knowledge to classmates, challenging each other's reasoning and conclusions, and connecting present with past learning. Promotive interaction also includes interpersonal processes such as supporting and encouraging efforts to learn, jointly celebrating the group's success, and modeling appropriate use of social skills.

Contributing to the success of a cooperative effort requires interpersonal and small group skills. In cooperative learning groups, students are expected to use social skills appropriately [10]. Leadership, trust-building, communication, decision-making, and conflict-management skills have to be taught just as purposefully and precisely as academic skills. How to teach students social skills is the focus of Johnson [21] and Johnson and Johnson [20].

Finally, students need to engage in group processing. Group processing may be defined as the examination of the effectiveness of the process members use to maximize their own and each other's learning, so that ways to improve the process may be identified [10]. Group members need to (a) describe what member actions are helpful and unhelpful in ensuring that all group members (a) achieve and maintain effective working relationships, (b) decide what behaviors to continue or change and (c) celebrate group members' hard work and success [22].

These five basic elements are the educator's best resource. They enable instructors to (a) structure for cooperative learning any lesson in any subject area with any set of curriculum materials, (b) fine-tune and adapt cooperative learning to their specific students, needs, and circumstances, and (c) intervene in malfunctioning groups to improve their effectiveness. These five essential elements allow instructors to structure any lesson for student activeness and engagement. It is only when these five aspects are carefully structured in a lesson that the lesson becomes truly cooperative and students become active and engaged.

6. Return to active learning

Characteristics of active learning are that students engage in dialogs, interact with classmates in small groups, generate new ideas and cognitive structures within the groups, and coordinate with groupmates as to the direction and speed of the work. Active learning

typically requires a learning partner or a small group in which the information being learned is analyzed, synthesizes, evaluated during discussions. In a discussion, students construct new cognitive structures or access their existing ones to subsume the new information and experiences.

It is clear from the research that having students compete with each other will result in students opposing each other's learning, thereby reducing their motivation and achievement. It is also clear that having students work alone without interacting with classmates will have students being indifferent to each other's learning, also reducing their motivation and learning. What does increase motivation and achievement is cooperative learning. In cooperative learning lessons, students are assigned to small groups (usually two, three, or four members) and given an assignment to complete (such as solving a problem or mastering a set of procedures). Working cooperatively with classmates to solve a problem is far more effective than competing with classmates or working by oneself to solve the problem. It is the cooperative structure that promotes students to engage cognitively and emotionally with other students, the task assigned, and the materials or resources used to complete the task. Doing so allows students to construct, discover, and transform their own knowledge.

Students are engaged in a learning task when they exert effort to complete the task successfully, focus on the task, are curious about the task and its content, persist in completing the task, and use higher-level cognitive strategies in completing the task. Students engaged in cooperative learning activities tend to engage in more on-task behavior (and therefore are more engaged, behaviorally, cognitively, and emotionally) than do students participating in competitive or individualistic learning activities [10].

Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Cooperative learning is based on two theories: Structure-Process-Outcome theory and Social Interdependence theory. There are four types of cooperative learning: formal cooperative learning, informal cooperative learning, cooperative base groups, and constructive controversy. To be cooperative, five basic elements need to be structured into the learning situation: positive interdependence, individual accountability, promotive interaction, social skills, and group processing. Cooperative learning, compared with competitive or individualistic learning, tends to result in students exerting more effort to learn, building more positive relationships with classmates, and improving their psychological health.

Cooperative learning is one of the foremost active learning procedures. It is also the foundation on which many of the active learning procedures are based.

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Chapter 6

Dictionary Learning-Based Speech Enhancement

Viet-Hang Duong, Manh-Quan Bui and
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Additional information is available at the end of the chapter

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Abstract

This chapter presents an overview of dictionary learning-based speech enhancement methods. Specifically, we review the existing algorithms that employ sparse representation (SR), nonnegative matrix factorization (NMF), and their variations applying for speech enhancement. We emphasize that there are two stages in a speech enhancement system, namely learning dictionary and enhancement. The two scenarios of learning dictionary process, offline and online, are discussed carefully as well. We finally present some evaluation methods and suggest the future lines of work.

Keywords: dictionary learning, nonnegative matrix factorization, projected gradient descent, speech enhancement, sparse representation

1. Introduction

Speech is the most important tool of expression and it is crucial information carrier of language communication. Speech signals in real-world scenarios are corrupted due to some disturbing noise such as background noise, reverberation, babble noise, etc. The purpose of speech enhancement (SE) is to extract the clean speech signal from the interferer components mixture as much as possible, so as the clarity and intelligibility of the speech signal. The research of speech enhancement technology is particularly important and difficult. Speech denoising is an importance problem with increasing various applications as hearing aids, speech/speaker recognition, mobile communications over telephone, and Internet [1]. The difficulties arise from the nature of real-world noise that is often unknown, nonstationary, potentially speech-like, overlapping between [1–3].

Assume that the noisy speech x is a linear additive mixture of the clean speech s and the interfere n as defined in the following equation:

$$x(t) = s(t) + n(t) \tag{1}$$

where $x(t)$ is the time-domain mixture signal at sample t, and $s(t)$ and $n(t)$ are the time-domain speech and interferer signals, respectively. The speech enhancement algorithm attempts to suppress noise without distorting speech and obtain the enhanced speech components $\hat{s}$ from the noisy signal and reconstruct the original clean speech. In other words, speech enhancement algorithms try to reduce the impact of background noise on the speech signal. Most traditional speech enhancers are implemented in the short-time Fourier transform (STFT) domain with $\mathbf{X} = |STFT\{x(t)\}|^{\gamma}$ where γ = 1 gives the magnitude of spectrum or the power spectrum by γ = 2. The inverse Fourier transformation then is used to convert the estimated speech to the time domain, assuming that the phase of the interferer can be approximated with the phase of the mixture [4].

The speech enhancement techniques mainly focus on removal of noise from speech signal. The various types of noise and techniques for removal of those noises are presented [5–13]. The famous spectral subtraction technique [5] extracted the clean speech spectrum based on the principle that the noise contamination process is additive. The major advantage of the spectral subtraction method is their simplicity by subtracting an estimation of the interfere spectrum from the observed mixture spectrum [5, 6]. The main problem with the magnitude spectral subtraction is that it does not attenuate noise sufficiently negative magnitude by error in the subtraction.

Filtering techniques [7, 8] or short-time spectral amplitude (STSA) estimators [9] or estimators based on super-Gaussian prior distributions for speech DFT coefficients are [10–13] the statistical models assumed for each of the speech and noise signals that estimate the clean speech from the noisy observation without any prior information on the noisy type or speaker identity. However, in the case of nonstation of background noise, these methods face much difficulty in estimating the noise power spectral density (PSD) [14–16].

Recently, dictionary learning (DL) techniques, which build dictionary consisting of atoms and represent a class of signals in terms of the atoms, have been shown to be effective in machine learning, neuroscience, and audio processing [17–20]. In speech enhancement, the dictionary models utilize specific types of the a priori information considered for both the speech and noise signals [21–25]. This class of methods assumes that a target spectrogram can be generated from a set of basis target spectra (a dictionary) through weighted linear combinations. Generally, this approach decomposes the time-frequency representations (the power or magnitude spectrogram) of noisy speech in terms of elementary atoms of a dictionary. One of the key issues in dictionary-based speech enhancement is how to precisely learn a dictionary. Dictionary learning methods are commonly based on an alternating optimization strategy, in which the signal representation is fixed, and the dictionary elements are learned; then the sparse signal representation is found, while the dictionary is fixed. Two popular methods have appeared to determine a dictionary within a matrix decomposition including sparse coding [26] and nonnegative matrix factorization (NMF) [27].

The observation that speech and other structured signals can be well approximated by few atoms of a suitably trained dictionary [28], which lies at the core of sparse representation (SR). In SR, sparse signals can be reconstructed with a few atoms of an overcomplete dictionary. Recently, developed SR has been shown to be effective in data representation, which factorizes given matrix with regularization methods or regularization term to constrain the sparsity of desire representation. Since speech signals are generally sparse in the time-frequency domain and many types of noise are nonsparse, the target speech signal was decomposed and reconstructed from the noisy speech-driven sparse dictionary [21–23].

In many reality applications, the nonnegativities of the signals and the dictionary are required such as multispectral data analysis [29, 30], image representation [31, 32], and some other important problems [33, 34], the so-called nonnegative dictionary learning becomes necessary. Nonnegative matrix factorization is a popular dictionary method, which projects the given nonnegative matrix onto the subspace spanned by nonnegative dictionary vectors. Treating speech enhancement as a source separation problem between speech and noise, NMF-based techniques can be used to factorize spectrograms into nonnegative speech and noise dictionaries and their nonnegative activations. On the one hand, a clean speech signal can be estimated from the product of speech dictionaries and their activation.

In this chapter, we review the dictionary learning approaches for speech enhancement. After a brief introduction to the problem and its characterization as a sound source separation task, we present a survey on both theoretically and applicable of dictionary-based techniques, the main subject of this chapter. We finally provide an overview of the evaluation methods and suggest some future lines of works.

2. Background

Dictionary learning performs approximate matrix factorization of a data matrix into the product of a dictionary matrix and a coding matrix, under some sparsity constraints on the coding matrix. Dictionary learning is the generalization of gain-shape codebook learning. Signal vectors are represented as linear combinations of multiple dictionary atoms, allowing for lower approximation error while maintaining equal dictionary size. Two relatively different methods are described for how to form the dictionary from the given data including sparse representation (SR) and nonnegative matrix factorization (NMF).

2.1. Sparse representation (SR) and K-SVD algorithm

Let $\mathbf{X}$ be a matrix of M training signals $\mathbf{X} = \{\mathbf{x}_m\}_{m=1}^{M} \in \mathbb{R}^N$. SR dictionary learning framework consists in finding a dictionary $\mathbf{D}$ of K unit-norm atoms $\mathbf{D} = \left[d_{(1)} \ldots d_{(K)}\right] \in \mathbb{R}^{N \times K}$ and sparse coefficients $\mathbf{C} = \{\mathbf{c}_m\}_{m=1}^{M} \in \mathbb{R}^K$ such that the approximation error between $\mathbf{X}$ and $\mathbf{DC}$ is sufficiently small. For example, if the exact sparsity level T_0 is known, the problem can be formalized as minimizing the error cost function $O_{SR}(\mathbf{D}, \mathbf{C})$ defined as:

$$f_{SR}(\mathbf{D},\mathbf{C}) = \|\mathbf{X}-\mathbf{DC}\|_F^2, \quad \text{s.t.}\forall i, \|\mathbf{c}_i\|_0 \le T_0 \tag{2}$$

where $\|.\|_F$, $\|.\|_0$ denote the Frobenius and l_0 norm, respectively.

Eq. (2) shows that a signal **x** can be expressed as the linear combination of only a few column vectors in **D**. Matrix factorization problem (2) is a difficult problem, since the joint optimization of **D** and **C** is nonconvex. Many dictionary algorithms follow an iterative scheme that alternates between updates of dictionary **D** and sparse coding **C** to minimize the cost function (2). K-SVD, one of the methods, goes under the category of sparse representation (SR), which came from the theory of sparse and redundant representation of signals. It was first introduced by Aharon et al. [34]. The K-SVD algorithm defines an initial overcomplete dictionary matrix $\mathbf{D}_0 \in \mathbb{R}^{N\times K}$ and operates alternating two step iterations between optimizing the coding and the dictionary as follows:

The sparse coding approximation step derives the column $\mathbf{c}_m$, $m = 1. M$ by using the orthogonal matching pursuit (OMP) algorithm with given **X** and **D** to solve the following equation:

$$\text{argmin}\|\mathbf{c}_m\|_0 \quad \text{s.t} \quad \|\mathbf{x}_m - \mathbf{D}\mathbf{c}_m\|_2 \le \sigma \tag{3}$$

The updating dictionary step is taken by minimizing the approximation error (2) with the current coding **C**. Atom-by-atom is updated in an iterative process.

$$\text{Because } \|\mathbf{X}-\mathbf{DC}\|_F^2 = \left\|\mathbf{X}-\sum_{i=1}^{K}\mathbf{d}_i\mathbf{c}^{[i]}\right\|_F^2 = \left\|\left(\mathbf{X}-\sum_{i\neq j}\mathbf{d}_i\mathbf{c}^{[i]}\right)-\mathbf{d}_j\mathbf{c}^{[j]}\right\|_F^2 = \left\|\mathbf{R}^{(j)}-\mathbf{d}_j\mathbf{c}^{[j]}\right\|_F^2 \tag{4}$$

where $\mathbf{c}^{[i]}$ is the *i*th row of **C**. The residual norm is minimized by seeking for a rank-one approximation [35]. The approximation is based on computing the singular value decomposition (SVD) [23].

2.2. Nonnegative matrix factorization (NMF) theory

Nonnegative matrix factorization (NMF) can be viewed as an approach for dictionary learning. NMF, first introduced by Paatero and Tapper [36] and later popularized by Lee and Seung [23, 27–37], has been known as a part-based representation model. Different to other matrix factorization approaches, NMF takes into account the fact that most types of real-world data, particularly sound and videos, are nonnegative and maintain such nonnegativity constraints in factorization. Moreover, the nonnegativity constraints in NMF are compatible with the intuitive notion of combining parts to form a whole, that is, they provide a parts-based local representation of the data. A parts based model not only provides an efficient representation of the data but can potentially aid in the discovery of causal structure within it and in learning relationships between the parts.

Given a nonnegative matrix $\mathbf{X} = [\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_M] \in \mathbb{R}_+^{N\times M}$, a positive integer $K << \min\{N, M\}$, NMF projects **X** onto a space by a linear combination of a set of nonnegative basis vectors $\mathbf{D} = \{\mathbf{d}_{nk}\}$, that is, $\mathbf{X} \approx \mathbf{DC}$ where $\mathbf{C} = \{\mathbf{c}_{km}\}$, $\mathbf{c}_{km} \ge 0$. In order to find an approximate factorization

for the matrix **X**, cost function that quantifies the quality of the decomposition needs to be defined. Operationally, NMF can be described as the following objective function

$$\min_{\mathbf{D},\,\mathbf{C}\geq 0} f(\mathbf{X}\|\mathbf{DC}) \tag{5}$$

where f is denoted a distance metric.

Different the similarity measures between **X** and the product **DC** lead to different variants of NMF. The common choices include Euclidean distance [38], generalized Kullback-Leibler divergence [39], Itakura-Saito divergence [40]… For instance, the NMF based on Kullback–Leibler (KL) divergence is formulated as follows:

$$f_{KL}(\mathbf{X},\mathbf{DC}) = \sum_{i,j}\left(\mathbf{x}_{ij}\log\frac{\mathbf{x}_{ij}}{(\mathbf{DC})_{ij}} - \mathbf{x}_{ij} + (\mathbf{DC})_{ij}\right) \tag{6}$$

There exist different optimization models for the approximation factorization (5) [36, 39, 40]. The most popular solution is alternative multiplicative update rules (MURs) [36], which do not have required user-specified optimization parameters. For a KL cost function (6), the iteratively updating rules are given by:

$$\mathbf{c}_{a\mu} \leftarrow \mathbf{c}_{a\mu}\frac{\sum_i \mathbf{d}_{ia}\mathbf{x}_{i\mu}/(\mathbf{DC})_{i\mu}}{\sum_t \mathbf{d}_{ta}} \tag{7}$$

$$\mathbf{d}_{ia} \leftarrow \mathbf{d}_{ia}\frac{\sum_\mu \mathbf{c}_{a\mu}\mathbf{X}_{i\mu}(\mathbf{DC})_{i\mu}}{\sum_s \mathbf{c}_{as}}; \tag{8}$$

However, it is found that the monotonicity guaranteed by the proof of multiplicative updates may not imply the full Karush-Kuhn-Tucker conditions [39, 40]. MUR is relatively simple and easy to implement, but it converges slower in comparison with gradient approaches [41]. More efficient algorithms equipped with stronger theoretical convergence property have been introduced. One popular method is to apply gradient descent algorithms with additive update rules, which are represented by the projective gradient descent method (PGD) [42]. In PGD framework, to select the learning step size, a line search method with the Armijo rule is applied [42] and the new estimate is obtained by first calculating the unconstrained steepest-descent update and then zeroing its negative elements. In addition, considering the separate convexity, the two-variable optimization problem is converted into the nonnegative least squares (NLS) optimization subproblems, which alternate the minimization over either **D** or **C**, with the other matrix fixed.

Because of the initial condition $K << \min\{N, M\}$, the obtained basis vectors are incomplete over the original vector space. In other words, this NMF approach tries to represent the high-dimensional stochastic pattern with far fewer bases, so the perfect approximation can be achieved successfully only if the intrinsic features are identified in **D**.

NMF will not get the unique solution under the sole nonnegativity constraint. Hence, to remedy the ill-posedness, it is imperative to introduce additional auxiliary constraints on **D**

and/or **C** as regularization terms, which will also incorporate prior knowledge and reflect the characteristics of the issues more comprehensively. The constrained NMF models can be unified under the similar extended objective function

$$\min_{\mathbf{D},\,\mathbf{C}\geq 0} f_{constrainedNMF}\left(\mathbf{X}\middle\|\mathbf{DC}\right) = \min_{\mathbf{D},\,\mathbf{C}\geq 0}\left[f(\mathbf{X}\|\mathbf{DC}) + \alpha g(\mathbf{D}) + \chi h(\mathbf{C})\right] \tag{9}$$

where the regularization parameters $\alpha$and χ are used to balance the trade-off between the fitting goodness and the constraints $g(\mathbf{D})$ and $h(\mathbf{C})$.

The performance of NMF can be improved by imposing extra constraints and regularizations. For the sparseness learning, the sparse term $h(\mathbf{C})$ expects to constraint the mount of nonzero elements in each column of the projection matrix. The L_0 norm could be selected to count nonzero elements in **C** [43]. One limitation of using L_0 norm is that the solution is not unique because of many local minima of the cost function. In this situation, the L_1 norm of the projection matrix is usually replaced as a relaxation of the L_0 penalty [44, 45].

$$\|\mathbf{C}\|_1 = \sum_{j=1}^{M}\left\|\mathbf{c}_{:j}\right\|_1 = \sum_{j=1}^{M}\left(\sum_{i=1}^{K}\left|\mathbf{c}_{ij}\right|\right) \tag{10}$$

3. Dictionary learning-based speech enhancement

A major outcome of speech enhancement techniques is the improved quality and reduced listening effort in the presence of an interfering noise signal. The decomposition of time-frequency representations, such as the power or magnitude spectrogram in terms of elementary atoms, has become a popular tool in speech enhancement since their success in finding high-"quality" dictionary atoms that best describe latent features of the underprocessed data. The dictionary-based techniques utilize specific types of the a priori information of speech or noise [21, 23, 46–50]. A priori information can be typical patterns or statistics obtained from a speech or noise database. Dictionary-based speech enhancement consists of two separate stages: a training stage, in which the model parameters are learned, and a denoising stage, in which the noise reduction task is carried out. In the first step, dictionary **D** is learned while fixing coefficient matrix **C**, and in second step, **C** is computed with the fixed dictionary matrix **D**. This process of alternate minimization is repeated iteratively until a stopping criterion is reached. In order to learn dictionary atoms capable of revealing the hidden structure in speech, long temporal context of speech signals must be considered. Two major classes of dictionary-based speech enhancement techniques may be the offline learning and online learning. Offline algorithms for dictionary learning are second-order iterative batch procedures, accessing the whole training set at each iteration in order to minimize a cost function under some constraints [21–23]. In speech enhancement, learning spectrotemporal atoms spanning several consecutive frames is done through training large volumes of datasets, which places unrealistic demand on computing power and memory. In large-scale tasks, online dictionary learning tends to gain lower empirical cost than conventional batch learning [46–50].

Speech enhancement herein is implemented in the short-time Fourier transform (STFT) magnitude domain, assuming that the phase of the interferer can be approximated with the phase of the mixture. The number of frequency bins per frame is determined by the length of the time-domain analysis window, where a Hamming window was chosen for the STFT. The temporal smoothness frames are determined by the time-domain analysis window overlap, where a minimum amount of overlap is necessary to avoid aliasing.

3.1. Offline dictionary

Sparse representation has been described as an overcomplete models wherein the number of bases is greater than the dimensionality of spectral representations. In sparse representation, sparse signals can be expressed as the linear combination of only a few atoms in an overcomplete dictionary. While speech signals are generally sparse in the time-frequency domain and many types of noise are nonsparse, the target speech signal reconstructed from the noisy speech is considered as clean speech. A possibly overcomplete dictionary of atoms is trained for both speech and interferer magnitudes, which are then concatenated into a composite dictionary. The training process of updated dictionary is drawn in **Figure 1**.

When applying the sparse coding technique to speech enhancement, it is desirable to have the trained offline clean speech dictionary $\mathbf{D}_{speech}$ to be coherent to the speech signal and incoherent to the background noise signal as well as a coherent noise dictionary $\mathbf{D}_{noise}$. In the enhancement step, the noisy speech is sparsely coded in the composite dictionary $[\mathbf{D}_{speech}, \mathbf{D}_{noise}]$. As a result, this mixture of speech and interferer $\mathbf{x}$ is explained by a sum of a linear combination of atoms from the speech dictionary $\mathbf{D}_{speech}$ and a linear combination of atoms from the interferer dictionary $\mathbf{D}_{noise}$. The noisy $\mathbf{x}$ is coded using the least angle regression (LASSO) [51] with a preset threshold θ as follows:

$$\arg \min_{\mathbf{c}^{speech}, \mathbf{c}^{noise}} \left\| \mathbf{x} - \left[\mathbf{D}_{speech}\ \mathbf{D}_{noise}\right] \begin{bmatrix} \mathbf{c}_{speech} \\ \mathbf{c}_{noise} \end{bmatrix} \right\|_2 s.t. \frac{\|\mathbf{c}\|_1}{\|\mathbf{x}\|_2} \leq \theta \tag{11}$$

The clean speech magnitude is estimated by disregarding the contribution from the interferer dictionary, preserving only the linear combination of speech dictionary atoms (analogously for the interferer) and

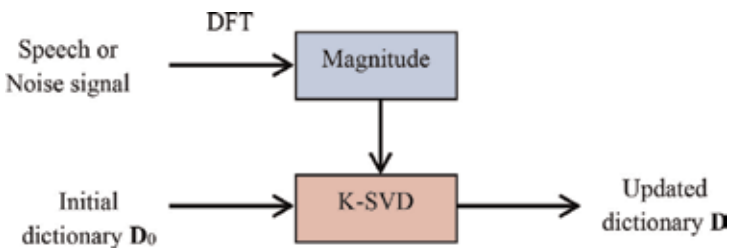

Figure 1. The training process of updated dictionary.

$$\hat{s} = \mathbf{D}_{speech}\mathbf{c}_{speech} \tag{12}$$

It is known that NMF represents data as a linear combination of a set of basis vectors, in which both the combination coefficients and the basis vectors are nonnegative. Although the basis learned by NMF is sparse, it is different from sparse coding [26]. This is because NMF learns a low rank representation of the data, while sparse coding usually learns the full rank representation. Treating speech enhancement as a source separation problem (speech and noise), NMF-based techniques can be used to factorize spectrograms into nonnegative speech and noise dictionaries and their nonnegative activations. Assume that a clean speech spectrogram as $\mathbf{X}_{speech}$ and a clean noise spectrogram as $\mathbf{X}_{noise}$. Consider a supervised denoising approach where the clean speech basis matrix $\mathbf{D}_{speech}$ and the clean noise basis matrix $\mathbf{D}_{noise}$ are learned separately by performing NMF on the speech and the noise. During training process, minimized $f\left(\mathbf{X}_{speech}\middle\|\mathbf{D}_{speech}\mathbf{C}_{speech}\right)$ and $f(\mathbf{X}_{noise}\|\mathbf{D}_{noise}\mathbf{C}_{noise})$ are employed.

To reduce the noise in the noisy speech, the concatenated dictionary $\mathbf{D} = [\mathbf{D}_{speech}, \mathbf{D}_{noise}]$ is fixed and utilized in decomposing the noisy speech $\mathbf{X}_{noisy}$ by

$$\min_{\mathbf{C}_{noisy}\geq 0} f\left(\mathbf{X}_{noisy}\middle\|\mathbf{D}\mathbf{C}_{noisy}\right) \tag{13}$$

where the time-varying activation matrix is formulated $\mathbf{C}_{noisy} = \begin{bmatrix} \mathbf{C}'_{noise} \\ \mathbf{C}'_{speech} \end{bmatrix}$.

Discarding the noise coding matrix, the target speech is estimated from the product of speech dictionaries and their activations as

$$\widehat{\mathbf{X}}_{speech} = \mathbf{D}_{speech}\mathbf{C}'_{speech} \tag{14}$$

The clean speech waveform is estimated using the noisy phase and inverse DFT and the general framework of NMF-based speech enhancement is drawn in **Figure 2**.

3.2. Online dictionary learning

The aforementioned dictionary learning approaches access the whole training set to determine the bases, which are referred as offline training process. These methods were reported to have good performance on modeling nonstationary noise types, which had been seen during training. For the time-frequency analysis of audio signals, however, the obtained basis may not be adequate to capture the temporal dependency of repeating patterns within the signal, and the success of these methods strongly relies on the prior knowledge of noise or speech or both, which limits implementations of the models. Recently, the online dictionary learning methods have been proposed in two aspects of implementing scheme [46–50] and circumventing the mismatch problem between the training and testing stages [24, 52].

One drawback of the multiplicative update procedure on offline dictionary learning is the requirement of all the training signals to be read into memory and processed in each iteration.

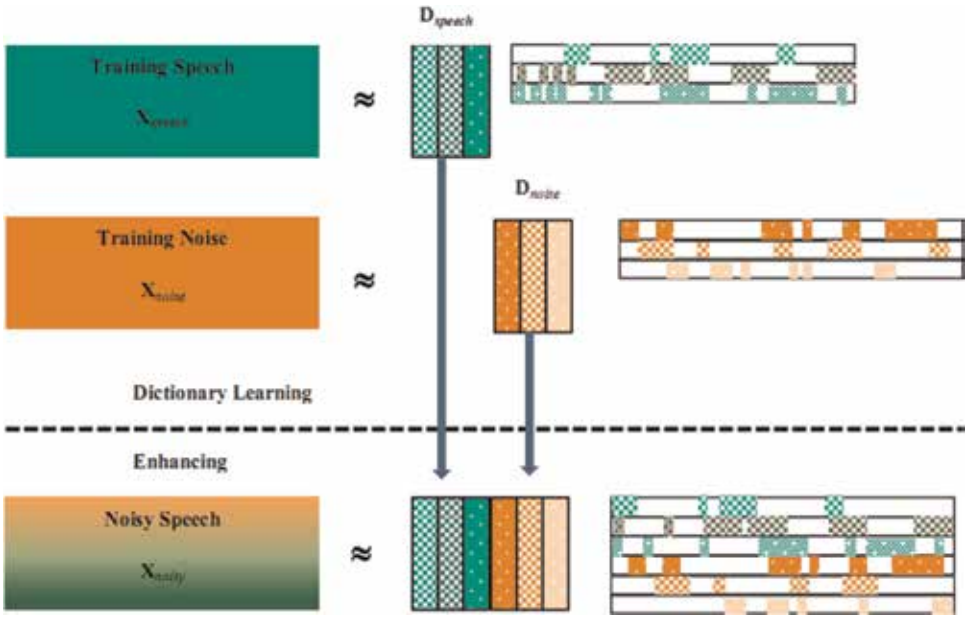

Figure 2. Block diagram of NMF-based speech enhancement.

This high demand on both computing resources and memory is prohibitive in large-scale tasks. To address this problem, the online optimization algorithms were developed in an incremental fashion, which processes one sample of the training set at a time based on stochastic approximations or only a part of the training data at a time and updates patterns gradually until completely processed whole training corpus [46–48, 51]. More specifically, given M samples $\{\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_M\} \in \mathbb{R}_+^N$ distributed in the probabilistic space $\wp \in \mathbb{R}_+^N$, the conventional NMF learns subspace $Q \subset \wp$ spanned by a base $\{\mathbf{d}_1, \mathbf{d}_2, \ldots, \mathbf{d}_K\} \in \mathbb{R}_+^N$ and satisfies the expected cost:

$$\min_{\mathbf{D} \in \mathbb{R}_+^{N \times K}} \sum_{i=1}^{M} f(\mathbf{x}_i \| \mathbf{D}\mathbf{c}_i) \text{ with fixed } \mathbf{c}_i \tag{15}$$

$$\text{or } \min_{\mathbf{D} \in \mathbb{R}_+^{N \times K}} E_{\mathbf{x}_i \in \wp}(f(\mathbf{x}_i \| \mathbf{D}\mathbf{c}_i)) \tag{16}$$

where $E_{\mathbf{x}_i \in \wp}$ denoted the expectation on $\wp$.

The coefficient matrix is computed by

$$\min_{\mathbf{C} \in \mathbb{R}_+^{K \times M}} f(\mathbf{X} \| \mathbf{D}\mathbf{C}) \tag{17}$$

For the online NMF framework, at step t, on the arrival of sample $\mathbf{x}^{(t)}$, the corresponding coefficient $\mathbf{c}^{(t)}$ is formulated by

$$\min_{\mathbf{c}^{(t)} \in \mathbb{R}_+^K} f\left(\mathbf{x}^{(t)} \middle\| \mathbf{D}^{(t-1)}\mathbf{c}^{(t)}\right) \tag{18}$$

where $\mathbf{D}^{(t-1)}$ is the previous basis matrix. The matrix $\mathbf{D}^{(t)}$ is updated by

$$\mathbf{D}^{(t)} = \arg \min_{\mathbf{D} \in \mathbb{R}_+^{N \times K}} E_{\mathbf{x} \in \wp^{(t)}}(f(\mathbf{x} \| \mathbf{D}\mathbf{c})) \tag{19}$$

where $\wp^{(t)} \subset \wp$ is the probabilistic subspace spanned by the arrived elements $\left\{\mathbf{x}^{(1)}, , \mathbf{x}^{(2)}, \ldots, , \mathbf{x}^{(t)}\right\} \in \mathbb{R}_+^N$ and the corresponding $\left\{\mathbf{c}^{(1)}, , \mathbf{c}^{(2)}, \ldots, , \mathbf{c}^{(t)}\right\} \in \mathbb{R}_+^K$ are computed available in the previous t steps.

In [50], an online noise basis learning scheme is proposed that uses the temporal dependencies of speech and noise signal to construct informative prior distribution. In this model, the noise basis matrix is learned from the noisy observation. To update the noise basis, the past noisy DFT magnitude frames are stored into a buffer and the buffer will be then updated with fixed speech basis when a new noisy frame arrives.

Kwon et al. [52] present a speech enhancement technique combining statistical models and NMF with online update of speech and noise bases. A cascaded structure of combining a statistical model-based enhancement (SE) (the first state) [53] and NMF approach (second stage) with simultaneous update of speech and noise bases is proposed. In this model, the output clean speech at current frame is fed as an input to update the speech and noise bases in the following frame. In other words, at each frame, the clean speech estimation is obtained; the speech and noise bases for the NMF analysis in the following frame are updated. This online bases update makes it possible to deal with the speech and noise variations that cannot be covered by the training noise database and is considered a promising way to cope with the nonstationary nature of the signal. The noisy data $\mathbf{X}'(t)$ used for the online bases update herein is constructed by concatenating preenhanced output $\mathbf{X}_{SE}(t)$ of performing statistical model-based enhancement (SE) with the current frame input $\mathbf{X}(t)$. The updating dictionary process will be learned by adding a regular term to the original objective function as follows:

$$f_{onlineSE+NMF}\left(\mathbf{X}'(t) \middle\| \mathbf{D}'(t)\mathbf{C}'(t)\right) = f\left(\mathbf{X}'(t) \middle\| \mathbf{D}'(t)\mathbf{C}'(t)\right) + \alpha \|\mathbf{D}(t) - \mathbf{D}'(t)\|^2 \tag{20}$$

where $\mathbf{D}'(t) = [\mathbf{D}'_{speech,}(t)\mathbf{D}'_{noise}(t)]$ denotes the basis matrix in NMF decomposing of the concatenated noisy data $\mathbf{X}'(t)$ and $\mathbf{D}(t) = [\mathbf{D}_{speech,}(t)\mathbf{D}_{noise}(t)]$ is the basis matrix used to analyze the t-frame $\mathbf{X}(t)$ in the second state.

4. Summary and discussion

In the experimental simulations, speech and noise materials were selected from TIMIT [53] (192 sentences), NOISEX-92 DBs (15 types of noise: birds, casino, cicadas, computer keyboard, eating chips, f16, factory1, factory2, frogs, jungle, machineguns, motorcycles, ocean, pink, and volvo) [54], the GRID audiovisual corpus (34 speakers of both genders) [55], the NOIZEUS

speech corpus (30 utterances with clean samples) [1]. The noisy speech examples were synthesized by adding clean speech to different types of noises at various input SNRs.

Speech enhancement algorithms aim to improve both the speech quality and the speech intelligibility. A high-quality speech signal is perceived as being natural and pleasant to listen to, and free of distracting artifacts. An effective technique should suppress noises without bringing too much distortion to the enhanced speech. Measuring speech quality is challenging, as it is subjective and can be classified into subjective and objective measures. The speech enhancement performance was commonly evaluated in terms of three criteria including the signal to noise ratio (SNR) of enhanced speech [56], the segmental SNR (segSNR) [56], or the perceptual estimation of speech quality score (PESQ) [57–59]. Given the true and estimated speech magnitude spectra, the frequency-weighted segmental SNR is defined as:

$$SNR = 10 \times \log \left(\frac{\sum_t \left(\mathbf{X}_{noisy}(t) - \mathbf{X}_{speech}(t) \right)^2}{\sum_t \left(\widehat{\mathbf{X}}_{speech}(t) - \mathbf{X}_{speech}(t) \right)^2} \right) \tag{21}$$

segSNR is a conceptually simple objective measure, computed on individual signal frames, and the per-frame scores are averaged over time.

$$segSNR = \frac{1}{N} \sum_{b=1}^{N} 10 \times \log \left(\frac{\sum_t \mathbf{X}_{b,\,speech}^2(t)}{\sum_t \left(\mathbf{X}_{b,\,speech}(t) - \widehat{\mathbf{X}}_{b,\,speech}(t) \right)^2} \right) \tag{22}$$

where $X_{b,speech}$ (t) is the frequency-domain representation of the clean speech signal, for frequency b and time frame t, $\widehat{\mathbf{X}}_{b,\,speech}(t)$ is the frequency-domain representation of the estimated speech signal. PESQ indicates the quality difference between the enhanced and clean speech signals. PESQ is analogous to the mean opinion score, which is a subjective evaluation index. The PESQ score ranges from 0.5 to 4.5, and a high score indicates that the enhanced utterance is close to the clean utterance.

Contrary to spectral subtraction, dictionary approach does not assume a stationary interferer, optimizes the trade-off between source distortion and source confusion, and thus shows superiority over objective quality measures like cepstral distance, in the speaker-dependent and -independent case, in real-world environments and under low SNR condition. One possible reason could be due to lack of plenty of data to estimate a noise dictionary. At low SNR levels, the total volume of noise is much higher than that at high SNR levels, which offers a higher chance to obtain a good dictionary or noise modeling. However, under high SNR conditions, a lot of noise spectrum is buried in speech spectrum, which could make the learning of a noise dictionary difficult. The pretrained speech dictionary models outperform state-of-the-art methods like multiband spectral subtraction and approaches based on vector quantization [21–23]. Offline speech dictionary learning in a joint decomposition framework of the noisy speech spectrogram and a primary estimate of the clean speech spectrogram. Online learning approach processes input signals piece-by-piece by breaking the training data into

small pieces and updates learned patterns gradually using accumulated statistics. With this approach, only a limited segment of the input signal is processed at a time. The online estimated dictionary is sufficient enough in basis subspace to avoid speech distortion. The online approaches tend to give better performance than batch learning [53].

The computing demand for both offline learning and online learning consists of updating the coefficient matrix **C** and the pattern matrix **D**. The learning task is defined as an optimization problem, which aims to minimize an objective cost function $f(\mathbf{D})$ with respect to the pattern matrix **D**. It is observed that the reconstruction error for both the online and offline methods converges to a similar value after several iterations and not monotonically decreasing at the beginning. Both batch and online learning converge to a stationary point of the expected cost function $f(\mathbf{D})$ with unlimited data and unlimited computing resources. This situation is only valid in theory. For small-scale tasks where data are limited, but computing resources are unlimited, batch learning converges to a stationary point of the cost function $f_t(\mathbf{D})$, while online learning fails to converge, resulting in suboptimal patterns. For large-scale tasks, the more common situation is where training data are abundant but computing resources are limited. In this situation, due to its early learning property, online learning tends to obtain lower empirical cost than batch learning [49]. For sparse coding where the pattern matrix is overcomplete, for example, $(K > M)$, then online learning is slower than batch learning. The online learning is significantly faster than the batch alternating learning by a factor of the large number of spectrograms reconstructed at each iteration [60].

In short, dictionary learning plays an important role in machine learning, where data vectors are modeled as sparse linear combinations of basis factors (i.e., dictionary). However, how to conduct dictionary learning in noisy environment has not been well studied. In this chapter, we have reviewed speech enhancement techniques based on dictionary learning. The dictionary learning-based algorithms have gained a lot of attention due to their success in finding high-"quality" dictionary atoms (basis vectors) that best describe latent features of the underprocessed data. As a multivariate data analysis and dimensionality reduction technique, two relatively novel paradigms for dimensionality reduction and sparse representation, NMF and SR, have been in the ascendant since its inception. They enhance learning and data representation due to their parts-based and sparse representation from the nonnegativity or purely additive constraint. NMF and SR produce high-quality enhancement results when the dictionaries for different sources are sufficiently distinct. This survey chapter mainly focuses on the theoretical research into dictionary learning-based speech enhancement where the principles, basic models, properties, algorithms, and employing on SR and NMF are summarized systematically.

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Section 2

Technologies and Active Learning

Chapter 7

Innovative Approach for Renewing Instructional Design Applied in the Context of e-Learning

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Additional information is available at the end of the chapter

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Abstract

This research aims to present an overview of an innovative approach for renewing instructional design by offering new form of research in e-learning design. Instructional innovations need to stand back and review the design of innovative components for e-learning system. We postulate in this chapter that the design of learning devices requires the design of complex multifaceted object which supports adaptive learning and lets learners bring into play their knowledge in order to carry out the prescribed tasks. Our approach is centred on the design of this complex object called pedagogical instrument, whose molecules are the smallest collection of the components retaining the properties of that material (according to the teaching intentions). The goal that we have set ourselves is to create the first specification of the micro-instructional engineering design. This specification aims at micro pedagogical technology which needs various types of competencies; our discussion implies that instructional innovation is better likely to succeed if it takes into account the actors, the constraints and the standards required to describe the tools allowing the integration of ICT.

Keywords: learning object, learning activity, instructional material, activity theory, instrument, instructional design, instructional engineering, knowledge object, instructional innovation

1. Introduction

The question that we propose to raise in this work is to know what advantage can be gained from a new type of design based on infrastructure. In the light of this question, we formulate the definition of instructional engineering as specified in Paquette et al. [1]. Thus, instructional engineering is what designers do as they construct and preserve

global learning systems that focus on engaging learners in two main processes: knowledge extraction and knowledge dissemination.

In fact, this definition let us think that instructional engineering is a particular case of knowledge engineering applied in education domain. Instructional engineering should present tools offering multi-views of instructional material models. Micro ID (Instructional Design) has to integrate these perspectives by the principles of divide and conquers. The designer should differentiate clearly the features of the instructional materials and its contents (with all models being able to represent the various aspects of the instructional material). The outcome of the presented approach should be the convergence of cognitive, didactic, interface and content designs.

Our proposition is focused jointly on the innovative and routine designs. The innovative micro-components of the pedagogical instruments are designed to be used and reused within the principles of an object-oriented paradigm. Our approach is intended to renew ID methodology to support the creation of reusable artificial objects for learning systems in order to operationalise the theoretical foundations.

The purpose of this work is to present a new current of learning activity design based on activity theory where its design means the specification of its specific teaching materials called pedagogical instruments; this material has the role of mediator between the learner and the objects presented in the activity. Vygotsky [2] proposed a point of view based on the subject-object-artefact triangle. The main problem is to know how learners interact with content using mediating artefacts (pedagogical instrument). All the higher psychological processes are mediated through a tool.

In reality, the application of activity theory to ID is not new; Jonassen and Rohrer-Murphy [19] have taken up and applied activity theory to the domain of ID. This theory has now spread and is applied to many educational domains [3–5] (Schmitz, 2010; Levy, 2008). All these works are applying activity theory for modelling the learning activity without taking into account ICT constraints. The micro-design shows how to represent and use artefact and instrument in the context of e-learning. Research in activity theory was continued in another way according to the instrumental approach called the psychological approach to education by Rabardel [6] in which he proposes to specify the instrument as something constructed by the user during interaction. We will review Rabardel's [6] work in what follows and make a theoretical comparison with our own specification of the pedagogical instrument according to what we call micro ID.

2. Theoretical foundation of micro-instructional design

The instrument is defined as an intermediate entity situated between two other entities which are the subject, actor and user of the instrument and the object on which the action is performed. This instrument can be called a pedagogical instrument if there is pedagogical intent behind its use.

A pedagogical instrument is defined as being any entity (symbolic or not), capable of operationalizing an action of the system. This entity can be used, reused or referred to in the course of a didactic activity in order to carry out a task with an underlying pedagogical intent.

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According to the instrumental approach Rabardel [6], the instrument is composite; it contains components from artefact and components from users' utilization schemes. The artefact part comes from the designer and from his/her anticipation as to the future use of the artefact. The users' utilization schemes part comes from the subject's involvement in the completed activity. Thus the instrument is not only part of the world which is external to the subject but also the result of the subject's personal involvement in the action.

When we look at instrumental approach from the computer science perspective, we find that schemes of use are not prescribed but dynamically constructed by user during the process of the utilization of the tool. In our approach, instrument would thus be an object (within oriented object paradigm) which includes an artefact part (as properties of the object) and a scheme components part representing all possible prescribed uses of the tool (as methods representing its scheme of use called in our case scenario of use).

The design of the learning activity means the specification of the nature of this mediation by the design of different instructional material layers. The instructional designer should specify the elements used for modelling each layer of pedagogical instrument (**Figure 1**) to be constructed by other actors (the pedagogical and didactic layer, the cognitive layer, the knowledge objects model and the interface layer).

The pedagogical instrument is characterized by five criteria corresponding to its different roles (**Figure 1**):

- Its pedagogical function as pedagogical artefact: this corresponds to the pedagogical intentions represented as: <action, knowledge unit> or <Action; status-of-learner's-knowledge; knowledge unit>.
- Its scenario of use: the life cycle, number of tests, imposed or proposed help, etc.
- Its content to be taught.
- Its effects as cognitive artefact: this concerns the learner's behaviour with the instrument (its effects on the progress of its knowledge and cognitive states).
- Its form: the shape of the instrument as digital resource (buttons, text fields, word, letter, image, colours, size, etc).

The problem of e-learning design is that knowledge is of different kinds. Consequently, a single person cannot manipulate precise knowledge in all domains. The main role of the team is to allow the learner's knowledge to progress according to his/her preferences, the identification of the knowledge actually used by the learner, how to manage and activate certain learner strategies and the translation of the collected results in terms of the effectiveness of the techniques used. The issue at stake is the "divide and conquer" principle which makes teamwork an absolute requirement. The various actors involved in the design process are:

- *The instructional designer*: he/she defines the general characteristics of the pedagogical instrument; his/her role is to specify the shells for the other specialists to integrate the various standard specifications.

- *The learning domain theoretician*: his/her role is concerned with the specifications of each knowledge object and its micro-components within his/her domain of work. In the learning to read domain, this actor is the linguist (various sub-fields: semantics, psycholinguistics) who specifies the knowledge object of this domain (letter, sentences, texts, etc.).
- *The domain expert*: is the teacher who is in contact with reality (learners), whose role is to fix the limits of acceptance of tests. He/she also prepares a critical report, which may contain a lot of rejections.
- *The cognitician*: there is, therefore, much communication between the different design actors, the cognitician and the domain expert even if in certain cases he/she could take care of the final specifications himself/herself. His/her role is to identify the individual knowledge, the cognitive structure, the strategies implemented by the learner and the various stimuli according to the learning style envisaged.
- *The ergonomist*: the role of ergonomics in the project is to design the pedagogical instrument as being a medium of knowledge as well as an interface tool. This articulation should create a better comprehension of the effects of the knowledge object to be taught and the other types of practical knowledge used by the learner (for example, the logic of use of the interface, etc.). For this reason, the knowledge effectively used must be specified by including facts or learner's behaviour which could be characterized by other models.

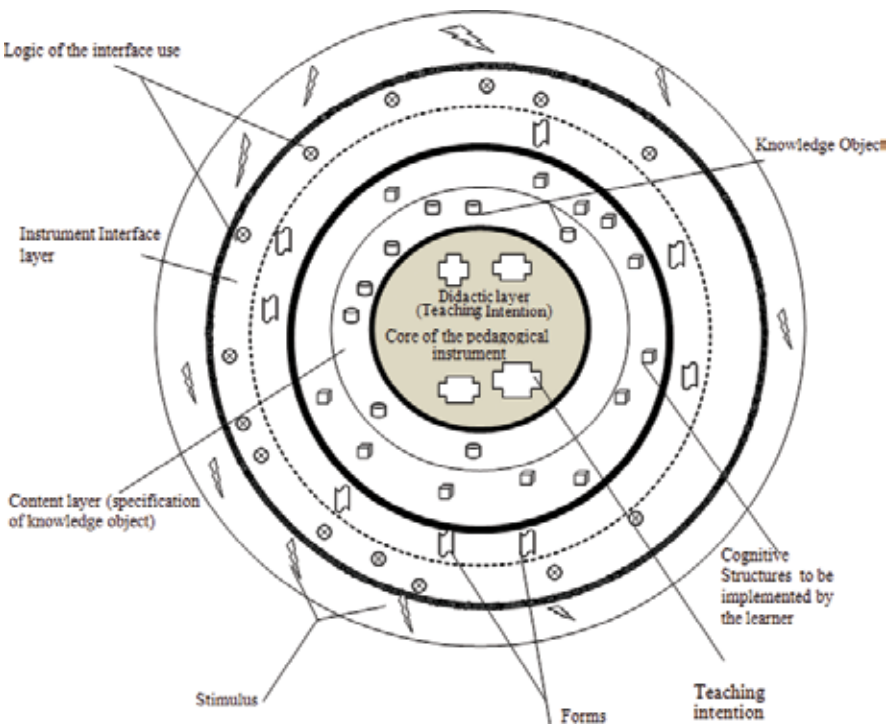

Figure 1. Pedagogical instrument structure.

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- *Finally ontological engineer*: he/she should have a high level of technical ability in order to be able to manage the knowledge projects and dialogue with all the design actors. Ontological engineering play fundamental roles in understanding artefacts by computer, through providing more structural knowledge for using formal models expressed in languages with computational semantics [7, 8]. In reality, whereas we are looking at this from the research standpoint, many actors of the design process can wear several caps.

The divide principle is based on the projection technique to have a multi-view of the pedagogical instrument. That means to create more elaborate models for pedagogical instrument taking into account all aspects of acquisition of knowledge by the learner. The conquer principle is done by connecting theses different models for individualizing learning activity. These models can be described in terms of four projections (**Figure 2**): (1) content projection model, (2) a pedagogical and didactic projection model, (3) a cognitive projection model and (4) a delivery model describing the interface projection of each pedagogical instrument. The realization of these models needs to share pluridisciplinary knowledge between the various design actors to arrive at the specification of the pedagogical instrument.

2.1. Pedagogical projection model

The entities manipulated and adopted in the pedagogical model have progressive degree of smoothness (macro-, meso- and microscale); the entities presented in macroscale are the objective units, these entities are the objective units which can be represented in the form of couples of information: <action; knowledge unit>; or triplets: <action; status of learner's knowledge; knowledge unit>. The objective units represent the properties part of the learning object. For example, in the learning to read domain the following are valid information couples <Make acquire; sentence limits> or <verify; Known; word>. In the mesoscale, we use classes of didactic situation. The entities represented in the microscale are the individualizing elements of the instantiated didactic situation which is considered as a learning object.

By instantiating parameters of the contents, words will be instantiated. These couples and triplets are used to report the progress in the state of the learner's knowledge of reading but with the hypothesis that this takes into account the different pedagogical factors and policies used within a learning theory (our case is concerned with activity theory). Consequently this model is defined to provide to our system the possibility to adapt the pedagogical behaviour to a specific student. From this point of view, the choice of pedagogical actions with respect to learning strategies will be more adaptive.

2.2. Interface projection model

We distinguish between the model of use of the interface which is a sub-model of the cognitive model and the interface model. The model of use of the interface can be considered as a set of functions that allows communication and finalizes the form by which the system transmits information. The use of the artefact associated with the instrument is interpreted by a logic implemented by the learner to be more familiar with the instrument (**Figure 1**). This process is called instrumentation of the learner [6]. Know that learning is defined as

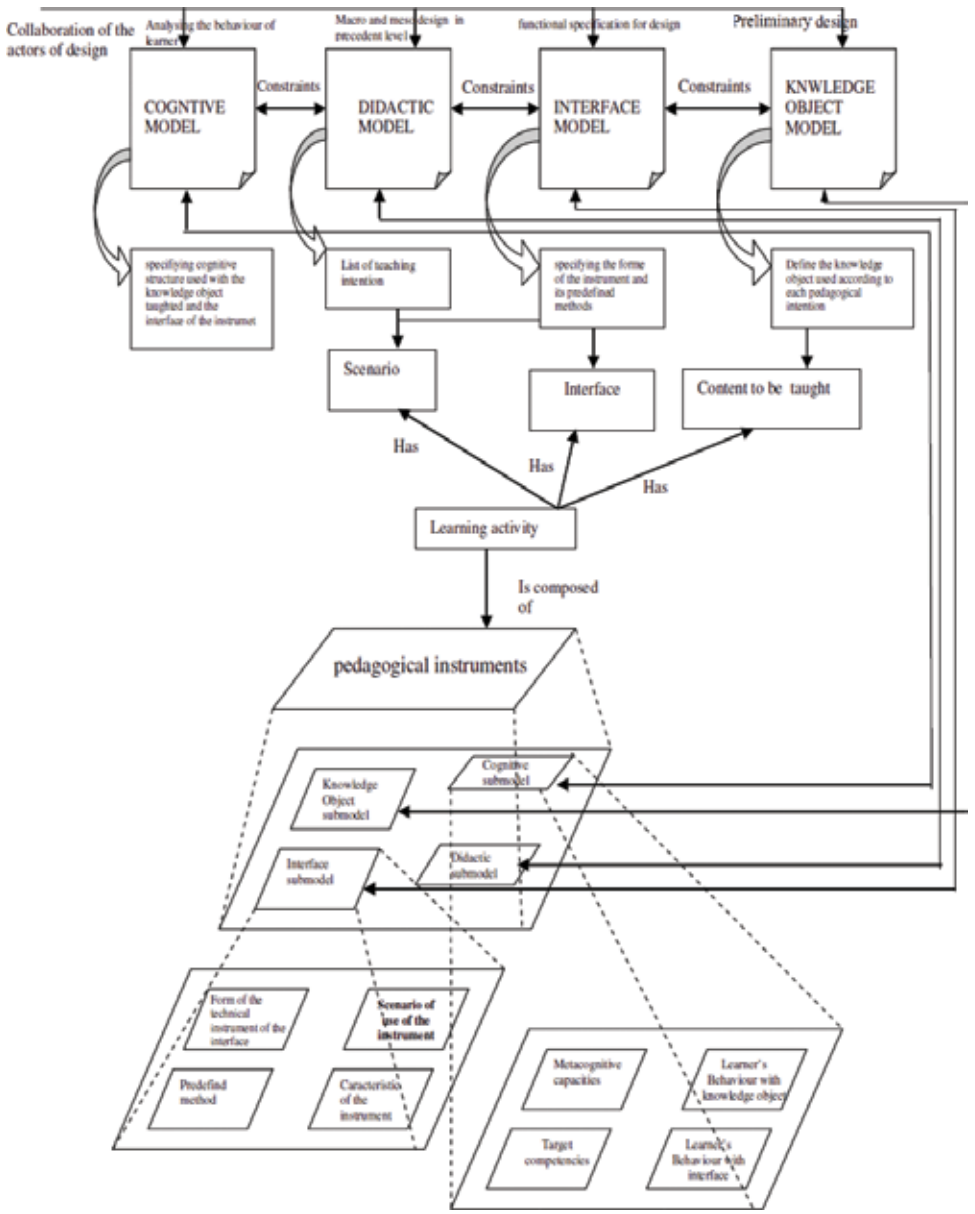

Figure 2. Multi-view projection technique for the design the pedagogical instrument.

transformation of information into knowledge [9–11]. The learner uses his technical skills for processing all information presented in the interface to transform it into knowledge. This model works coupled with the pedagogical, cognitive and knowledge object models. This model deals with appropriate pedagogical instrument to be used in order to propose the final form to the learner corresponding to his learning style and preferences.

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The interface model incorporates all the elements of adaptation (how it can be adapted to a given learning style). The most popular technologies are hiding for adaptive navigation support. Hiding technologies are commonly used for adaptive navigation support. The idea of navigation support by hiding is to restrict the navigation space by hiding links to nonrelevant pages [12] or if it presents materials which the user is not yet prepared to understand (see Section 5).

2.3. Knowledge object projection model

The knowledge object framework is the same for different subject matter domains [10]. Knowledge object of "learning to read domain" are letters, words, sentences and texts; the micro-component of a knowledge object sentences are the components of words (letters). It would be necessary to characterize the differences between knowledge object as entity and its proprieties, for example: The knowledge objects sentences have two types of knowledge (**Figure 4**):

- Knowledge associated with properties of the object "sentence" as theoretical space for example: "The association between written/spoken sentences"—association grapheme/phoneme, the noun indicates letters, the grapheme representing the word, structure of word, syntactic categories, the relation between the verbs and the subject and the correspondence written/spoken words. These objects are highlighted systematically each time that a written sentence is spoken out.
- Knowledge associated with an entity as a semantic unit, which requires the knowledge of the learner about the property of this object (conceptual representation of the sentences).

2.4. Cognitive projection model

Many cognitive psychologists have proposed a diversity of theories of how knowledge is represented in memory [13]. Schema theory postulates that learners represent knowledge in memory as some form of cognitive structure. A knowledge structure has a form of a schema representing the information that is required by a learner to be able to solve complex problems.

The processes of activation of a cognitive process for learner could be defined as a complex knowledge based on the cognitive structure implemented at the time of learning. Thus, artefacts are carriers of strategies, processes and the logic of the manipulation of its interface. These knowledge is manifested in both the structural properties of the tool and in the way the tool should be used. Hence, knowing how to use it is a crucial part of the artefact (symbolic or physical artefact). The notion that cognitive artefacts amplify the cognition of the learner has been adopted by [14]. He finds that this notion is fairly commonplace. "If one focuses on the products of cognitive activity, cognitive artefacts do seem to amplify human abilities". When the learner uses cognitive artefacts, he can easily achieve his actions. For example, noting down all information by using a pen is considered as a tool used to amplify his abilities. We will explain in the following how use symbolic instrument to amplify the knowldge of learner in the context of learning to read domain.

3. Application of microscopic approaches in the learning to read domain

Our approach is applied in the context of a theoretical and development project for a multi-agent and knowledge-based computer for teaching and learning reading. It's related to the mother tongue (French) and addressed to children in normal schooling in their first year of primary school. The microscopic approach to design is centred on the components of learning object which is characterized, firstly, by knowledge being brought into play for learning and secondly by materials considered as the medium for this knowledge (**Figure 1**). The basic idea is that the learning objects would be staged, (instantiation of the content, preparing the list of the instrument to be used and finally specifying the scenario of each pedagogical instrument), a process referred to as "sequencing".

Our proposal lies in the use of the rational agent, which individualizes its parameters according to the student model and using three types of rules (didactic rule related to the learning domain, pedagogical rules concerned by the general teaching rules independently of learning to read domain and finally linguistic rules). So the sequencing of the learning object reveals the various aspects of learning activity: (1) its contents which represent the primary teaching matter, (2) its interface which is represented as a set of pedagogical instruments constituting the teaching equipment and finally (3) the scenario of use of each pedagogical instrument.

The sequencing is done by the learning object sequencing agent. It uses its dynamically built knowledge bases starting from the agents of the environment and the knowledge defined the contents to find all suitable methods for creating the scenario of each pedagogical instrument. The detailed modelling of the agent and its reasoning is not the subject of this article. Our goal is to specify the micro-design of the instrument as multifaceted artefact by the application of projection technique.

3.1. The pedagogical instrument as a didactic artefact

The didactic characteristics of the pedagogical instrument are related to teaching intentions calculated in precedence levels. Pedagogical knowledge concerns all didactic knowledge, which does not depend on the domain of reading. The pedagogical characteristics of the instrument relate to the holding information about the didactic usage and quality of the entities belonging to other domains. Its elements are all the entities including a certain number of didactic attributes. There are two kinds of didactic entities, related to either conceptual or instructional entities. Each entity has a priority depending on its importance as part of the learning process (a measure of the importance to the student). For example, the pedagogical intention: <"Present text without reading"; "display the word on the screen"; "suggest help" > is associated with the "Visual comparison strategy" to be implemented by the learner.

The instrument is to be considered as an artefact representing the pedagogical material to be used by the learner. As for the symbolic characteristics of the instrument, it is difficult to show in a detailed way the exact nature of the cognitive instruments that the learner uses or the role of the didactic artefacts used in the text reading activity. Such a process is by nature very complex requiring a definition of not just the instrument's components but rather its actual

molecules according to an advanced microscopic design approach. Thus, the instrument as a didactic artefact means in our view a meta-instrument enabling the learner to construct his/her own cognitive instruments as the didactic activity progresses. Variation in the mode or time of the instrument's intervention may have different effects according to its pedagogical function, for example, a help instrument which intervenes only after a certain number of mistakes. So the didactic role here can address different kinds of skills (the intervention mode of the help instrument, when left to the learner's initiative, may increase his/her metacognitive skills, for example). The pedagogical instrument is individualized after using the basis firstly of the knowledge collected from the student model and secondly on that illustrated in the properties of learning object (its content). An example of a pedagogical instrument is "the text field" that can be considered as a support of the text. The text is considered as knowledge representing its content associated with its different scenarios of use. Among the examples of cognitive instruments constructed by the learner in the presenting of text activity, we will mention the following:

A dictionary access instrument (decoding—dictionary access): a tool that the learner constructs in order to access the dictionary; the activation is both automatic and on two levels: (1) activation of the spelling and phonological information of the word to enable reliable and accurate coding and (2) activation of the semantic information followed by a selection of the information which is relevant to the context.

A morphological processing instrument: such instruments are constructed and used by learners in a text reading situation, during the reading activity, which is a special situation at the limits of the recognition and comprehension processes. According to the specialists, morphological analysis skills are poorly developed prior to learning how to read. Directionality in writing involves greater processing of words according to their morphological structure; furthermore the morphological structure of words is more explicit in writing. The mediation of this instrument constructed by the learner depends on one of the following prospective outcomes:

- The morphologically complex words are systematically analysed in order to be recognized, and in this case the morphological analysis is clear;

  Or

- All the derived forms have their own unique access code obviating the need for morphological analysis.

There is a strong assumption that the vocabulary is morphologically organized with, however, each derived from having its own entry. According to different parameters (frequency, position of the affix), however, morphological analysis actively contributes to the selection of a given item and takes its place at the early stages of development (the semantic and syntactic roles of suffixes in word recognition and in comprehension).

The other cognitive instruments involved in the activity are linked to each interface instrument. This principle has been presented above according to the theoretical foundations of activity theory. Thus, each artefact is associated with an object of the activity which becomes an instrument in the course of the didactic activity.

3.2. The micro-components of a knowledge object

The text is the most complex knowledge object related to the learning to read domain; it acts of as a complex task to be accomplished by the learner during his/her reading of the text. The learning is in the form of a syntactic analysis of sequences of identified words, a realization of their significance and the combination and integration of the clauses deduced from the various clues (morphological, morpho-syntactic and pragmatic). The status of the knowledge for learning could be regarded as a combination of other statuses of knowledge at the same time as it could be for a single status; this status would be given according to the various statuses of the different micro-components of the knowledge objects. The focus on these micro-components can explain some micro-complications arising when the learner starts to recognize the letters using micro-components of this knowledge corresponding to the learning activity.

3.3. The pedagogical instrument and cognitive structures

The pedagogical instrument is designed to conduct the learner's strategies. An example of this conduct is to allow the learner to identify words by using in the first phase syntactic analysis of word sequences without ambiguous syntactic structures; the second phase is to let him/her learn the development of the syntactic structure of the various components starting from various clues (morpho-syntactic, morphological, sets of themes and pragmatic) and exactly establishing the coherence between inferred clauses starting from its knowledge bases in memory.

The cognitive model contains all the processes that are used by the learner to handle the interface and to learn for example: how to use the logic of reading: (left to right; top to bottom) and how to apply the logic of correspondence: (spoken word/ written word, spoken sentence/ written sentences). More generally, this model takes care of communications between the student and the system. In the microscopic approach, the instructional designer must specify in collaboration with the other design actors the knowledge that learners use by exploiting short-term memory and the knowledge which the agent proposes as being knowledge of the long-term memory. The other types of knowledge, "knowledge of the world" or rather everything that will be implicitly used by learners, are in fact considered as "practical knowledge".

An example of cognition amplification with the help instruments of the activity: Supposing we want to activate the semantic-spatial strategy of word recognition, the desired cognitive state would be represented as follows:

Desired cognitive state (action = activate word recognition strategy, knowledge = semantic-spatial strategy, status = high (degree of mastery)).

Desired cognitive state (action = activate object-strategy, knowledge = problem solving started, status = mastery).

Desired cognitive state (action = activate cognitive competencies, knowledge = content analysis, status = very high (degree of mastery)).

Knowing that the status of the degree of mastery is very low, low, average, high, very high, using the help instrument may amplify the learner's skills which may also improve his/her

metacognitive competencies. After the use of the help instrument by the learner, the system saves the news cognitive state of the learner in its knowledge bases as follows:

Cognitive state (metacognitive competencies, skill at using help, high (degree of mastery)).

3.4. Pedagogical instrument and the scenario of use

The instrument is described by the interface model by specifying its shape and its different way of use, which can be described as methods in the object-oriented paradigm where the pedagogical instrument is an object and the predefined methods for this object can be regarded as possible scenarios for its use. For example, if we have the text field in the didactic situation "presentation of the text". The different methods of presentation of this text can be considered as the possible scenarios to be presented to the learner (global reading of the text, reading sentence by sentence, reading word for word,). These different ways of reading the text give details of the tasks progress of the system which are associated with the constraints calculated from the student model. For example, if we detect from the behaviour of the learner that he/she has an impulsive character (the Answer validation button and next activity button should be hidden until the end of the tasks proposed by the system (**Figures 3** and **4**). The interface model of the instrument must integrate this element as a property of the interface instrument (the Answer validation button). The interface of the instrument should be adapted to the kind of learner; the reflective learner will have different types of interface [15, 16].

3.5. Pedagogical instrument surrounded by different types of stimulus

The visual style is characterized by the more effectiveness for the learner's memory by using vision; the auditory style is related to audition and the kinesthetic style concerns everything we touch. The difference between tactile and kinesthetic styles is that tactile style is characterized by a fondness for sense of touch. Kinesthetic learners need body movement and frequent breaks in activity [17]. The intervention modes of the interface instruments for visual learners should be centred on the visual aspect rather than an oral aspect (an example is the intervention mode of a Re-read Sentence instrument by blinking instead of providing an oral message for auditory learners). It is very difficult to apply kinesthetic stimuli because we haven't yet integrated touch screens in our system. As discussed above (Section 1) this difficulty shows a relationship between the micro-design and ICT. We need to integrate kinesthetic stimuli in the interface model of the instrument, which introduces a new type of problem in relation with new technology. The pedagogical instrument is the tool that activates these stimuli and allows the learner to make the most of his/her abilities to understand and to learn.

3.6. Connecting different models of the instrument

When the total design is sufficiently advanced, work can begin on the design of individualizing the process of learning materials by connecting different models. We will demonstrate this by specifying the decision variables of our illustrative models. Knowing that each knowledge object has possible statutes in the student's model: known, un-known, recognized and possible context where the student has constructed this status or modified its value, the

Figure 3. Word in context learning activity.

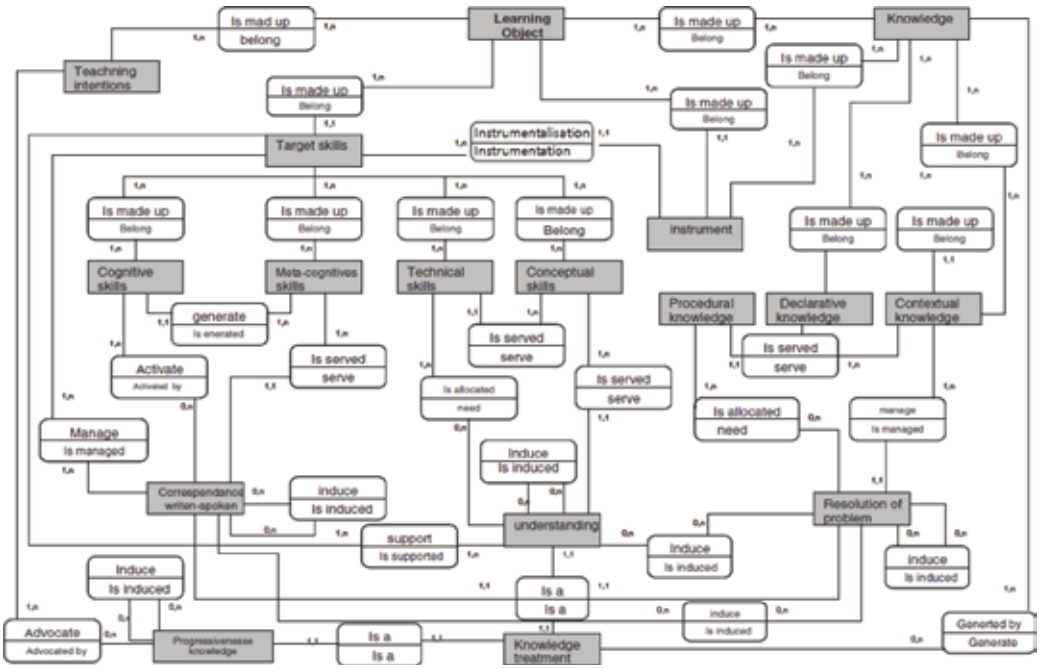

Figure 4. Relational model for learning object.

student model should give all these information. The student's strategy required to do tasks proposed by the system according to the criterion described by the instructional designer in the pedagogical action. In the knowledge object model (Text model) we can find the vector: T (Title, Kind, difficulty-degree, spatial-characteristic, number-of-time-of-reading); the kind of text can be related to the narrative text, dialogue text, and descriptive text [18]. The knowledge object model contains variables which are given in the pedagogical model. The agent formulates a set of request to instantiate all the elements related to the text for example: Find

in the student model text with status which is related to the learner's familiarization level with the text (the number of times where the text has been used by the learner, the number of sentences and words which have been used before by the learner). In the pedagogical model, the decision variables associated with each kind of text (for example, the pedagogical intention: present text, narrative text; status, new) are precised.

The objective of this specification is to give a successful manner for personalizing these components taking into account the complex dynamism of the learning activity presented by the relational model of the learning object (**Figure 4**).

In **Figure 4**, the four components of the activity are Instrument, Knowledge, target Skills and teaching intentions. The entity "Instrument" is related with the entity (target skills) by the relation (instrumentation/instrumentalization), the instrumentalization is related to four variations of the instrument (its interface, the content to be taught, the mode and the moment of intervention), and so the enhancement of the instrument by these variations gives it more interactivity and makes it adaptive to the advocates teaching intentions.

Different profiles of learners should be taken into account by the system to instantiate the parameters of instruments; for example, the moment of intervention of the instrument during the activity of training provides the learner with more time to identify all what is required to solve the problem. That lets the learner make a decision to use its metacognitive skills (let the learner request the help (instrumentation process)). The system can disable certain kinds of instrument (Instrument-state.disable) to be activated by the learner (for example: listening instruction (Instruction button **Figure 3**)) that makes the learner more autonomous and increase its cognitive skills. We can distinguish three types of knowledge (declarative, procedural and contextual knowledge); the internal relation between these kinds of knowledge serve as tools used to clarify the resolution of the problem by the learner (activating instrument by using its methods according to object-oriented paradigm principles). The entity "Progressiveness of knowledge" has a direct relation with teaching intentions defined by the expert of domain and the learning model used by the system.

In all cases, the overall scenario of the teaching activity is considered as a group of predictive scenarios corresponding to the time or mode of intervention of each instrument. The modelling of pedagogical scenario is a difficult task; it concerns the interpretation of a prior description of how the teaching activities given by the designer of the learning activity. The unwinding of the word in context activity UML activity diagram interprets the prior description given by the domain expert.

4. Conclusion

In this chapter, we have presented an overview of an innovative approach for renewing instructional design by offering a new form of research in e-learning design. The biggest advantage of the micro-design approach is obviously that of simplifying the administration of the e-learning system within an organization by improved delivery and tracking of content

and components. That provides insights into how an object-oriented paradigm can be applied and further developed in a variety of problem areas and fields: cognition, linguistics, psychology, etc. The solution is to represent the learning activity as learning object within the object-oriented paradigm where its structural components are the reusable objects representing the pedagogical instruments.

In general, we have found that the micro-design is highly theory-based, but for us this is opportunity of open innovation for designer in making analysis process more of an art form. So the micro-design offers multi-views of instructional material analysis models. At the same time it has allowed us to better describe the elements which contribute effectively to implementing the process of individualization of learning, which is at the heart of our research practices. More research in various domains is required to attain a higher level of technology able to discover all the micro-components of the key to e-learning design, the pedagogical instrument.

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Chapter 8

Strategies for Digital Creative Pedagogies in Today's Education

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Additional information is available at the end of the chapter

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Abstract

Creativity and digital technologies are considered to be central for success and development in the current society, becoming crucial educational objectives worldwide. Nevertheless, education often fails to keep pace with creative and digital economies; this is mainly because teachers are not prepared for adopting pedagogical strategies that foster creativity or for fully exploiting the educational potential of digital technologies. Based on the seminal theories of creativity, we propose an innovative framework for applying creative teaching practices mediated by digital technologies: in the light of constructivist and constructionist approaches, we suggest a series of digital tools which are particularly suitable to the emergence of creativity, i.e. manipulative technologies, educational robotics and game design and coding. Furthermore, we shape the concept of digital creative pedagogies (DCP) and establish a set of characteristic components of teaching practices which contribute to the development of students' creativity. Drawing on a substantial body of research, the chapter intends to embed educational creativity in the digital culture.

Keywords: creativity, digital creativityd, digital creative pedagogies, manipulative technologies, educational robotics, game design and coding

1. Introduction

Creativity is considered to be critical for facing the social and economic changes of today's society [1, 2], as well as for attaining personal development, social inclusion, active citizenship and employment [3]. In addition, the labour market depends more and more on employees' abilities to work with technologies, as well as to generate new ideas, products

and practices [4]. In this context, digital and creative skills have gained the attention of worldwide policies and have become important educational objectives [5].

Nevertheless, a gap remains between policies and practices, as education often fails to keep pace with creative and digital economies [4, 6]. This is mainly because teachers are not prepared for adopting pedagogical strategies that foster creativity or for fully exploiting the educational potential of digital technologies.

Beghetto [2] identified a series of obstacles to the integration of creativity in the classroom, including convergent teaching practices and teachers' negative beliefs towards creativity. Furthermore, educators are not prepared to apply creative teaching strategies which match their institutional and curricular requirements [7].

Regarding digital technologies, the 'EC report on initial teacher education in Europe' [8] states that only half of European countries integrate digital education in teacher education. Furthermore, most teachers use digital technologies mainly to prepare their teaching, rather than to work with students during lessons. As a result, between 50 and 80% of students in Europe never use digital textbooks, exercise software, simulations or learning games.

This chapter proposes an innovative framework aiming to prepare educators for applying creative teaching practices mediated by digital technologies. We first attempt to conceptualise educational creativity, i.e. we present the seminal theories and definitions of creativity and the main characteristics of creative education, as well as a series of creative pedagogies. Afterwards, we propose a framework for digital creativity in education, including a definition, a series of pedagogical theories and digital tools which are particularly suitable to the emergence of creativity. We finally establish a set of characteristic components of digital creative pedagogies (DCP), that is, teaching practices which contribute to the development of students' creativity.

2. Creativity in education

2.1. Different approaches to the study of creativity

Creativity constitutes a complex and elusive concept which remains difficult to explore. It has been studied through the lens of different paradigms, for example, pragmatic, psychodynamic, psychometric, cognitive and evolutionary approaches [9]. Some of those have brought valuable contributions to the understanding of creativity; nevertheless they do not allow for a holistic approach of the phenomenon. Hence, several theories attempted to explore its different dimensions in a comprehensive manner.

For instance, Csikszentmihalyi [10] described creativity as the result of a system composed of three distinct elements: (a) the *domain*, which contains a specific set of rules and practices; (b) the *individual,* who produces a novel variation in the content of the domain through cognitive processes, personality traits and motivation; this variation is evaluated by (c) the *field* for its inclusion in the domain.

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Furthermore, Rhodes [11] developed the four P's model, which places creativity at the interplay of four distinct strands, i.e. process (the different stages of a creative activity), person (the characteristics of individuals), press (the qualities of the environment where creativity happens) and product (the tangible or intangible outcomes of the creative process). Rhodes' classification has become a major framework for the holistic exploration of creativity. The next subsections examine the four components in the light of influential theories of creativity.

2.1.1. Process-oriented approaches

Those theories mostly explore and describe the creative process through an iterative sequence of stages [12], which commonly consist of the identification of the task, a phase of preparation and an evaluation of the obtained outcome. Nevertheless, process models present some discrepancies: some researchers view the emergence of ideas as a sudden and intuitive process characterised by an illumination or insight (e.g. [10]); on the contrary, other theories describe a mindful process of idea generation [12]. For instance, the well-known componential model of Amabile [13] proposes a system of five phases: (a) problem or task identification (conscious recognition of the task or problem), (b) preparation (building or reactivation of the information which is useful to the completion of the task), (c) response generation (creation of possible solutions or responses), (d) response validation (evaluation of the possible responses or solutions) and (e) outcome (evaluation and diffusion of the outcome).

2.1.2. Person-oriented approaches

Here researchers use biographical and historiometric methodologies to explore the individual characteristics and personality traits of creative persons. Such theories result in a series of creative individual components which include thinking styles, personality attributes (e.g. a positive disposition towards overcoming obstacles, taking risks and tolerating ambiguity) and intellectual abilities [14], as well as concentration, playfulness, discipline, passion and objectivity [10]. Amabile [13] brings a classification which differentiates domain-relevant skills (knowledge and skills in the domain), task motivation (extrinsic and/or intrinsic) and creativity-relevant skills (personality characteristics, like flexibility and a persistent work style).

2.1.3. Press-oriented approaches

This strand concentrates on the characteristics of the environment which may nurture or hinder creativity. First, social, cultural and political factors may influence creativity [15], like family upbringing, cultural traditions and the historical milieu [16]. In addition, Csikszentmihalyi [10] highlighted some environmental features which may foster creativity, including training, expectations, resources, recognition and reward. Similarly, Amabile and Gryskiewicz [17] identified a series of elements of the workplace environment which may foster creativity, such as freedom, challenge and leaders' recognition. At the contrary, some factors proved to hinder creativity, like time pressure, evaluation [17], lack of respect and competition [18].

2.1.4. Product-oriented approaches

The last dimension focuses on the tangible or intangible outcomes of the creative process. Researchers commonly define two characteristics of creative products, namely, usefulness and novelty [12, 13]. Usefulness refers to the adequacy of the outcome to its context of use. As for novelty, literature distinguishes between Big-C (consensual) and little-c (personal) creativity [19]. Kaufman and Beghetto [20] proposed a Four-C Model which differentiates mini-c (interpretive creativity), little-c (everyday creativity), Pro-C (expert creativity) and Big-C ('legendary' creativity).

2.2. Towards a definition

Defining creativity results to be a complex task [21]. The word has been applied to a variety of fields, settings and theories [22]; hence, scientific literature lacks a sound definition. Nevertheless, there appears to be consensus on the main features of creativity [23]: it refers to the ability to create something novel and appropriate [24]. The term 'novel' describes an original solution, while the term 'appropriate' refers to the usefulness of the product as applied to a specific need [9].

As applied to the field of education, the NACCCE [22] provided a comprehensive definition, which does not limit to the product dimension, describing creativity as an 'imaginative activity fashioned so as to produce outcomes that are both original and of value' (p. 30). Cremin et al. [25] added some components to this definition, so that it matches a personal view of creativity (little-c): 'purposive imaginative activity generating outcomes that are original and valuable in relation to the learner'. In this view, creativity processes involve four characteristics: (a) they consist of thinking imaginatively, (b) they are purposeful (i.e. directed towards a specific goal), (c) they result in an original and valuable outcome and (d) the learner constitutes the reference point.

2.3. Characteristics of creative education

The research community views creativity as a developmental quality which is amenable to teaching [7]. A review of literature in creative education allows for identifying three clear characteristics of creative education:

- *A democratic approach*: traditionally, creativity is seen as a quality reserved for exceptionally talented individuals [22]. This exclusive perspective recently changed towards an inclusive one, to which all people from all ages can be creative [16, 26]. This new angle is widely adopted in the field of education, considering that all students have a creative potential which can be fostered or hindered depending on the teaching strategies used [27].
- *A focus on little-c creativity*: small levels of creativity give importance to personal processes beyond outstanding accomplishments. As applied to education, this perspective encourages students to develop new and personally meaningful insights and discoveries, as well as to attain their full potential in their everyday domains [27].
- *A domain-wide approach*: creativity is often associated to the domain of arts [22]. Recently, this scope has been widened to other areas of everyday life [27]. Hence, in the field of education, creativity can be developed in all curricular subjects, such as languages and science [28].

2.4. Creative pedagogies

Creativity and education literature highlights a series of creative pedagogies, that is, teaching practices which contribute to the development of students' creativity. In a review of 210 pieces of educational research, Davies et al. [29] mentioned the flexible use of space and time, the study outside the classroom, collaborative and game-based learning approaches, as well as respectful relationships, non-prescriptive planning and the participation of educators as learners in the classroom activities.

Cremin and Barnes [30] outlined similar characteristics, i.e. an agency-oriented ethos, multimodal methodologies, exploration and discovery, risk-taking, tolerance of ambiguity and uncertainty and safe and non-judgemental environments. In this line, Sawyer [31] considers the possibility to try before getting it right and the use of failure as a positive learning factor. The author also considers collaborative and improvisational practices which allow students for externalising their understandings and reflecting on their learning processes.

Barajas and Frossard [32] proposed a set of four main creative pedagogies, each one characterised by different components: (a) learner-centred approaches (matching curricular objectives with students' interests, making learning relevant and engaging, encouraging students' ownership and problem-solving, value learning processes above outcomes so to promote students' reflection on their learning trajectory), (b) open-ended ethos (providing space for uncertainty, exploration and spontaneity in a safe classroom environment), (c) synergistic collaboration (rich collaborative practices based on joint problem-solving and collective decision-making) and (d) knowledge connection (linking content to real-life situations, bridging different domains and disciplines and placing knowledge in a wider context).

3. Digital creativity in education: a proposal framework

Technological devices have entered all aspects of our everyday life [33]. In this digital society, the concept of creativity is being rethought. Indeed, the affordances of technologies may have a strong influence on creative processes and achievements. As mentioned by Loveless [34], 'digital technologies can be tools which afford learners the potential to extend or enhance their abilities, allow users to create novel ways of dealing with tasks which might then change the nature of the activity itself, or provide limitations and structure which influence the nature and boundaries of the activity' (p. 64). Nevertheless, understanding the interplay between digital and creative yet appears as a challenge, and the two are often studied as separate domains [4].

As a first step to bridge this gap, we propose the following definition of digital creativity, as applied to education (based on [22, 25]): 'purposive imaginative activity, mediated by digital technologies, generating outcomes that are original and valuable in relation to the learner'. As applied to education, digital creative teaching would consist of applying digital technologies with the aim to support creative pedagogies, that is, learner-centred approaches, open-ended ethos, synergistic collaboration and knowledge connection.

The following sections propose pedagogical theories and digital tools which may support the development of digital creativity in the classroom.

3.1. Pedagogical underpinnings

To our view, four pedagogical theories are particularly suitable to the application of digital creative teaching practices, namely, experiential education, critical pedagogy, constructivism and constructionism.

3.1.1. Experiential education

This movement questioned the pedagogical assumptions of its time, to which education relates to an accumulation of knowledge, in favour of active student-centred methodologies based on learning by doing and problem-based learning. To this view, learners build knowledge on the basis of the present experience and the active interaction with their environment [35, 36].

3.1.2. Critical pedagogy

This philosophy and social movement denounces the 'banking concept of education' which consists of simply depositing knowledge in a decontextualised manner [37]. At the contrary, Freire promoted the importance of developing learners' critical awareness towards the society and viewed education as a path to empowerment and emancipation. In this line, education should directly connect to meaningful problem-solving [38].

3.1.3. Constructivism

This influential paradigm considers knowledge as an experience that is developed by interacting with the world on the basis of prior knowledge. Hence, students are not passive recipients of knowledge. Rather, they make sense of the world by actively building and transforming meaning [39]; teachers become facilitators who guide students towards processing information through active exploration. From this perspective, every learning process is creative, as learners create their own meaning as they attempt to understand the world. As stated by Craft [40], 'in a constructivist frame, learning and creativity are close, if not identical' (p. 61).

3.1.4. Constructionism

Influenced by Freire and Piaget, Papert elaborated the theory of constructionism. He shares Freire's endeavour to free the latent potential of students, by creating learning environments which connect to their passions [38]. Building on constructivism, constructionism argues that learning better occurs when students make and share tangible artefacts [41]. Hence, this theory is directly related to the *maker* and *digital making* movements.

Papert pioneered the educational use of digital technologies. More than information and communication devices, he considers technologies as powerful educational tools which allow students for concretising and expressing their ideas by designing, building and engineering. Constructionist learning environments are usually not based on a fixed curriculum. Rather, students use technology to build their own projects, while teachers act as facilitators of the process [38]. Hence, learners become designers. The constructionist view highlights

the importance of social participation in the knowledge construction process and considers making as an inherently social activity, through which learners design artefacts that are of relevance to a larger community [42].

3.2. Digital tools for creativity

We suggest the following tools and educational strategies which may support digital creative teaching activities.

3.2.1. Manipulative technologies

Manipulatives, in the context of education, are physical tools that engage students in hands-on learning. Based on the constructivist theories, the manipulation (i.e. organisation, combination, comparison, etc.) of objects, such as blocks, figures and puzzles, is central to the learning process, as it stimulates multisensory experience. Commonly, manipulatives are used to teach STEAM to young students and to bring fun to the learning process [43]. Recent studies show a high level of acceptance of digital manipulatives by teachers and students, as well as a positive impact on learning (e.g. [44]).

For example, Magic Blocks [45] are RFID-tagged logical blocks which children can manipulate in order to perform educational tasks set by a real or a virtual teacher, to stimulate learning of mathematical and logics concepts. LittleBits[1] are small electronic objects, each one with a distinct function (motion, light, sound, sensor, etc.) that easily fits to each other through magnets, used to create electronic circuits. They stimulate the inventive nature of children to create numberless projects while they learn not only logic, maths and electronics but also product design, prototyping and entrepreneurship. Furthermore, digital manipulatives stimulate a *makers* attitude, turning students into active creators. Learning in a makers environment provide opportunities for disrupting students' conventional practices of invention, exploring through play, failure, risk-taking and refiguring creation as remix and craft [46].

Virtual manipulatives, such as Wolfram Demonstrations Project,[2] Shodor Interactivate Activities[3] and GeoGebra,[4] completely substitute the physical elements. Empirical studies show that virtual manipulatives encourage creativity and increase the variety of solutions that students encounter [46], which is in line with the constructivist theory.

Cubelets[5] and Robo Wunderkind[6] enable young children to design and construct robots through manipulatives—mountable blocks that contain the functions of a robot (a switch, a motor, a sensor, etc.). These tools demonstrated to positively change students' attitude towards STEM and computer science [48], as well as to foster critical thinking skills [49].

[1] https://www.littlebits.com/
[2] http://demonstrations.wolfram.com/
[3] http://www.shodor.org/interactivate/activities/
[4] https://www.geogebra.org/
[5] https://www.modrobotics.com/
[6] https://robowunderkind.com/en/

3.2.2. Educational robotics

Educational robotics uses tangible materials to teach a variety of topics, including STEM, literacy, social studies, dance, music and art [50]. Such teaching strategy enhances students' learning experience through hands-on/mind-on activities integrated with technology. Nowadays, a large number of educational robotics tools are available on the market, including LEGO WeDo[7] and LEGO Mindstorms,[8] mBot,[9] Bee-Bot,[10] Ozobot[11] and Dash and Dot.[12] For the younger learners (age below 6 years) educational robotics often focuses on learning the basic programming principles, simple logics and mathematics concepts. Commonly, the creation of both hardware and software parts of a robot encourages children to think imaginatively, stimulates them to analyse situations and applies critical thinking in solving real-world problems.

Ina addition, robots can be involved in teaching and learning social skills [51]. Indeed, robotics activities are usually organised in a collaborative manner, with a small number of students working together to achieve the proposed objectives [52]. Hence, teamwork and cooperation are an integral part of any robotics project: students learn to express their ideas and listen to those of their peers; all can offer arguments and reach conclusions jointly. Students focus on resolving problems for achieving the goals of their projects and learn from their errors on the way.

3.2.3. Game design and coding

Since Papert first introduced the Logo programming language and the 'Logo turtle', coding and developing computational thinking skills have become more and more important in today's world and particularly in education [53]. Mass acceptance is enabled by the availability of programming tools which are appropriate for younger learners. Indeed, several visual programming languages using puzzle-like blocks appeared in recent years, such as Scratch[13], Kodu[14] and Alice.[15] Students focus on learning programming concepts and practise a variety of skills [54], instead of solving syntax problems. Those programming environments, when appropriately integrated in teaching practices, promote exploration, risk-taking and autonomous learning, as well as increase students' motivation [55] and spark students' imagination [56].

3.3. Digital creative pedagogies (DCP)

Based on the literature presented in the previous sections, it is possible to establish a series of characteristic components of DCP, that is, teaching practices which contribute to the development of students' creativity. We organised them into four dimensions:

[7] https://education.lego.com/en-us/support/wedo
[8] https://education.lego.com/en-us/support/mindstorms-ev3
[9] http://www.makeblock.com/mbot
[10] https://www.bee-bot.us/bee-bot.html
[11] http://ozobot.com/
[12] https://www.makewonder.com/dash
[13] https://scratch.mit.edu/
[14] https://www.kodugamelab.com/
[15] https://www.alice.org/

http://dx.doi.org/10.5772/intechopen.80695

DCP dimensions	Components
Learning environment	Flexible use of space and time
	Use of the outdoor environment
	Space for exploration and discovery
	Safe and non-judgemental climate
	Connect knowledge to students' life and interests
	Place knowledge in a wider context
Teaching strategies	Inquiry-/project-/problem-based learning
	Collaborative and improvisational practices
	Game-based learning approaches
	Multimodal teaching approaches
Teacher-student interactions	Non-prescriptive planning
	Participation of educators as learners
	Agency-oriented ethos
	Value learning processes above outcomes
	Tolerance of ambiguity and uncertainty
	Promotion of risk-taking and use of failure as a positive learning factor
	Mutual respect, dialogue and negotiation
Digital tools	Manipulative technologies
	Educational robotics
	Game design and coding

Table 1. The components of digital creative pedagogies (DCP).

- *Learning environments* refer to both the physical and organisational aspects of creativity at stage. Among other components, creative learning environments promote exploration and discovery and present few constraints in terms of space and time, as well as provide a safe and non-judgemental climate.
- *Teaching strategies* refer to the approaches and methodologies used by the teacher to reach specific pedagogical objectives. For example, problem-based learning, project-based learning and inquiry-based learning allow for exploring scientific phenomena by fostering students' curiosity. Usually, inquiry processes apply a cycle of learning actions, which do not necessarily occur in a linear sequence, that is, asking questions, proposing hypotheses, investigating those hypotheses, generating new knowledge, discussing results, presenting evidences and reflecting on emerging solutions. This open-ended process engages students in creative problem-solving and evidence-based reasoning. Students learn how to formulate problems into key questions so to get the best possible answers and propose creative solutions.

- *Teacher-student interactions* constitute an essential factor to provide rich learning processes. Indeed, learning occurs in social contexts, and creativity emerges with respectful exchanges which promote risk-taking, tolerate uncertainty, see failure as positive and promote students' autonomy.
- *Digital tools* are instruments which mediate the learning process; they aim to facilitate learners' expression, as well as to extend their possibilities and abilities while carrying a task. Digital tools also enhance manipulation, experimentation or risk-taking, which are key aspects of creativity. As argued earlier, manipulative technologies, educational robotics tools and game design/coding environments are particularly suitable to support digital creative practices.

Table 1 summarises the characteristic components of DCP and their corresponding dimensions.

4. Conclusions

This chapter aimed to embed educational creativity in today's digital society. Based on the seminal theories of creativity and creative education, we proposed an innovative framework for applying creative teaching practices mediated by digital technologies: in the light of constructivist and constructionist approaches, we suggested a series of digital tools which are particularly suitable to the emergence of creativity, i.e. manipulative technologies, educational robotics and game design and coding. Furthermore, we shaped the concept of digital creative pedagogies (DCP) and established a set of characteristic components of teaching practices which contribute to the development of students' creativity. We make the assumption that the application of this framework allows for engaging students in new, personally meaningful processes and in the creation of original outcomes, as well as for enhancing learning in any curricular subject.

The proposed framework highlights four different dimensions of DCP, namely, learning environment, teaching strategies, teacher-student interactions and digital tools. Each of these dimensions is equally important for ensuring the emergence of creative learning processes. Indeed, the use of adequate teaching strategies would allow for fully exploiting the affordances of the selected digital tools. Furthermore, a safe and flexible learning environment, paired with supportive interactions between teachers and learners (and among learners themselves), would create the necessary conditions and balance so that the learning activity takes on its full meaning.

The chapter contributes to linking two key educational research trends: one on creativity and the other on digital technologies. It provides educational practitioners and researchers with concrete strategies and tools for shaping and applying creativity in the digital classroom.

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Related Trends

Chapter 9

Social and Ethical Dilemmas in Working with School Counselors in Secondary Schools for Students with Learning Disabilities

Saied Bishara

Additional information is available at the end of the chapter

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Abstract

We examined the differences in the way school counselors handle social and moral dilemmas in secondary schools for children with learning disabilities. This study compared educational counselors with open approaches to counselors with more conservative approaches to social and moral dilemmas. The study raised two questions. (1) How do school counselors with more open pedagogical approaches handle social and moral dilemmas? (2) How do school counselors with more conservative pedagogical approaches handle social and moral dilemmas? The participants were 15 school counselors in secondary schools who worked with students with learning disabilities. We asked the counselors to describe a dilemma that they had experienced in the course of their work. The findings show that we can divide school counselors into two groups based on the way they handle dilemmas: a more open group and a more conservative group. The results of our study will enable us to improve the training programs for school counselors and provide more effective treatment approaches to solve social and moral dilemmas school counselors encounter.

Keywords: social dilemmas, ethical dilemmas, moral dilemmas, learning disabilities, open approach, school counselor

1. Introduction

In the educational reform introduced in 1968, junior high schools (7th through 9th grades) were established, and senior high schools were to include only 10th to 12th grades. Senior high schools, in contrast to elementary and junior high schools, include specialized learning tracks. High school students select a few areas of interest on which to focus their studies.

The goal of secondary school education is to develop the personality and creativity of students, offer them opportunities to develop diverse abilities, help them achieve their fullest potential as human beings, expose them to a variety of fields of knowledge, and provide them with the basic skills they will need as adults in a free society [1].

The major goal of this study is to examine the way school counselors handle social and moral dilemmas in secondary schools with students with learning disabilities. To date, no research has focused on counselors who work with students with learning disabilities, and therefore, this study makes a unique contribution to the literature. This study compares counselors who use a more open pedagogical approach to those who use a more conservative approach in solving social and moral problems.

Studying the differences among school counselors in their approach to solving such dilemmas will improve our understanding of their work and enable us to develop more effective counseling strategies in educational contexts. Furthermore, this research will help us identify the focus of problems school counselors encounter [2].

2. Social and moral dilemmas in secondary schools

Social and moral dilemmas have practical implications. When faced with social and moral dilemmas, we have to decide the best way to solve them, and the options available to us may be mutually exclusive. For example, a dilemma may be connected to values, beliefs, ethics, and behavior such as generosity, integrity honesty, the holiness of life, or obeying the law. The solution to dilemmas such as these is influenced by social and ethical values, and no single clear-cut approach exists. Human beings decide the importance of these values for themselves. To implement values they believe to be important, people must be willing to relinquish other important principles which they value less [3].

We can divide these dilemmas into two subcategories: dilemmas that occur when the interests of an individual clash with those related to the interests of the community and dilemmas in which the general interests clash with the general interests in which the individual must join one of two sides. These dilemmas arise in everyday life. We are aware of some of them and devote time to thinking about them, whereas there are other dilemmas which we are less aware of and unaware of the extent to which they affect us [4, 5].

Oser and Althof [6] claimed that when professional dilemmas occur in educational contexts, teachers respond as professionals, not as individuals, who might create a disequilibrium in their approach to moral dilemmas: concerned or caring behavior and honest behavior with a fair solution. The professional process of decision-making by the teacher is related to finding a balance between those directly involved in the dilemma without favoring one side or another, especially in the framework of schools with diverse cultural populations. Oser & Althof preferred a practical discussion as an approach to handling social and moral dilemmas over an ethical dialog.

Oser and Althof [6] defined five different models of decision-making in interpersonal conflicts. These models represent the structure of teachers' decision-making. The focus is on

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the process and the implementation. These are the models: **Model 1**, **avoidance**, the teacher avoids making a decision or taking responsibility for solving the problem; **Model 2, delegation**, the teacher transfers responsibility to an appropriate authority in the school, the principal, counselor, a colleague, etc. **Model 3**, **unilateral decision-making**, in this case, teachers make unilateral decisions based on their skills and professional experience and avoid negotiations with those directly involved. **Model 4, incomplete discourse**, in this case, teachers discuss the dilemma with the participants but make the final moral decision alone. **Model 5, complete discourse**, teachers facilitate the discussion with individuals involved in the conflict, and together they assume responsibility for the final decision and for its implementation. Maslovaty [7] expanded the model and developed two additional models: (1) **transfer of authority to the parents and the students** and (2) **private discussion dialog**—(2.1) **unilateral dialog**, (2.2) **incomplete dialog**, and (2.3) **complete dialog**.

One of Maslovaty's studies [8] touches on ways teachers in school cope with finding solutions to social and moral dilemmas. The research points out that teachers must first understand the problem and break it down into its components and only afterward suggest ways of thinking based on their professional experience.

Social dilemmas are characterized by an open and democratic approach, the characteristics of which are the preparation of appropriate treatment programs adapted to the students' unique needs. This approach emphasizes the student's abilities and enables appropriate and creative solutions. Supporters of the democratic approach believe in the ability of the students and enable them to find fair and creative solutions. However, moral dilemmas are characterized by a more conservative and closed approach and more routine solutions, which do not utilize innovative strategies. Those who use this approach favor the school and the system over the needs of the students [8, 9].

3. Various approaches of educators: conservatism versus openness

John Dewey (1052–059), an educational philosopher and thinker, was one of the individuals who strongly favored the open approach. He placed the learner at the center of the educational process, supporting learner-centered activities and an integrative curriculum [2]. Fereira [10] looked for open approaches and opposed conservative education, which he labeled "banking education," characterized by traditional roles in which the teacher teaches and the students learn, the teachers are in control and the students must obey, and the teacher determines the content of the lessons and the students accept it as a given. Fereira [10] attacked the present structure of schools in which the emphasis is on the achievement of the students and not on developing personalities. He claims that conservative schools as they exist today are becoming obsolete. In the future, learning will focus on independent activities of the student and greater individualization of learning [2].

Traditional, conservative education places the teacher at the center, and the students have to adapt themselves to the goals and values of society. These values are transferred from one generation to another by the principles of the tradition which symbolize continuity [11, 12].

4. The role of school counselors in treating students with learning disabilities

Students with learning disabilities have a neurodevelopmental disturbance with a biological base and cognitive implications. The biological background is evident in the interaction of genetic environmental factors that affect the ability of the brain to function effectively in cognitive activities such as perception and processing verbal and nonverbal information. These problems are long-term and impair learning in areas such as reading, reading comprehension, writing, spelling, and mathematics [13].

Four criteria are required to arrive at a diagnosis of specific learning disorder: (1) **Criterion A**—difficulty learning and using learning skills in at least one of the following areas: inaccuracy or slow pace in reading words, poor reading comprehension, poor spelling, poor written expression or difficulty in numerical concepts, and lack of numerical understanding which has persisted for at least 6 months, despite intervention and assistance. (2) **Criterion B**—The area of difficulty is below what is expected for the chronological age of the learner and causes disturbance in learning. (3) **Criterion C**—Difficulties begin in the early years of school, but it is possible that the full extent of the problems arises only when the academic demands became greater later on. (4) **Criteria D**—None of the following factors fully explains the learning difficulties: Intellectual impairment, overall late development, visual or hearing impairment, mental or neurological impairment, psychiatric distress, lack of language proficiency in the language used for studying, and poor instruction [13].

The effect of the learning disabilities on the life of the student is not limited to the school environment. It permeates every area of life, but it is within the framework of the institutions of formal learning that the learner experiences the greatest difficulties. The areas that present the greatest problems in school are reading, writing, spelling, and mathematics [14].

The mission of the school counselor working with students with learning disabilities is to enhance the educational experience of both the individual and the school by creating a cultural environment, respectful of the rights of the students [1]. The work of the school counselor can be summarized in the following ways:

1. **Work with the administration:** The counselor is a partner with the administration in the school in decision-making and locating and identifying the population in need of assistance.
2. **Work with the staff:** The school counselor provides assistance to staff both to individuals and groups training and developing the educational and therapeutic (teachers, assistants, volunteers) in the best approach and in development and prevention.
3. **Placement, absorption, and transfers:** The school counselor makes referrals, diagnoses, and placements so that the educational and therapeutic environment is appropriate for the personality of each student.
4. **Developmental programs from preschool to age 21—life skills:** The school counselor promotes implementation of developmental programs in keeping with the particular needs of each school.

5. **Intervention in times of pressure and crisis:** School counselors work to strengthen the resilience of the educational staff of the students to guarantee that they will function professionally during crises and prolonged pressure.
6. **Work with parents:** The school counselor promotes a school atmosphere in which the parent is an educational and central partner in the student's educational process and creates a climate of dialog with the parents.

In high schools, in addition to the roles already discussed, the guidance counselor is responsible for determining if the skills and ability of the students are consistent with their interests in learning specific subjects and their desire to learn in a specific type of program or to learn a vocation. The counselor has to help students make the best choices in choosing which subjects to learn and what type of program is suitable based on their ability.

Additionally, the school counselor must follow the progress of each and every student and offer advice regarding changes in subjects, levels, or course of study [15].

When an ethical dilemma arises in the work of a counselor, they must use their professional judgment to make decisions. This process is complex and sometimes does not lend itself to unequivocal solutions. Our study arose out of an interest in understanding the factors involved in the decision-making process of school counselors. We wanted to learn more about the ways school counselors cope with moral and social dilemmas and how they attempt to find a balance between the needs of the school establishment and the sometimes conflicting demands of the students and parents. We emphasized the types of dilemmas counselors regularly encounter, especially in secondary schools where these dilemmas are most likely to arise.

Simchi [16] claims that the perspective of guidance counselors is based on their personal outlook and that the approach they take is not connected to the actual event but is dependent more on the their personal beliefs, past experience, and training.

Shakedi [17] adds that the nature of the dilemma determines the way the counselors work forces the counselor to work according to particular ethical principles and to disregard other principles, which may be no less important.

In order for the school to perform all of its tasks, guidance counselors must be able to fulfill their roles and to handle the problems that arise in the schools with sensitivity. Our goal is to evaluate the way school counselors cope with social and moral dilemmas they encounter during the course of their work and the way they solve these dilemmas in schools with students with learning disabilities [18, 19].

The research compares counselors who use an open approach to those who use a conservative approach in solving social and moral dilemmas.

5. Research questions

1. How do school counselors with an open pedagogical approach cope with social and moral dilemmas?
2. How do school counselors with a conservative pedagogical approach cope with social and moral dilemmas?

6. Research sample

The sample study included 15 guidance counselors, most of whom were women (66%). All of the counselors worked in secondary schools with students with learning disabilities in the center of the country. The selection of the schools and counselors was random. They were chosen on the basis of their willingness to participate in the study. Twelve (80%) of the counselors had a BA degree, and the rest (20%) had an MA. All of the counselors had teaching certificates. Their experience ranged from 1 to 30 years (M = 11.50) (SD = 7.49).

Six of the counselors (40%) were also teachers, and the rest (60%) were coordinators or had another role in addition to their role as counselors in the school.

7. Research tools

We asked the participants to describe one major dilemma that had actually occurred during their work as counselors. Each of the 15 participants described a social or moral dilemma. We asked them what type of dilemmas they frequently coped with during the course of their work. Each of them selected one particular dilemma. We were particularly interested in their approach to solving the dilemma and the factors they took into consideration in solving it.

We categorized the strategies used in solving the dilemma into two groups. The more open, democratic group, for example, presented the dilemma for discussion to the class, listened to the student responses, asked them what they considered to be the best way to approach the problem, and considered their responses in implementing solutions. More conservative strategies simply told the students how they should behave, solving the problem for them.

8. Methodology

The research was conducted in secondary schools in the center of the country for students with learning disabilities. The schools all contained a heterogeneous population from a socio-economic perspective—the parents were middle class and above. The investigator went to each of the schools and met with the principals and the counselors, and they all signed consent forms and answered the questions on the written form.

9. Analysis of the data

This is a qualitative study designed to examine how school counselors cope with social and moral dilemmas. The findings were analyzed in accordance with the research questions with an emphasis on the nature of the specific issues that arise in coping with moral or social dilemmas [17].

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After gathering the data by way of the questionnaires, we identified phrases that were repeated and assigned them a primary category/code. Afterward, we broke them down into categories that were closer to the research questions. The ideas were grouped according to content categories. We reread the replies and checked the connections between them. We attempted to find content not related to the research, and these replies were eliminated. After the final collection of data, we were able to see if the information we had answered our research questions.

10. Findings

Below are descriptions of a variety of dilemmas and the way we categorized them based on the pedagogical approach used by the counselors: an open, democratic approach versus a conservative, traditional approach. The characteristics of the open, democratic approach for social and moral dilemmas are consistent with the fifth model—the complete discourse—according to Oser and Althof [6], and the features of the traditional, conservative approach to social and moral dilemmas are consistent with models one through four according to Oser and Althof's theory [6].

10.1. The open democratic approach to coping with moral dilemmas

Dilemma 1—The first dilemma focused on a boy, considered to be the class clown, who frequently disturbed the lessons. The school, through the counselor, avoided involving the parents because they found it so difficult to cope with their son that they used excessive punishment, which harmed his development and personality. The dilemma was whether the school counselor could cope with the problem alone or should involve the parents.

The school counselor said, "I am familiar with this case, the parents are not willing to hear that their son disturbs the class in school, and every time we turn to them they punish him severely, which is very disturbing to his personality and mental development, which makes it difficult for me to ever approach them."

Notwithstanding, the school counselor and the school tried to manage the student alone despite the difficulties. A program was developed for him with careful follow-up, for every time he acted out of place or was involved in vandalism, the seriousness of his actions was made clear to him.

Dilemma 2—The second dilemma concerned the violent behavior of a student who claimed to have experienced a tragic event. The student behaved in an offensive way and in opposition to all of the rules of the school. He fabricated stories and was aggressive toward teachers. The dilemma was whether to punish him based on the seriousness of his actions or to try to understand what was behind his behavior.

According to the counselor, "He shouted out and almost attacked me. I gave in and returned to class."

In this episode, the school counselor, in consultation with the teacher, decided to find out what was behind the student's behavior. They met with the parents and discovered that the

student often lied, and they apologized for their son's behavior. The school counselor decided to stay in close touch with the student, to continue to encourage him, and to give him a chance to start again.

Dilemma 3—The third dilemma was about a student who asked to be excused from participating in a school project due to serious economic problems. The project required the use of a personal computer after school to answer questions. The dilemma was whether to excuse him from participating in the project or to try alternative ways for him to participate for the sake of the educational experience.

According to the school counselor, "It seems that the student does not have a computer and the socio-economic position of the family is very poor. I asked him to meet with me and he explained the financial difficulties and his willingness for me to find a solution."

Through the treatment, the counselor involved another student who had a computer to work with him on the project. The counselor solved the problem with the involvement and agreement of both students, and as a result, the student with the financial problem was able to participate in the project that was a very important part of the classwork.

Dilemma 4—The fourth dilemma was about a student who behaved offensively to the school counselor, who was also his teacher, when she returned exams. The dilemma was how to respond to the student's offensive behavior. Should he be punished or should the teacher help him understand that his behavior was undesirable?

The school counselor said, "One of the students got up and shouted, 'The teacher made an arithmetical error on my grade and I deserve full credit.'"

The student saw that the school counselor made a mistake in the calculation. In response, she tried to convince the student that his behavior is undesirable. The student accepted the comment of the counselor and understood that his behavior was out of place.

Dilemma 5—The fifth dilemma is about a student who behaved aggressively toward the proctor (who is also the school counselor) during an exam. The dilemma is how to behave with the student—to punish her or to try to explain the seriousness of her unacceptable behavior and tell her the way she should behave.

The school counselor said, "When I approach one of my students, she shouted out in rage for no reason. I tried to quiet her down in a nice way, but unfortunately, I did not succeed in understanding or figuring out her behavior."

Dilemma 6—The sixth dilemma was about a student with learning disabilities who was asked by the teacher (who is also the school counselor) to buy a gift for a classmate who had broken his leg and was absent for an extended period. The student was supposed to use all of the money that had been collected from the rest of the class to buy the gift, but in fact she purchased a gift with only part of the money and kept the rest of the money for herself. The dilemma was whether to tell the student directly what she has done, which may be emotionally damaging to her, or to make her indirectly aware of the severity of her actions.

The school counselor said, "I was aware that the gift that was purchased by a good friend of the girls, and that she had taken some of the money, and that not all of the money she received from the class was spent on the gift that was purchased."

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The school counselor decided not to directly insult the girl but to help her understand the message by presenting parallel cases that had arisen in class. The counselor delivered the educational message to the girl in a way that was not harmful and not in front of the class, but helped her understand the seriousness of what she had done.

Dilemma 11—The 11th dilemma was about a popular (female) student, whom all the girls liked very much, but considered herself to be superior to the other girls and was not willing to be their friend. The dilemma was whether to involve the popular girl and to speak to her about her improper behavior or to allow time to prove to her that her behavior is not acceptable.

The school counselor said, "Donna rejects her because if she becomes her friend, she will not be as popular. Tali complains that Donna keeps her distance from her and is unwilling to be her friend."

This situation was brought to the attention of the school counselor, and it was decided not to intervene. He believed that as time passes, the popular girl would understand the value of the other girls in the class and the importance of maintaining good relations with them all. The school counselor presented a number of stories to the class on the topic of accepting others to illustrate models of desirable behavior that were especially important for this one particular girl.

Dilemma 14—The 14th dilemma is about someone who is a teacher as well as a counselor and whether to show support and to identify and participate with a strike that the Parents Committee and other community organizations called, which would help their demands gain acceptance by the authorities. Alternatively, the counselor could take the side of the authorities and not identify with the strike in any way.

The counselor said, "The strike also has a negative side. Students in special education in secondary school would miss a lot of material, and if the strike persists, would make it impossible for them to learn what is required. On the other hand, it is important to join the parents and the community groups so that they will succeed in their struggle".

In this case, the counselor decided to participate in the strike, to strengthen the groups supporting it, and to disregard orders not to strike.

10.2. Traditional, conservative approaches to solving moral dilemmas

Dilemma 7—The seventh dilemma was about a students who made fun of a classmate who mispronounced words when he spoke.

The counselor said, "The dilemma was whether to punish the student for upsetting his classmate or to ignore the episode."

In this case, the school counselor decided to punish the offending student and to speak to him about the mistake he made in hurting the other student's feelings. Although the school counselor did not discuss the episode in class, he explained the mistake to the student and punished him appropriately for his actions.

Dilemma 8—The eighth dilemma was about a girl who cheated on an exam. The proctor (who is also the school counselor) saw that the student was using extraneous material during the exam. The dilemma was whether to approach the student during the exam and tell her that she was cheating or to discuss it with her privately after the exam.

The counselor said, "During the exam, I saw the girl using additional pages while she was writing […] and only after I was certain that she was cheating did I approach her and ask her to give me the pages."

The proctor, who was the school counselor, involved the exam coordinator who, on the proctor's word, rejected the exam.

Dilemma 9—The ninth dilemma was about a student who had saved a sum of money to participate in a class trip. Before the trip, the student's father needed the money and requested it from him. As a result, the student could not participate in the trip. The dilemma was whether to cancel his participation because his father had taken the money that he had paid or to try to find alternative sources of funding so that the student could come on the trip.

The school counselor said, "The student's father needed the money suddenly and that is why he asked his son to give him all of the money he had saved and not to go on the trip."

The school counselor said that the student should take the money that he had already paid for the trip back, give it to his father, and not participate in the trip. In this case, the seriousness of the harm that this caused the student (who had learning disabilities) was not taken into consideration. The school counselor did not attempt to find an alternative solution or to allow the student to come on the trip and to remain integrated in the class.

Dilemma 10—The tenth dilemma was about a group of students who decided to surprise the teacher and make him a party for his birthday. The students had not consulted the teacher about the preparations for the party. The dilemma was whether or not to continue with the plans for the party respecting what the class had organized or to stop the party plans because the teacher was strongly opposed.

The school counselor said, "The response of the teacher was very strong claiming that the plans were made without his knowledge, and was in conflict with the everyday work that should be carried out in a high school […]. The teacher expressed serious concern and asked that the party be canceled."

The response of the teacher was very strong and showed that he was unwilling to digress from the format of the curriculum. The teacher asked the students to cancel the party, but the counselor supported a more modest event.

Dilemma 12— The 12th dilemma was about two girlfriends, when one of them is very dependent on the other so much so that the stronger one exploits her and asks her for personal favors. The dilemma was whether to intervene to stop the exploitation or to ignore the situation and hope that the girl would find a way to end the dependence on her friend.

The counselor said, "One is following the other, when the second exploits her for personal purposes."

In this case, the school counselor intervened. He met with one of the girls privately and afterward met with them together. He explained more desirable ways of behaving toward friends and threatened both of them with severe punishment if the situation did not change.

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Dilemma 13—The 13th dilemma is about a social event held in the home of one of the students. The event was considered problematic because a few of the students who regularly misbehave were likely to destroy property in the home of the hosts. The dilemma was whether the counselor should intervene and prevent the event from taking place out of concern that the problematic students would destroy the home of the host or to leave it up to the host to handle the behavior of the students.

The teacher (who is also the school counselor) said, "In this class there are a number of students who are considered to be trouble makers and who are likely to destroy personal belongings in the home of the hosts."

Here the counselor decided to intervene and to forbid the students from having the event and did not allow the student to host the event. He spoke to them directly and gave them strict instructions forbidding the event from taking place.

Dilemma 15—The 15th dilemma is about a girl who took a history matriculation exam. Her father is a history teacher in the school. During the exam, the father walked into the class and gave her the answers to the questions. The dilemma was whether the school counselor should report this event to his supervisors and jeopardize the man's future and his income or to act as if nothing unusual had happened, allowing such immoral behavior to repeat itself in the future and making it impossible to guarantee that exams would be given fairly and honestly.

The school counselor said, "The history teacher entered the classroom and handed her the questions so she could copy the answers on her own exam sheet."

In this case, the school counselor decided not to report the episode, taking a traditional approach, protecting his own personal interests above the interests of the community.

11. Discussion and conclusions

The main goal of the research was to examine the ways school counselors coped with social and moral dilemmas in secondary schools for students with learning disabilities.

In this study, we asked 15 school counselors to describe the dilemmas they encountered in their work and tell us how they handled them.

From an analysis of the dilemmas that we examined, we observed two different approaches: one expressed a more open, democratic approach to solving dilemmas and the other a more closed conservative approach.

Handling dilemmas in the more open, democratic way was characterized by an individualized, therapeutic approach to meet the needs of the students with close follow-up by the school counselor. This approach included many creative solutions to problems they encountered. The counselors emphasized the internalization by the students of their unacceptable behavior, met with the students, and raised the dilemmas for discussion in class by presenting parallel examples [7].

The characteristics of the open approach are consistent with the fifth model—the complete discourse—according to Oser and Althof [6]. According to this model, the teacher facilitates a discussion among those involved and allows them to be involved in the decision-making process and in the implementation of the decision [7, 20, 21].

In contrast, the more traditional, conservative approach to solving dilemmas is through punishment related to the severity of the act by the school counselor or other authorities in the school. This is without giving a chance to the students to internalize the severity of the acts or to improve their behavior. Handling dilemmas in this way is based on traditional principles, which focus on the rules without taking into consideration the needs of the students.

These characteristics of the traditional, conservative approach to solving social and moral dilemmas are consistent with Models 1–4 of Oser and Althof's theory [6] which include avoidance, transfer of authority, one-sided decision-making, and incomplete dialog.

According to the typology used in this research, we examined the way school counselors handled social and moral dilemmas in two conflicting ways: the open democratic approach and the conservative, traditional approach. There are other pedagogical approaches discussed in the professional literature. We will focus on three of them: (a) the behaviorist approach, (b) the constructivist approach, and (c) the cognitive approach [22].

According to the behaviorist approach, the educational process is based on observable behavior that takes place through stimulus and response. The emphasis is on strengthening the desired response that improves the chances that the response will repeat itself when the appropriate stimulus appears [22].

Coping with social and moral dilemmas using a behaviorist approach includes practicing and repetition, creating a gradual sequence and immediate feedback. This way of handling dilemmas emphasizes adopting routine, automatic skills where the role of the school counselor focuses on training, transfer of information, and providing feedback [23].

In the process of coping with these dilemmas, no attempt is made to provide a given structure of knowledge to the students or to determine which mental processes are necessary for them. Students are characterized as respondents to environmental conditions and do not play an active role in creating the environment. The main factor is the organization of stimuli and results within the environment.

This description is consistent with the following dilemmas: in an episode in which the student ridiculed another student who mispronounced words or the student who was caught cheating on an exam. In these episodes, the school counselor responded with punishment without conducting any prior discussion. The school counselor did not give the students a chance to understand their mistake, which could result in the repetition of the mistake. Instead, the counselor used punishment following the inappropriate actions of the students [24].

According to the constructivist approach, the educational process is an active process in which the students' contributions are not less important than those of the teacher. The learning takes place in an active way, by building knowledge and responsibility of the learner for the knowledge. The ability of students in learning develops along with their cognitive

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development, and each stage is based on the previous stage through interaction with the environment in an active process [19].

According to the constructivist approach, knowledge is a function of the way students create reality through their experiences. Students sift through knowledge of the world to create a unique reality of their own. Experimenting directly with the environment is of utmost importance in building knowledge. Students construct knowledge; they do not acquire it. There is no single predetermined "correct" reality. The student does not transfer knowledge of the world from the outside to his mind, but constructs his own personal interpretation of the world based on personal experiences and interaction with the environment. Accordingly, the internal representation of knowledge is not static. There is no objective reality that the student must know [19].

In order to understand learning, genuine experiences must be examined. Factors related to the student and to the environment are important, and the interaction between them creates knowledge. Behavior is determined by the situation, and every act is perceived as an interpretation of the present situation based on a complete history of prior interactions. It is important for learning to take place in real situations and that they are relevant to the life of the student.

Ways of coping with social and moral dilemmas based on the constructivist approach include active, gradual, focused building from a social perspective with the idea that knowledge is not isolated from the individual. The focus is on creating cognitive tools that reflect the cultural contexts, the insights, and the experiences of the students. There is no need to acquire concepts or set details or abstract ideas. The counselor must use active practices, concepts (knowledge), and culture (context). Authentic tasks, based on real contexts, must be used [19].

The school counselor should identify incorrect, biased, or primary concepts that were acquired at an earlier stage and discuss these concepts when they arise. They should facilitate the examination of their environment and help them understand complex ideas that will enable them to think like experts. This type of knowledge is not abstract. It is directly related to the experiences of the students. The students should be encouraged to construct knowledge and to validate it through social discussions [15, 25].

This type of discussion is desirable for solving some of the dilemmas mentioned, such as the student who acted out as a class clown and constantly disturbed the class during lessons or the student who behaved aggressively in school. In both of these cases, the school counselor conducted discussions with the students and involved the teachers and the parents, in order for the students to internalize their mistakes, and the learning is constructed with a way that will be remembered. She solved problems in both cases by placing the emphasis on the problem and raising the seriousness of the issue to the students. Using the cognitive educational approach is based on complex mental cognitive processes, such as thinking, problem solving, language, creating concepts, and processing information. The emphasis is on acquiring knowledge as a mental process, which includes internal coding. The student is an active partner in the educational process.

Ways of handling social and moral dilemmas based on the cognitive approach include explaining, illustrating, practicing, and providing feedback. The emphasis is on mental activities of the learner who brings responses and mental planning, establishing goals and

organizing effective strategies of processing information. It is important to pay attention to the ways the learner codes, processes, practices, stores, and retrieves information. The focus is on the thoughts of the students, their beliefs, their perspectives, and their values as influential participants in the educational process. The goal is to change behavior by practicing appropriate strategies. The students' understanding is based on information such as laws, concepts, and distinctions. Because of the emphasis on mental constructs, the cognitive approach is suitable for explaining complex types of learning (thinking, problem solving, knowledge processing) [26].

According to the cognitive approach, the school counselor focuses on the pre-disposition of the student (how the student activates, preserves, and directs the learning process), will plan learning to include internalization based on the focus of mental structures of the learner, and will attempt to transform information to relevant knowledge for the student. The school counselor will help students organize new knowledge and relate it to existing knowledge already in their memory. The counselor will base mental structures or reviews and organize the information in such a way that the students will be able to relate the new information to existing information in a way that will make it personally relevant. According to the cognitive approach, the student will bring many learning experiences to an educational situation that can influence the results. The educational process determines the most effective way to organize new knowledge so that it interacts with previously acquired knowledge of the students, their abilities, and their experiences, and it will be absorbed in the cognitive structure of the learner (Lemmens et al., 2016).

These theories are consistent with some of the dilemmas presented in this research, such as the student who was unable to participate in a project because of serious financial problems or the student who used some of the money collected in class for a gift for a student who broke his leg. In both of these cases, the counselor used creative thinking based on creative mental processes, without upsetting the students in front of their peers [27].

The typology used in this research to distinguish between two conflicting pedagogical approaches (open, democratic approach versus a traditional conservative approach) presents the broadest ways of conceptualization in dealing with developments and changes in the field of education and includes three pedagogical approaches described above (behaviorist, constructivist, and cognitive). It is important to present these three approaches on a continuum—behaviorist, cognitive, and constructivist—when the focus changes along the continuum from passive transfer of facts and routine to active processing of ideas and problem solving. The principles of the constructivist approach and the cognitive approach are consistent with the open, democratic approach, and the principles of the behaviorist approach are consistent with the traditional, conservative approach [8, 28, 29].

The question is asked as to which of the pedagogical approaches to handling social and moral dilemmas are more effective. The educational process is dynamic and is influenced by many factors. It is a process of continuous change. One pedagogical approach is likely to be more effective for a new learner who encounters a complex body of knowledge for the first time, but not effective or more challenging for a learner who knows the content already. Furthermore, teaching facts is different from acquiring concepts or solving problems.

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12. Limitations of the current research and suggestions for future studies

This study used qualitative methods of research. The conclusions, therefore, are dependent on and based on subjective interpretation, which is the essence of this qualitative approach. Inclusion, validity, and reliability that serve as indicators of research quality are significant in qualitative research only in relation to the researcher's stated perspective [17].

In the present study, participants chose to reveal experiences and particular positions, and it is possible that there are other perspectives. Additionally, the researchers chose to focus on a particular type of analysis, and there may very well be other perspectives.

Future studies should use a quantitative approach to look at similar problems and should expand the population studied to confirm the link between methods of handling social and moral dilemmas with personal and professional characteristics of school counselors.

13. Recommendations and pedagogical implications

Based on the knowledge that we have, we can develop intervention programs that lead to the development of more effective ways of handling these dilemmas. We will be able to improve the training of school counselors and to expose them to a range of social and moral dilemmas that they are likely to experience in their professional life in schools. In the framework of their training, participants will be able to reconsider their earlier opinions through exposure to newer approaches and to develop new ideas for solving complex problems.

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Chapter 10

Women Entrepreneurs as Employers

Emete Toros and Mehmet Altinay

Additional information is available at the end of the chapter

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Abstract

This study is the first empirical research that focuses only on successful female entrepreneurs in North Cyprus to identify their motivational factors, personality traits and challenges shown and faced by them. To accomplish this objective, an in-depth analysis of 10 female entrepreneurs employing at least 5 staff is used. Results indicate that pull factors are the key motivational drives of successful female entrepreneurs. Self-determination and an achievement-oriented mind set together with honesty and reliability in business life are found to be their main personality traits. The level of risk especially due to the Cyprus conflict and difficulties in accessing funding are found to be the key constraints on these successful female entrepreneurs.

Keywords: entrepreneurship, female entrepreneurship, successful women entrepreneurs, pull factors, push factors, personality traits, challenges, North Cyprus

1. Introduction

The dramatic growth and participation of women in entrepreneurship have become an important subject, due to its positive impact on the global economy. This trend has continued to attract the attention of governments, industrialists and academics. However, worldwide, women have lower participation rates in entrepreneurship since they confront more social and cultural limitations than men [1–4]. The recent OECD/EU [5] report on women's entrepreneurship also indicates that women were half as likely as men to be self-employed, even in the European Union. All the research conducted in the field of entrepreneurship indicates that less than 10% of those studied are female entrepreneurs [6]. Moreover, most of these research have been conducted in developed countries [7]. As a developing country, North Cyprus reflects this sad reality. Female entrepreneurship has not been the subject of many studies despite this proliferation of interest and research on female entrepreneurship. However, women have a key role in

active business life, in both the state and private sectors. Despite their strong presence in the workforce, according to a 2016 report by the State Planning Organisation (SPO) of North Cyprus, 1416 (3.3%) of female entrepreneurs have the status of 'employer'. It is important to understand the motivations, personal traits and challenges facing those female entrepreneurs who have proven themselves to be successful business owners. Even though 'success' can be defined by intrinsic criteria like 'freedom', 'independence' and 'controlling one's own future' [8], the term 'success' is used here in terms of economic and financial returns [9] and specifically in the number of employees employed by a business. Female entrepreneurs have been designated the new drivers of growth in economies, and they have started to play key roles in bringing prosperity and improving general welfare [10]. It is important to pay detailed attention to those women who have contributed to the economic and social fabric of their communities by their role in increasing the employment rate and serving as role models for others. A limited number of previous studies have included both the self-employed and employers in their samples, in an effort to understand the factors affecting the performance of female entrepreneurs and their general profile in North Cyprus [11, 12]. This study will be the first to focus on only those female entrepreneurs who employ a minimum of five personnel in their businesses which are considered to be extrinsically successful within the scale of North Cyprus. Therefore, the purpose of this study is to use North Cyprus as a case to contribute to a better understanding of the motivational factors, personality traits and challenges shown and faced by successful female entrepreneurs in North Cyprus. To accomplish this objective, an in-depth analysis of 10 female entrepreneurs, employing at least five staff, is used to gain insights and uncover hidden issues that go beyond the usual clichés used in regard to female entrepreneurs.

1.1. Research context: North Cyprus and female entrepreneurship

North Cyprus, with a population of 313,626 people, is the Turkish speaking part of the island whose government is only recognised by Turkey. In comparison, the Republic of Cyprus is the internationally recognised part of the island, and it became a member of the European Union in 2004. The Republic of Cyprus is classified as a developed country within the parameters of United Nations. According to the OECD/EU [5] report on women's entrepreneurship, Cyprus is one of the countries with the narrowest gender gap in the proportion of men and women who are self-employed. Despite the fact that in North, women and men personnel proportion employed by the government institutions is very close (54 vs. 46%), this figure for women's entrepreneurship is very different: the number of self-employed (including employers) men is almost three times greater than women, where this number is 12,984 for men and only 4,376 for women [13]. As indicated earlier, out of 4,376 of those women who own her own business, only 1412 of them are in the status of employer and moreover this figure reduces further to 498 for those who have five and more employees employed in their businesses and thus considered successful within the framework of this study. On the other hand, recent figures from the Small and Medium Enterprises Development Centre [14] in North Cyprus indicate an increasing intention amongst women of becoming an entrepreneur. This centre was established within the North Cypriot Ministry of Economy in 2016 with the aim of supporting and developing projects for small- and medium-sized businesses. Since that time, they have been funding budding entrepreneurs who satisfy the evaluation criteria set down by the centre and

who successfully complete the training programmes provided by the centre. In 2016, 412 aspiring entrepreneurs applied to the fund, of which 211 (51%) of them were women and 28 (56%) of the 50 successful female candidates were granted funding.

Several studies have focused on female entrepreneurship in North Cyprus. In their research, Jenkins and Katırcıoğlu [12] examined the factors affecting business performance for a selected group. Their findings indicated that many female entrepreneurs in the North had started their own businesses without having prior business activity in their families. The main reasons for establishing their enterprises included taking advantage of a market opportunity that they had spotted and that they liked the idea of establishing their own businesses and that all the subjects had had the encouragement of their husbands in their activities.

Eyüpoğlu and Tülen's [11] study was conducted in order to broaden the understanding of the nature of the female Turkish Cypriot entrepreneur through an investigation of their demographic profiles; business characteristics; the impact of prior experience on their successes; their motivational factors and the measure of their successes. Their findings indicated that entrepreneurship seemed to be a more viable option than paid employment for married women who wanted to balance their careers with their domestic obligations. Similar to Jenkins and Katırcıoğlu's [12] findings, they also found that there was no family effect, since none of the subjects had parents who had been self-employed. They measured their business success through the metrics of sales and/or profits and through the growth and/or expansion of their ventures. Those women with prior business experience identified their greatest motivation as their desire for independence. However, those women who had no prior business experience made their entrepreneurial plans primarily for financial reasons.

1.2. The motivational factors of female entrepreneurs

People may have a variety of motivations for becoming an entrepreneur. In her literature review of the subject, Kirkwood [15] identified four key drivers of entrepreneurial motivation that were a desire for independence; finances; unemployment due to redundancy and/or the lack of job or career prospects and family-related motivations including desire for a more equitable work-family balance and family obligations. The primary theory that is used in explaining the motivations of women in starting their own ventures is the 'push and pull' factors outlined by Brush [16] and by Buttner and Moore [17]. The push factors are characterised by personal or external factors, which are usually associated with negative motivators in encouraging women to start their own businesses [18], such as having an inadequate family income, dissatisfaction with a salaried position, difficulty in finding work and a need for a flexible work schedule due to family responsibilities. The pull factors, on the other hand, are associated with positive reasons for starting a business such as independence, self-fulfilment, entrepreneurial drive and a desire for wealth, social status and power [19].

1.3. The personality traits shown by female entrepreneurs

Opposing arguments exist as to whether there is a relationship between personality and entrepreneurial behaviour. Moreover, the difficulty in making generalisations about the

personality traits of successful entrepreneurs lies in the impact of non-psychological factors including demographics, training and experience, and this has been pointed out in the literature [20, 21]. Brandstätter's [22] study revealed that in order to become and continue as an entrepreneur, one needs to possess some distinctive character attributes such as self-motivation; a moderate risk propensity; an internal locus of control, as well as a personal talent for innovation, pro-activity, a high tolerance for stress and self-efficacy.

1.4. The challenges facing female entrepreneurs

In many of the women entrepreneurship literature, availability of financial resources and government support are indicated as important external environment factors limiting the success of women entrepreneurs ([7, 23, 24]). In a study dedicated to the challenges facing women entering entrepreneurship, Still [25] identified three different classes of barrier that also include availability of financial resources. The first class is composed of the motivational factors that push women to establish their own businesses, including creating the confidence necessary in starting a venture, finding proper sources of help and advice, financial resources, coping with risk and access to networks. The second class of barrier again includes motivational factors, but this time the pull factors include women's lack of access to finance, mentors, knowledge and information. The third barrier class refers to the youth of such entrepreneurs, which elicits discrimination on the basis of age by consumers, insufficient family and peer support, and the lack of proper business advice.

In light of this literature review, the motives, personal characteristics and challenges facing successful female entrepreneurs in North Cyprus are investigated.

2. Methodology

A phenomenological approach allows researchers to get close to participants, penetrate their realities and generate an understanding of the research in question (Bygrave, 1989) [26]. Within this paradigm, an in-depth interview was identified as the most appropriate method to the purpose of the study. The interview guide for the study was designed by a panel of experts, including two entrepreneurship and strategy professors, and one active female entrepreneur. Once piloted, the interviews were conducted face-to-face for a period of about an hour and all tape-recorded and transcribed. The purposive sampling technique was used for this study, since it is a non-random technique that does not need underlying theories or a set number of participants and it enables the researcher to select individuals and groups who are proficient and well-informed within a phenomenon of interest and are willing to assist with the relevant research [27]. As a result, 10 women entrepreneurs who are acknowledged successes and are active members of the Business Association in North Cyprus were selected.

The interviews were semi-structured to enable women entrepreneurs talk about range of topics but also specific questions on three key issues of the study: (1) the motivational factors of the respondents to become entrepreneurs, (2) their personality traits and (3) challenges they

face in their businesses. As recommended by Silverman [28], field notes and inter-coder agreement were used to increase the reliability of the study.

3. Findings

3.1. The demographic profile of the female entrepreneurs

The demographic characteristics of those interviewed are presented in **Table 1**. The mean age of the sample was 46.1, and 80% of the women had a university degree, while the remaining 20% had completed high school. The marital status of the respondents is broken down as 80% married, and 20% divorced. Half of the respondents were active in both the service and productive sectors, while 30% were active only in the service segment and 20% were involved in trading businesses.

Demographics	No	%
Age		
35–39	2	20
40–44	3	30
45–49	1	10
≥50	4	40
Education level		
High school	2	20
University	8	80
Marital status		
Married	8	80
Divorced	2	20
Type of business activity engaged in		
Service oriented	3	30
Trading	2	20
Both service and manufacturing	5	50
Number of employees		
5–10	3	30
11–20	1	10
21–30	2	20
31–40	2	20
≥41	2	20

Table 1. Demographic profile of respondents.

30% of the female entrepreneurs interviewed were in service businesses such as boutique hotels, car rentals and insurance. 20% were in trading businesses covering the importation of fruit and vegetables or textiles. The majority of this group had both production and service functions within their concerns. Some had had operations in both areas since opening their businesses as they were active both in the production and distribution of their goods. Many of them had added a function when expanding their businesses. 30% of the entrepreneurs had the minimum 5 employees necessary for inclusion in this study, and 2 entrepreneurs had staffs of 70 and 125, respectively, and both are involved in large-scale production and service businesses.

3.2. The motivational factors of the female entrepreneurs

As illustrated in **Table 2**, five pull factors were found to motivate the entrepreneurs interviewed. Three factors–money, interest in the work and achievement were the most frequently indicated reasons for starting the business.

> *"I wanted to establish a better future for my children, which motivated me to look for opportunities"*, and *"I wanted to have a better income."*

Such were some of the statements elicited in interview and which indicated strong identifier of money as a motivation for starting enterprises. However, none of the respondents mentioned money as the sole motivation. Some indicated an interest and love of the work, whereas others indicated a striving for achievement, seizing an opportunity, flexibility and a desire to have their own business.

> *"I had a passion for clothing which motivated me to open a small clothing shop."*

> *"I always set goals to help me achieve and be successful."*

> *"We focused on the weaknesses and incompetence of our competitors in the packaging and display sector."*

> *"I worked for 15 years in the private sector, and I realised that I wanted to be my own boss, setting my own goals and schedule."*

Even though having flexible working hours was indicated by few of the respondents, this did not mean that they work less than 8 hours a day. Ironically, despite wanting to set the pace of their own lives, they ended up working even harder. Those who indicated a great passion for their work, pointed out that the key to their success was, "*opening the doors of their businesses every morning and locking them at the end of the day*", and not missing even 1 day of work, even if they were sick.

As illustrated in **Table 3**, we identified two push factors as motivators in starting a business of their own, and more importantly, all the subjects indicated an additional pull factor in their reasoning for opening their ventures.

Pull Factors	Number	%
Money	2	20
Interest in the business	2	20
Independence	1	10
Opportunity	1	10
Achievement	2	20
To have flexible hours	2	20

Note: In most participants more than one motivating factor was indicated by the respondents.

Table 2. Pull motivators.

Push factors	Number	%
Job dissatisfaction	3	30
Family business	3	30

Note: In most participants more than one motivating factor was indicated by the respondents.

Table 3. Push motivators.

Three respondents were in the second generation active in a family business, but who had broken away to separate a particular area of the operation or who had added a new arena to the existing business. These breaks represented independent enterprises and reflected a concrete measure of success and failure of the new business. One of the respondents had had a conflict with her brother and then had left the family patisserie business. After some hard times, she decided to open her own patisserie shop. She described her decision as follows:

"Then I decided that the best business is, what you do best."

Another important push factor indicated was dissatisfaction with her previous job:

"I struggled with the classic civil servant mentality in this country for three months."

"I realised that I didn't want to work as a teacher."

3.3. The personality traits of female entrepreneurs

All the respondents exhibited more than one clear personality trait in their reasoning. The most shared characteristic was a strong orientation towards achievement in their personalities. Responses as follows confirm their determination to achieve better in their businesses:

"You have to put goals and you have to be determined to achieve them. When this is the case, there cannot be any obstacles in front of your success".

"I never say, I am the best and that's it! It's been 21 years and I still have goals to achieve".
"I always set measurable goals to ensure that I achieve them".

"Managing to survive within this competitive environment and keeping the vision to achieve your goals are the main elements of my business success".

"If you set goals and try to achieve them and put further goals instead of thinking you are done, that's how you improve and develop yourself".

The setting of measurable goals was a trait indicated by majority of subjects, and this was generally combined with honesty and reliability both in their personal and business lives.

"One of the most important things my father had taught me in my early ages was honesty".

"My principle in life is to have a good name and to establish trust and being acknowledged as a trustworthy and reliable person in this small community".

"Since at the beginning of my business life, the main principle of my business has been honesty and sincere business ethics. Our high business ethics has given us an edge and put us one step ahead of our competitors".

"My dedication, hard-work and especially my reliability are the most important reasons of my growing business".

Such were some of the statements pointed out in interview and which indicated strong identifier of the importance of trustworthiness in their business successes.

Self-efficacy was another important characteristic in respondents, which was supported by their levels of determination in business. Half of the respondents pointed out the considerable risks they have taken to develop their businesses, especially those who have undertaken significant expansion in the scales of their businesses. Some of the responses were as follows:

"Life itself is a risk. You can never know the end from its beginning. I always take reasonable risks".

"Taking all the necessary risks and challenges to make changes and innovations is what I do to develop my business".

"The key to success is self confidence and capturing the opportunities by confronting risks to a certain extend. Following and adapting the changes and especially using the technology in the best way. Open to the advices of experts of the field is another important personality trait I have".

It is these women who are the ones most willing to take bigger risks. They closely follow innovations in their sectors and strive to keep their competitive positions by taking greater risks in adapting and developing their enterprises (**Table 4**).

Personality traits	Number	%
Achievement oriented (setting goals)	8	80
Honest (reliable)	6	60
Innovativeness (creating differentiation)	4	40
Risk taking	5	50
Self-efficacy (determination)	6	60

Note: In most participants more than one personality traits were indicated by the respondents.

Table 4. Personality traits.

3.4. The challenges facing female entrepreneurs

The most important constraint that respondents indicated was the on-going Cyprus conflict, which has affected their decision-making concerning further investment in particular. The instability in the currency market was another key factor challenging our entrepreneurs as well as lack of proper government planning in some sectors. Two of the respondents' statements regarding to these challenges were as follows:

> *"I have so many things I plan for my work. But we decided to postpone our investments because of the ongoing instability in politics and economy. We import our products in Euros and our current debts are in British pounds. The Turkish Lira keeps depreciating and I sell my products in Turkish Lira. We decided to close our debts before going into further investments".*

> *"I have fears for the tourism sector. The uncertainty of the country and its negative impact on the economy due to international embargos are my main concerns. Another problem is the growing number of competition since government continuously gives permission to the openings of new rental car businesses. As a summary, we don't have a clear picture for the future but we will continue to move forward with caution".*

Despite the fact that two of the respondents had utilised grants provided to entrepreneurs, one from the European Union and the other from the Turkish Embassy, they had also needed to access additional financial sources. Gaining access to those financial sources and hiring competent staff were the other two more challenges these women had faced in their careers.

4. Discussions, conclusion and implications

This study aims to understand the motivational factors, personality traits and the challenges facing female entrepreneurs, employing at least five personnel, and who, within the scale of North Cyprus, can be considered extrinsically successful. The results show that the majority of these successful female entrepreneurs' key motivational drives are pull factors rather than push factors and that even those who prioritised a push factor as their dominant reason for

embarking on their own businesses were also subject to at least one additional pull factor. Increasing personal wealth, their depth of interest in the business sector, fulfilment of their professional passion, and working more flexible hours were the most important pull factors indicated by the respondents, and this is consistent with the literature. Job dissatisfaction and being in the second generation in a family business were the only two push factors demonstrated by the female entrepreneurs we interviewed.

Despite the fact that honesty and reliability in business life are not personality traits that have been indicated in the entrepreneurship literature, in this study, they were the second most vocalised characteristics, together with self-determination, an achievement-oriented mind set and ability to take risks to develop their businesses.

In other results in-line with the literature, the level of risk and difficulties in accessing funding were pointed out as serious constraints on these successful female entrepreneurs. However, the risks taken by these women appear to be beyond those mentioned in much of the entrepreneurship literature. The Cyprus conflict and its negative impact on North Cypriot economy are the main reasons behind many of these risks. Since many of them have a personal tendency to take risks, they appear to have been managing the ambiguity of the markets very well, but this does not change the fact that they have all faced many additional risks in comparison with other trading environments.

Government support is considered to be one of the key elements in empowering the development of entrepreneurship in any nation, especially developing ones [7, 29, 30], and as a developing country with additional individual economic risks, we have identified a need for greater financial support and better credit terms if the authorities wish to encourage the increased involvement of women as entrepreneurs in North Cyprus. Present funding programmes for entrepreneurs provide trainings and consultancy to the successful candidates in the fundamentals of entrepreneurship. These programmes include trainings in team development, marketing, sales, production/service and investment and financial planning. Related associations and institutions can provide more of these training programmes that are not a part of any funding programmes. These trainings will not only help to extend the vision of female entrepreneurs but also give them the opportunity to create networks and obtain mentorship.

This study can be developed by replicating the research with male entrepreneurs to see if there is a difference based on the gender. Moreover, since this research is focused on the descriptive nature of motivational factors, personality traits and challenges, it can be developed by combining both qualitative and quantitative methods.

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