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ejer.editor@gmail.com
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Prerequisites for Elementary School Teachers before Practicing STEM Education with Students: A Case Study*

Ganime AYDIN[1]

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ABSTRACT

Purpose: Implementing STEM education in the early grades is a more effective way to encourage creativity, problem-solving, and innovation. There is a need for elementary teachers to implement STEM education to integrate and contextualize science, technology, engineering, and mathematics (STEM) in their teaching. This research aims to examine the prerequisites for elementary teachers before practicing STEM education with students.

Research Method: This study is a case study and implementations were undertaken with six teachers over 13 weeks and were delivered in theoretical and practical ways. Open-ended pre-test and post-test, interviews, diaries of both researcher and participants, worksheets, lesson plans, assessment tools and engineering design process (EDP) reports were used as multiple data sources to triangulate findings. Thematic analysis was utilized using open coding and cross coding of data.

Results: Several codes emerged from the analysis that were grouped under five salient themes as follows: understanding STEM, instructional gains of STEM education for teachers and benefits of STEM education for students, instructional prerequisites for teachers and conditions of schools to perform effective STEM education.

Implications for Research and Practice: Theoretical and practical integrated STEM education can be planned in a long-term manner for the education program of elementary school teachers consisting of problem-based, inquiry-based and project-based learning enriched with content knowledge integrated STEM practices.

* This study was partly presented at the 3rd International Conference on Lifelong Education and Leadership for All-ICLEL, 12 September, 2017, Porto.

[1] Canakkale 18 Mart University Lapseki Meslek Yuksekokulu, TURKEY, e-mail: ganime31@gmail.com
ORCID: 0000-0001-6112-5243

Introduction

In the 1990s, the National Science Foundation (NSF) in the United States of America supported the abbreviation SMET (1990) as educational policy, including the science, mathematics, engineering and technology disciplines at the regional level, emphasizing integrity rather than integration. Later, the term STEM began to be used despite objections due to comparisons with the definitions for the body of a plant or stem cells (Byee, 2013). The inclusion of STEM both as a definition and on curricula at national and international levels was of different importance in the 1990s due to the foundation of STEM schools, research centers, and inclusion on teacher education programs and in the educational policy plans of countries. When we examine definitions related to STEM education, in addition to the effects of STEM education on students, there are details related to implementation. Hence, Chute (2009) defined STEM as an education system where students produce solutions to problems encountered in real life and create opportunities, while Sanders (2009) identified STEM education as the purposeful integration of various disciplines used in solving real-world problems. STEM education ensures the development of many features, such as student's self-confidence, problem-solving, gaining life experiences, innovation, spatial skills and invention, and critical thinking (Baenninger and Newcombe, 1989; Morrison, 2006; Wai, Lubinski and Benbow, 2010).

The next generation of science standards ([NGSS], 2012) presents the goal of the framework for K-12 science education as:

> "Ensuring that by the end of 12th grade, all students will have some appreciation of the beauty and wonder of science, possess sufficient knowledge of science and engineering to engage in public discussions on related issues, be careful consumers of scientific and technological information related to their everyday lives, be able to continue to learn about science outside school, and will have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology" (p. 14).

STEM education, in addition to preparing scientific and technical instincts used more often over time with the increasing integration of technological research and development, also aims to create a more knowledgeable society with scientific and technologic literacy (NAS, 2014). When we look at definitions related to the implementation of STEM education, it is defined as adopting the perspective that these four disciplines are one unit. Thus, they should be taught as one cohesive entity (Breiner, Harkness, Johnson and Koehler, 2012). It is expected that students at the K-12 level will be able to engage in scientific research about the main science concepts and undertake engineering design projects based on the emphasis that engineering is included in STEM education (NGSS, 2013). STEM education aims to train individuals to be successful engineers by directing them to work with others in different disciplines who have communication skills, can find the best solutions to problems, think systematically, and have ethical values and creativity (Bybee, 2010; Dugger, 2010; Guzey, Tank, Wang, Roehrig and Moore, 2014; Mann, Mann, Strutz, Duncan and Yoon, 2011; Rogers and Porstmore, 2004). The general outputs of the STEM education

highlighted in the engineering design section of engineering courses applied at the K-12 level is to increase students' success and motivation according to the National Research Council (NRC, 2012) report. Students develop their motivation for learning, science and mathematics, and solving problems at a better level (Furner and Kumar 2007; Stinson, Harkness and Stallworth, 2009) as they develop conceptual learning, higher-order thinking skills and engineering design skills (Fan and Yu, 2015). As seen in these explanations, integration of disciplines included in STEM is stated to contribute to the engineering and the importance of engineering in STEM education, the required skills for occupations in the future, and that even if occupations in the STEM field are not chosen, it contributes to raising scientifically and technologically literate citizens. In light of all this, we can define the STEM concept in summary as:

> "Instead of separate teaching of the science, technology, mathematic and engineering disciplines forming the basis of STEM, it is an applied teaching method targeting science and mathematics learning of 21st century skills with technology integration ensuring connections between engineering-based science and mathematics concepts in the process of producing products providing solutions to problems or desires occurring in daily life."

Within the many gains of STEM education, the research in the literature reveals that learning science should begin in elementary school in order for students to succeed in high school (Belden, Lien and Nelson-Dusek, 2010).

A student's interests, fundamental knowledge and skills concerning STEM mainly develop during early grades. Antony Murphy (2011) who is executive director of the National Center for STEM Elementary Education at St. Catherine University indicated that

> *Children at birth are natural scientists, engineers, and problem-solvers. They consider the world around them and try to make sense of it the best way they know how: touching, tasting, building, dismantling, creating, discovering, and exploring. For kids, this isn't education. It's fun! Yet, research documents that by the time students reach fourth grade, a third of boys and girls have lost an interest in science. By eighth grade, almost 50 percent have lost interest or deemed it irrelevant to their education or future plans. At this point in the K–12 system, the STEM pipeline has narrowed to half. That means millions of students have tuned out or lack the confidence to believe they can do science* (Murphy, 2011, para. 4- 5).

The implementation of STEM education in the early years ensures the development of not only mathematics skills and general knowledge in science and social studies but also reading skills that are fundamental for the scientifically literate people of the future (Brenneman, 2014). Also, to eliminate gender differences in the STEM field, starting STEM education in the early years was endorsed by Xie, Fang and Shauman (2015) and Belden, Lien and Nelson-Dusek (2010). The focus is not on achievement, but on the process of engaging the student in learning and thus, forming an interest in STEM. It is recommended that rather than a separate engineering education program, integrated STEM education is applied at the K-5 level since it focuses on the key

knowledge and skills for 21st-century citizens (Lamb, Akmal and Petrie, 2015; NGSS, 2013). While Tseng, Chang, Lou and Chen (2013) observed that project-based learning activities integrated into STEM significantly affect students' positive attitudes towards engineering, the positive attitude that emerges is mostly in the form of engineering, then science, thirdly technology and finally mathematics. They stated that they were ranked. Researchers defending the integrated approach in STEM education have proposed that students' interest, motivation and success in lessons increases with topics, including problems encountered in daily life; as a result, this situation is expected to increase the academic success of students in addition to increasing the number of students planning careers related to STEM in the future (Gulhan and Sahin, 2016; Honey Pearson and Schweingruber, 2014; Stohlman, Moore and Roehrig, 2012). Engineering design in STEM education encourages students to engage in more formalized problem-solving in which they define a problem using criteria for success and constraints or limits of possible solutions. Students research and consider multiple possible solutions to a given real-world problem (Purzer, Goldstein, Adams, Xie, C. and Nourian, 2015; Moore et al., 2014a; English, Hudson, and Dawes, 2013; NGSS, 2013; Mehalik, Doppelt and Schun, 2008; Diefes-Dux, Hjalmarson, Miller, Lesh, 2008; Cunningham and Hester, 2007). Within the advantages of engineering education in STEM integration, there were arguments about the integration of four disciplines concerning how integration will be planned. The main problem lies in the definition of STEM education are being the combination of science, technology, engineering, and mathematics in one class. However, according to Stohlmann et al. (2012, p. 30), "in general, integrated STEM education can involve multiple classes and teachers and does not always have to involve all four disciplines of STEM." Hurley (2001) and Byee (2013) presented many different forms of integration, giving the advantages and disadvantages of each form. Byee (2013) indicated that no one approach is best and Morrison (2006) also pointed out the needs for transdisciplinary integration. Bryan, Moore, Johnson and Roehri (2015) identified three forms of integration considering content and context; (a) content integration where learning experiences have multiple STEM learning objectives, (b) integration of supporting content where one area is addressed (e.g., mathematics) in support of the learning objectives of the main content (e.g., science) and (c) context integration where the context from one discipline is used for the learning objectives from another. In this research, in the research- and inquiry-based 5E learning model, the Life-STEM topics of the brain and stomach were chosen. In the 5E learning model, topic content is learned practically in the engage, explore, explain sections, while the engineering design process (EDP) is applied in the extended section. In the extended stage, technology, physics (helmet design) and chemistry (acid, choosing material against acidity) are integrated.

STEM education positively affects the academic success of students in future experiences, is effective in choosing an occupation in the STEM fields and develops positive attitudes to mathematics and science lessons, so this requires changes for teachers who will provide this education (Daugherty, Carter and Swagerty, 2014) and their education programs (Wyss, Heulskamp and Siebert, 2012). However, the application of new teaching methods in the classroom rather than traditional models or the existing professional development models used by teachers has been discussed

for a long time. Furthermore, even the teachers that were involved in education programs of new teaching methods were unable to keep using them over a long time in practice since they did not assimilate these strategies (Ebert-May, Derting, Hodder, Momsen, Long and Jardeleza, 2011; Henderson et al. 2012). Elementary school teachers need STEM education to integrate and use engineering in the teaching, learning, and assessment of their content (Guzey et al., 2014). During the education of teachers, various researchers have documented the many difficulties that have been encountered in presenting STEM education. A summary of these problems is outlined below with the implications of many studies: **a) Lack of enough time**: Generally, there is not enough time allocated for the application of engineering practices and teachers believe that engineering is just another addition to their heavily loaded science curriculum (Czajka and McConnell, 2016; Guzey, Tank, Wang, Roehrig and Moore, 2014; Lee and Strobel, 2010; NRC, 2013). Teachers specifically consider the weekly plan that allows the students time for engineering practices (Dorph et al., 2011) and also other non-formal education and STEM practices that would need to be implemented out of school to improve students' positive attitude and beliefs toward science (OECD 2012). **b) Need for an integrated curriculum:** The curriculum needs to be flexible (Jardine, 2006) rather than rigid (Pinar, Reynolds, Slattery, and Taubman, 2000). Integrated programs in teacher education (Berlin and White, 2010; Offer and Mireles, 2009) have been implemented or are planned, but problems found were the lack of the development of supporting curricula materials and instructional models for STEM integration (Stohlmann et al. 2012). **c) Lack of adequate content knowledge and skills**: Elementary school teachers need content knowledge for both science and mathematics and for the integration of engineering, they also need knowledge and skills (NRC, 2013; Guzey et al., 2014; Czajka and McConnell, 2016)**.** Furthermore, in addition to mathematics and science background, they need engineering and technology education (Debiase, 2016) and their lack of STEM content knowledge affects their self-efficacy to practice STEM in the classroom (Bencze, 2010).The problem is dealing with the teacher education programs or elementary education curriculum. Thus, teachers are reluctant to undertake many science activities in class giving their reasons as the level of conceptual knowledge (Chaney, 1995; Darling-Hammond, 2000; Druva and Anderson, 1983), level of education (Furtak, 2005; Ingersoll, 2003), experience (Wenglinsky, 2000) and habits of primary teachers (Abd-El-Khalick et al., 2004) and level of self-confidence (Harlen and Holroyd, 1995; Kind, 2009). **d) Overcrowded classrooms**: Engineering is not accessible to a large number of students (Douglas et al., 2004). **e) Insufficient tools and technical facilities of schools**: Tools and resources available to students are essential in providing multiple learning strategies that support student learning in the class (Puntambekar and Hubscher, 2005) and the classroom environment is also associated with students' achievement and attitudes (Fraser,1998). Interactive lectures encourage students to engage in practices, understand more concepts, generate better explanations, and increase their productivity working with classmates (Eslinger, White, Frederiksen and Brobst; 2006; Krajcik and Delen; 2017; Metz 2004; Wolf and Fraser; 2008; White and Frederiksen 1998). Dorp et al. (2011) commented that kits rather than hands-on instructional materials were preferred by teachers and schools because these kits can be rotated

through the classes in accordance with the order of units in the curriculum. **f) Need for assessment tools**: Currently, there are not enough assessment tools that teachers can use to measure student outcomes and the effectiveness of STEM applications in schools (Lee and Strobel, 2010; Dorp et al., 2011; NRC, 2011; NRC, 2013). Using multiple-choice questions in systemic measurement exams to measure the academic achievement of students rather than skills, scientific literacy, and cognitive development of students restricts teachers from implementing STEM practices. Thus, restricted content is presented by the teachers. **g) Teachers' beliefs, confidence and efficacy:** The factors which affect primary teachers when teaching science are self-efficacy which is the combination of feelings and beliefs about their knowledge, abilities and experience (Van Aalderen-Smeets, Molen and Asma, 2011) and self-confidence in their science knowledge, skills related to daily lives of individuals, and familiarity with science (Appleton, 2002; Mulholland and Wallace, 1996). Even though short professional development interventions can effectively influence relatively stable constructs, such as teacher confidence and efficacy (Nadelson et al., 2013), it is the teacher's belief concerning STEM disciplines and integrating engineering into science and math that has the strongest effect in terms of whether STEM can be successfully implemented in their classroom (Czajka and McConnell, 2016; Wang, 2012). The results of research in the USA found that there was a positive impact on the levels of efficacy, confidence, and attitudes from two years of a STEM teaching program (Nadelson, Callahan, Pyke, Dance and Pfister, 2013). **h) Inadequate practices**: Children already have a great deal of knowledge about the natural world, including concepts related to physics, biology, psychology, and chemistry but both the breadth of the curriculum and teacher's practices are not sufficient to develop skills in science (Brenneman, 2014) and teachers need to adopt STEM, which is based on integrated practices (NRC, 2013; Radloff and Guzey, 2017). **i) Integrated STEM education:** Teachers need an integrated STEM curriculum and samples of integrated STEM practices (Jardine, 2006; Stohlmann et al., 2012) and successful integration requires the teachers to understand the subject matter (Pang and Good, 2000).

STEM refers to a purposeful integration of the various disciplines, and STEM education aims for individuals to gain 21st-century skills that are required to solve real-life problems. Therefore, in elementary school teacher education programs or in-service teacher training programs, content-rich lectures engaging problem-based and project-based learning are needed to influence students' interest, content knowledge, and skills in STEM fields (Daugherty et al., 2014). Also, Roehrig, Moore, Hui-Hui Wang and Park (2012) implied that integration could be implemented most successfully when mathematics and science teachers work together in a single classroom (co-teaching) and in multiple classrooms (a common theme). Therefore, elementary school teachers teaching both science and mathematics can apply STEM efficiently while integrating art, music and other disciplines. This paper mainly aims to determine the prerequisites for elementary school teachers before practicing STEM with their students. STEM education consisted of theoretical and practical lessons that were applied to six novice elementary school teachers considering their requirements in the processes of education over 13 weeks. The main integrated STEM practices focus on the biology of the brain and stomach. The research results referred only to the first

part of the continuing teacher education program and did not take into account the teachers' practices with students.

The problems in this study are:

1- Are there any changes in teachers' understanding of STEM?

2- What are the instructional gains of STEM education for teachers?

3- What are the prerequisites to implement effective STEM education?

4- What are their opinions about the benefits of STEM education for students?

Method

Research Design

The adopted research model was a case study consisting of six elementary school teachers, attending an elementary school teachers' master's program, which included a Science and Nature Course as an elective course. Yin (2009) defines a case study as an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (p. 18). The use of qualitative methods in case studies has the ability to bring a deep understanding of a case and to provide intrinsic knowledge and details regarding a problem or issues of interest to a researcher (Stake, 1995).

Research Sample

The teachers explained the reason for selecting this course as their need for a deep understanding of science concepts, the requirement of new teaching methods in the classroom with changing student attitudes and skills and finally because they wanted to learn about STEM to apply the system in their schools since they would be teaching within the new curriculum in which STEM is integrated with engineering practices (MoNE, 2018). Briefly, the elementary school teachers were willing to learn about STEM and implement it in their classrooms. This research focuses on the results of 13 weeks of their education program. The participants continued with their professional education program and engaged in classroom teaching, which included STEM education practices. For the anonymity, pseudonyms were used for each participant: Danny, Nagi, Aida, Jenny, and Lisa were participants in this research who are working as elementary school teachers. Their brief data are shown in Table 1.

Table 1

Brief Explanations about Participants with Alias

Alias	Experience	Age	Department of graduation
Danny	Three years in public school	28	Science Education
Nagi	Two years in private school	26	Elementary education
Aida	Two years in private school	37	Vocational high school teacher education program
Jenny	Part-time teacher at a private school	24	Newly graduated from elementary education
Lisa	Three-months experience in a public school	24	Elementary education
Sera	No experience	23	Newly graduated from elementary education

Implementations

The implementations were carried out over 13 weeks within three hours each week in the Education Faculty Master Program of a Foundation University. Before practicing STEM activities, theoretical knowledge required by teachers determined by the pre-test, and observations of the researcher (diary notes, worksheets of teacher) were given to participants. For example, the Programme for International Student Assessment [PISA] and Trends in Mathematics and Science Study [TIMSS] were not included in the planned STEM education program. The identification and integration model of STEM disciplines was explained theoretically according to the recommendation by Wang, Moore, Roehrig and Park (2011) to develop a theoretical STEM integration framework that describes how STEM integration could be put into practice. The other problem that was detected on pre-test results was the incompetence about teaching strategies, methods and learning models used in the STEM practices. Therefore, problem-based learning explained with theoretical knowledge was used and the group designed examples for 3rd and 4th-grade students based on the curriculum level and were related to questions. For example, 'Can we produce a telescope for everybody?' and 'How can we prevent the decay of food in a refrigerator?'. Again, the same treatment was administered for theory and examples of practices with project-based learning, inquiry-based learning, situated learning and the 5E learning model. According to Wang et al. (2011), two major foci of STEM integration were mentioned of problem-solving by developing solutions and inquiry. Therefore, in this research, main STEM practices about the brain and stomach were practiced with inquiry-based learning enriched by contents in the first three steps of the 5E learning model and in the elaborating step EDP was applied for the problem

which is mostly seen in Turkey (epilepsy) of integrating technology (appendix). The technology was chosen as an example of integration because of the advice of Hsu, Purzer, and Cardella, (2011). They conceived the unfamiliarity of elementary school teachers about the usage of technology in engineering design. Also, Brush et al. (2008), Kurz and Middleton (2006) and Watts-Taffe et al. (2003) reported the insufficient usage of technology by elementary school teachers. Before the main activities, the engineering design process (EDP) and its applications in science and mathematics were explained through video, diagrams and discussion later about two activities; Activity 1: space shuttle and Activity 2: Building a bridge. They completed EDP reports containing a step-by-step account, drew their design, and wrote up their results. At the end of the session, we compared the possible benefits of EDP and the possible difficulties involved with practice in the classroom. Later, the 'Brain and Helmet' (appendix) and 'Artificial Stomach' life-STEM activities were carried out and teachers were introduced to the design program, Solidword, developed by a software engineer. They used a 3D printer to produce their prototypes for the bicycle helmet or artificial stomach. In the last two weeks, teachers prepared lesson plans and activity notebooks (worksheets) for classroom applications depending on the elementary education curriculum, and their lecture plans and activity drafts were evaluated. Finally, the details about how to assess students for STEM activities were explained by giving many examples of specific measurement tools during the whole process. The teachers prepared their assessment tools as homework. Finally, teachers presented their assessment tools, and their products were evaluated with explanations and sampling of better solutions.

Data Sources

In this study, more than one type of qualitative data was gathered during the whole intervention period to perform an in-depth investigation of the impacts of STEM education on teachers. Multiple data sources were collected through an open-ended pre-test and post-test, teacher interviews (questions are given in Table 3), diary notes of the researcher, worksheets, lesson plans, assessment tools, diaries of teachers, and EDP reports. 'The aim of gathering qualitative data based on different sources is to eliminate the risk of the researcher's systematic error' (Maxwell, 2008) and to discover a theory about completion of the research based on systematically obtained data (Glaser and Strauss, 1967). In addition, a key strength of the case study method involves using multiple sources and techniques in the data-gathering process (Soy, 1997, p. 2).

Table 2

Open-ended Questions on Pre-test and Post-test

1- Which disciplines are included in STEM?
2- Can you draw a diagram that explains the relations between the disciplines in STEM?
3- What is STEM education? Can you briefly explain it?
4- What are the skills of the 21st century?
5- Which teaching approaches can be used in STEM education?
6- Why are STEM integration interventions required in an education system?
7- Can STEM be applied in the education system?

Table 3

Interview Questions

1- What was your initial expectation for this STEM course?
2- What kind of awareness have you gained?
3- What is the most influential activity in this STEM teaching process?
4- Was there a change in your perception when identifying the concept of engineering?
5- How your experience of technology had an impact on you?
6- Which type of assessment tools will be useful to measure the impact of STEM on students? Can you produce these tools?
7- Can you apply STEM practices in your classroom?

Data Analysis

In this case study, the long-term interaction between the researcher and participants, the long-term observations of the researcher through continuous data gathering during the 13-week implementations, and the use of different data sources for triangulation were considered as proving the reliability of the research (Creswell, 2012). In addition, the participants' main role, pre-test results, questions and responses were considered during the implementation in this research (Stake, 1995). Data analysis was undertaken during the process by the researcher and one of the external inspectors, not at the end of research; therefore, for any unexpected result, it could be considered that the implementation plan needed to be changed (Patton, 1980, 1990). Thematic analysis was chosen. Because many different data sources were used, answers to research problems were not directly related to one or two data tools, and themes were explained within data (Braun and Clarke, 2006). Thematic analysis as an independent qualitative descriptive approach is mainly described as 'a method for identifying, analyzing and reporting patterns (themes) within data' (Braun and Clarke, 2006, p. 79). Ten Have (2004) indicated that the researcher finds out attitudes, behavior and real motivation of studied people. Therefore, in the research, the focus of research problems was examined through the detailed outcomes of elementary school teachers' STEM education with flexible perspectives.

In the beginning, all data were transcribed by the researcher, codes, then themes were produced by eliminating data with a few samples by two experts who specialize in STEM education other than the author. Validity and reliability were provided by generating themes, and multiple data sources require the preparation, organization, and assessment of the interaction of the data on multiple levels (Creswell, 2007, 2012). At this point, the theme 'prerequisites of elementary school teacher' was the most discussed theme. Because although the research question was trying to find prerequisites for teachers to practice STEM, they also mentioned requirements for conditions in school to apply effective STEM. Therefore, we divided requirements to apply effective STEM education into two themes as follows: prerequisites of teachers and conditions to implement STEM in schools. Furthermore, the other most discussed code was EDP. In the beginning, teachers did not know the meaning of the letter E in the synonym STEM, and through the implementations, they learned what EDP is. However, when practicing, they learned the steps of EDP, such as designing and

testing. Therefore, we placed EDP under the two themes explaining differences in detail. Themes and codes and samples of codes were checked and discussed many times to provide the reliability of the analysis, and the reliability of the codes for all data groups was determined using the Miles and Huberman (1994) formula:

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements + disagreements}}$$

The reliability was calculated as an average of 90%. This result indicated that the codes of the research were reliable. The final results of the thematic analysis are summarized in Table 4 below to understand themes, codes and examples from data sources.

Table 4

Themes, Codes and Examples

Themes	Codes	Samples from participants
Understanding STEM	defining stem learning approaches and learning models STEM integration learning EDP	**Aida:** The most efficient part of the implementations was the engineering bicycle-helmet session through learning
Instructional gains of STEM education for teachers	teamwork brainstorming technology competencies learning science concepts self-belief self-confidence EDP steps communication	**Serra:** Integrating mathematic in STEM will provide easy understanding of mathematical concepts. **Nagi**: The engineering design part of education was the most enjoyable and now I understood some physics laws and rules. **Lisa:** Technology is difficult for me; for example, I learned the PowerPoint application only two years ago; so, the technology part was not interesting for me and I think I cannot implement this part in my teaching. **Jenny**: I learned the correct meaning of the centrifugal force.
Benefits of STEM for students	choice of job creativity long term memory critical thinking asking questions problem-solving	**Aida:** If I had learned the Solidword program before, I would have been a designer, but now I will use the program to design toys to avoid paying more for imported toys.
Instructional prerequisites of teachers to use STEM with students	contextualizing problems from daily life produce assessment tools integration practices	**Lisa**: I couldn't apply STEM without a mentor and without the support of an advisor. **Danny**: Teachers should work together to design activities. **Serra**: The curriculum should be regulated to support integrated STEM education

Table 4 Continue

Themes	Codes	Samples from participants
Conditions of schools	curriculum mentor materials overcrowded classroom time	**Danny**: Insufficient materials may be a problem in my classroom, but I believe that I can use simple materials. **Jenny**: How could I evaluate so many students with the observation rubric?

Results

In this section, all the themes will be explained with multiple data sources as pieces of evidence for the discussion in light of the literature.

Understanding STEM

At the beginning of the implementation, Aida and Danny knew all the disciplines in STEM, but Nagy appeared to have no idea about the STEM disciplines, and Lisa wrote the word 'mechanic' instead of mathematics. Jenny wrote that STEM included science and mathematics, whereas Sera defined science as studying everything. At the end of the implementations, all the teachers correctly defined the STEM disciplines. However, when we compared their figures to determine whether they understood integrated STEM, none of them could correctly explain integrated STEM with their drawings. The teachers' drawings are shown in Figures 2 to 5.

Figure 2. *Danny and Sera's STEM Integration.*

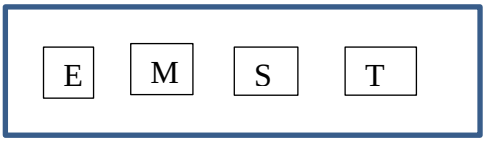


Figure 3. *Jenny's STEM Integration.*

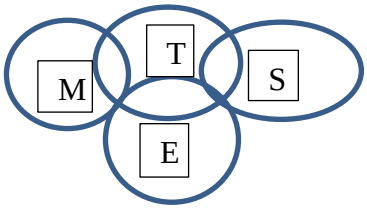


Figure 4. *Aida's STEM Integration.*

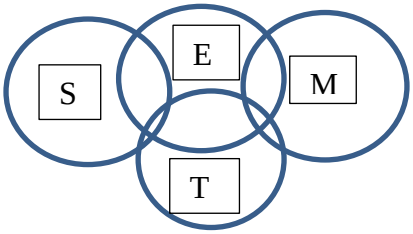
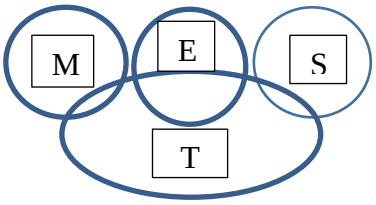


Figure 5. *Lisa's STEM Integration.*



The extracts below from the teachers' diary notes and the interviews reveal the way the teachers understood STEM integration. **Serra** stated that *the most interesting part of implementations was the engineering practices; now I can easily adapt the engineering design process in mathematics, art and science, I could also integrate literature, such as stories into*

the lessons. Aida drew the engineering part at the center of her figure because of her background, having graduated from a technical teacher education program and the science department of a high school. She explained in her interview that *the most beneficial part of STEM is practicing EDP because it improves the creativity of students and they can connect engineering with science and mathematics with problems in daily life and there is a product at the end of EDP.* In his response in the interview, Danny said, "*I heard and read something about STEM before the implementations, and I expected that I only needed to practice STEM, but I then realized that I had many misunderstandings and I didn't know the steps of EDP. The most efficient part of the implementations was the engineering bicycle-helmet session through learning how we can apply [engineering] in practice.*" There appears to be no problem with the drawings of the teachers probably because they had the opportunity to practice and we can see that they mostly enjoyed the EDP part of activities. When we look at the data about the usage of learning approaches, which can be used during STEM practices, Aida, Lisa, and Nagi did not give a response in the pre-test, Danny gave hands-on activities as a method, and Serra defined brainstorming as a method. Jenny defined teaching techniques, such as problem-solving and brainstorming in STEM education. Furthermore, from the diary notes of the researcher '*the teachers' main problem is that they knew what problem-based learning or project-based learning was, but they could not apply this theoretical knowledge into the practice of a given topic, and they were unable to differentiate the main differences between problem-, project- and inquiry-based learning and situated learning*. However, at the end of interventions, they used various terms in the post-test; problem-based learning, project-based learning, inquiry-based learning, learning by doing and living, constructivist approach, 5E model, active learning, discovery, situated learning and meta-cognition.

Instructional Gains of STEM Education for Elementary school Teachers

In this part, we selected words and sentences from at least two examples from the participants' statements as codes to determine the improved skills of teachers during interventions. The first example relates to the steps of the EDP cycle**.** The review of the reports about the EDP cycle practices revealed that the teachers designed an imagined model of a bicycle helmet and an artificial stomach, but after testing of their prototypes, they did not make any changes to the design. During the interviews, they were asked the reason for not redesigning the models. The responses from five of the teachers were as follows: *We don't need to draw it again because we know the parts which should be changed or improved (*Danny). *We realized that we have no ability to draw because we tried it, especially for the bicycle helmet, but couldn't do better than before (*Alice). Serra commented that *engineering parts were the most interesting part of the course because there was a product at the end and thinking step-by-step to produce a model improved our critical thinking abilities*. Thus, Serra referred to one of the aims of STEM education, which is to think systematically (Bybee, 2010a; Dugger, 2010; Duncan and Yoon, 2011; Guzey et al., 2014; Roehrig and Moore, 2014; Morrison, 2006; Rogers and Postmortem, 2004). In an interview, Lisa was also affected by the engineering part of the course, saying that *engineering means producing something new, which is required by society.* Nagi's focus was on the transfer of daily life problems into EDP, saying in an interview, "*students never forget when they create their solutions with products*" (Morrison, 2006). All the teachers had a positive attitude about the EDP cycle after producing the bicycle helmet, space

shuttle and artificial stomach; thus, it can be seen that EDP motivates not only student learning (Bybee, 2010; Dugger, 2010; Guzey et al., 2014; Mann, et al., 2011; Rogers and Porstmore, 2004) but also in-service elementary school teacher learning. However, the teachers did make mistakes and had difficulties without explaining the content knowledge; for example, (according to the researcher's diary) they chose the wrong materials for the inner structure of the stomach which should not be a thin and rough surface and instead of reading and investigating the structure and functions of the stomach, they preferred to ask the researcher. With the guidance of the researcher asking new questions to encourage them, they read articles and engaged in research on the internet to find solutions to the problems concerning the artificial stomach problem. If they did not know or were not sure about the elements of the stomach, such as acid, epithelial tissue and smooth muscle, they used the time to argue with each other concerning the decision about the correct materials. However, when they redesigned the artificial stomach, they corrected and understood the structure of the stomach, depending on its functions. Thus, the EDP part of STEM improved their reading skills and, thus, their scientific literacy (Brenneman, 2014). **Serra,** who does not like biology concepts, said, *I will never forget the structure of the stomach, and I will change my eating habits*. Thus, STEM does not only provide academic achievement or 21st-century skills; it also affects social behaviors, such as attitudes to health (Dauer and Dauer, 2016). **Jenny** wrote in her diary notes, *I learned the correct meaning of the centrifugal force and if I had experienced EDP, I would be an engineer*. Consequently, even though they were practicing EDP, they were also learning concepts, but elementary school teachers still need the theory of content knowledge (Czajka and McConnell, 2016; Guzey, et al., 2014; NRC, 2013) before STEM implementations. In addition, the teachers put themselves into the students' position and experienced the possible impacts of EDP from the perspective of the students, including creativity, long-term learning, and critical thinking.

When we analyzed the impacts of the use of **technology** in STEM applications for teachers, they were generally surprised about the usage areas of the 'Solidworks program' and they realized that becoming proficient in this application could help them find a job in Turkey. Furthermore, self-belief and self-confidence concerning technology literacy surfaced in their diary notes and interviews. Apart from **Danny and Alice,** who have technical and science education backgrounds, the other teachers had difficulties using Solidworks, but at the end of the technology applications, learning new things enlarged their vision and could possibly affect their teaching and self-confidence. Of the teachers, **Danny** was the most interested in learning how to use the program. This could be due to him having better competency about computer usage than the others. **Danny** commented, *when I saw the Solidworks program, I thought I could use it to teach electricity. I have no ability to think in 3D. Maybe the reason is my brain or the education system; I don't know.* **Serra:** *I am not good at using computers, but it was interesting that without paper and pencil, we could draw objects in 3D.* **Aida:** *If I had learned the Solidworks program before, I could be a designer, but now I will use the program to design toys to avoid paying high prices for imported toys.* **Lisa:** *Technology is difficult for me; for example, I just learned PowerPoint two years ago, so the technology part was not interesting for me and I think I cannot apply this part in my teaching.* **Nagi** also mentioned the lack of

computer competency*: this part was difficult for me, but this created awareness about the need to improve my computing skills.* **Aida** developed her self-confidence and explained her feelings: *It was incredible to produce a bicycle helmet from a 3D printer and for the first time, I realized that having good technology literacy would improve the quality of my teaching.* The examples from the teachers reveal that the elementary school teachers' insufficient experience of computer technology prevented them from using technology-based instruction in the classroom (Brush, et al., 2008; Kurz and Middleton, 2006, Watts-Taffe, et.al., 2003) and also affects their self-belief (Appleton, 2002; Mulholland and Wallace, 1996). In this part, the most important results were the teachers' negative beliefs and lack of self-confidence, which were mainly based on the lack of computer technology skills. However, with the evidence from interviews and teachers' diaries, through the practice in the intervention program, their negative beliefs were eliminated, they relaxed, and their confidence developed, allowing them to learn and engage in the new technologies in their classrooms. Pajares (1992) pointed out the effects of a well-designed education program, including the organization and design of tasks on the teacher's beliefs rather than knowledge. Also, there was a positive impact of long-term STEM teaching program on the levels of efficacy, confidence, and attitudes among elementary school teachers (Nadelson et al., 2013). In this research, practicing technology during activities improved teacher's self-beliefs and self-confidence about the usage of technology.

During the coding of the data in the diary notes of the author, in particular, the communication abilities and teamwork of teachers improved day to day through collaboration. Although **Serra** did not listen to any of the opinions of the other teachers during the space shuttle production directing the actions of the group members (researcher's diary), she did mention the importance of brainstorming when creating the bicycle helmet as follows: […] *brainstorming results in better production than self-production and using Aida's knowledge we created a perfect helmet together.* Another data (teacher's diary) is related to Danny**. Serra** indicated that Danny had better scientific knowledge background *when we were making the prototype of the helmet, the group members asked him questions about the materials and he helped us*. **Aida** also supported her group in the technology parts of the implementations. Furthermore (according to the interviews), when the teachers were generating lesson plans together, they realized that *it was better than doing it by oneself.*

Instructional Prerequisites for Teachers

Again, multi-source data and an open axial coding system found teachers need to learn assessment tools, the practice of EDP and contextualization of problems from daily life to apply effective STEM education. When we checked assessment tools in their lesson plans, we found that the teachers tended to prepare rubrics, which generally measured EDP and the whole STEM activity with a 5-point Likert scale. The teachers' lesson plan did not, for example, include rubrics about the evaluation of the product or the use of mathematics and technology, engineering knowledge test, and concept test. Extracts from the teachers show the problems in producing assessment tools. **Aida:** *You did not accept my lesson plan although I corrected it twice, but we have not prepared lesson plans and measurement tools. We obtained the plan from internet sources*.

Nagi: *It will take too much time to complete this rubric for each student.* **Serra:** *We need examples of assessment tools*. **Lisa:** *It was difficult in this part to produce the assessment tools; the pictures need to be evaluated.* Danny believed that students should be evaluated during all processes, but he didn't mention portfolios. He prepared the assessment tools to evaluate the EDP scale with a 5-item Likert scale. **Serra** also talked about brainstorming as an assessment tool, but she could not explain how it would be used. The main reasons for this feedback could be related to the insufficient practice and usage of multiple-choice test questions within the general examination system in Turkey and insufficient examples of assessment tools that teachers can obtain as samples. Also, the same problems were mentioned in the research by Harwell Moreno, Phillips, Guzey, Moore and Roehrig (2015) and Lee and Strobel (2010), who found that dealing with an insufficient number of assessment tools and inadequate tools resulted in not being able to measure the deep understanding of students and there was no reference to the STEM application in the answers to the questions on the tools (Stern and Ahlgren, 2002). Smith, Wiser, Anderson and Krajcık (2006) explained the properties of assessment tools as organizing the main concepts and other disciplines at the center of tool production, how they could be improved and contextualized, and how they could be transferred to instructions. Teachers can be supported by the experience of experts in the assessment of STEM, who have produced many kinds of assessment tool samples which measure skills, content knowledge, EDP cycle, products, development of cognitive skills, transfer of information from one discipline to another and take into account student reports (Dorp et al., 2011)

The other prerequisite for teachers was to seek problems from daily life and to engage in the contextualization of concepts with daily life. The examples from their diaries, worksheets and researcher diaries were; *Apart from Danny (graduated from a science teacher education program), none of the others could find examples of an atom, molecule and compound from daily life. None of them could write the problem of noise pollution from daily life.* **Nagi** stated: *My questions changed; for example, before asking questions, I think about how I can improve the student's thinking abilities and now I continue asking more and more difficult questions to improve the students' cognitive thinking levels and also, I learned to wait for their responses. This was a change in my teaching.* **Lisa***: I understood the importance of questions, especially how and why questions.* **Nagi and Lisa** realized the importance of questioning for children, as indicated by Morrison (2006). When their lesson plans were examined, the content had been chosen from the curriculum. **Danny** included a good problem to begin the planned lesson on microorganisms: *When I was leaving my home-city, my mother gave me a bag with many kinds of cookies and muffins for me to eat when I got home. I arrived home, I forgot about the bag and later, I smelt a very bad odor and realized that the cookies and muffins had gone moldy. Why did they decay? How can we protect foods from decaying?* **Jenny's** lesson plan focused on teaching the structure of teeth: *My grandmother likes to eat boiled corn, but when she lost most of her teeth, she couldn't eat corn any more. How can you help my grandmother eat the corn again?* **Aida's** problem was based on the questions: *What is hibernation? Which animals hibernate?* However, even though Aida has sufficient content knowledge and science and technology background. She could not develop her questions. The teachers presented several problems from daily life, such as *what are the living and non-living things in your environment?* **(Lisa). Serra**'s

plan to teach the use of a microscope included a video about microorganisms and she asked the question, *how can we see microorganisms*? **Nagi** presented the question, *how can we produce nests for birds to protect them from cold air?* The evaluation of the teachers' problems related to daily life in terms of their lesson plans shows that Aida, Lisa and Nagi could not understand how to improve the structure of their problems in accordance with STEM applications. The problem examples revealed the teachers have the insufficient ability about authentic questioning depending on their background, content knowledge and experiences. Daugherty et al. (2014) recommended that elementary school teacher education providing integrated STEM content and pedagogy include content-rich, standards-driven and engaging problem-based learning. This requires that they improve their scientific knowledge, develop the ability to form authentic questions and tasks and contextualize concepts about real life (Ayar and Yalvac, 2010; Bencze, 2011; Guzey, et al., 2014; Nadelson, et al., 2013).

In addition to generating authentic questions, STEM integration was evaluated in their lesson plans. In their lecture plans, integration of two disciplines was put as a restriction. In his own words, **Danny** integrated technology by *investigating technologies that prevent the production of microscopic organisms*. In the engineering part, he explained: *Students design and produce a dish which prevents the production of microscopic organisms*. In the mathematics part, he integrated the counting of microorganisms in the unit area under the microscope. **Serra** integrated mathematics by discussing the use of geometrical shapes, such as a sphere, cube, and rectangular during EDP. She used technology as homework to investigate different kinds of microscopes. **Nagi** integrated science content concerning the kinds of birds and their characteristics into EDP by undertaking nest examination; however, technology and mathematic integration were absent in her plan. **Lisa's** plan did not include any integration; she just wrote up the activity of living and non-living things**. Aida** presented a video about animals for the integration of technology, and she planned mathematics integration concerning the calculation of the bird nest's surface area, but she did not include any details of calculations. All the teachers integrated science into EDP about the units in the curriculum. However, there was a problem in the integration of mathematics and technology. The teachers believed that the learning of mathematics would be easy when provided by STEM applications. For example, **Serra** explained, *integrating mathematics in a STEM application will provide the easy understanding of mathematical concepts.* Similarly, **Danny** commented that *STEM applications would offer an easy understanding and improve the student's interest in the meaningful understanding of mathematics within daily life problems. However, mathematic teachers and science teachers should plan activities together, and the math teachers should take STEM education*. However, the teachers' lesson plans only included mathematics as summation, extraction, and measurement rather than mathematical thinking processes, such as drawing tables and graphs or the analysis of mathematical results. Pang and Good (2000) indicated that the successful integration of science and mathematics depends largely on teachers' understanding of the subject matter. The results had no connection with the background of teachers; for example, Aida did not reflect her technology and science background, experience and motivations in her lesson plan. The best lesson plan was prepared by Danny, who took many science courses during his bachelor's education.

The other teachers did not plan lessons that involved the four disciplines of STEM (Stohlmann, et al., 2012). This showed that integration of all four disciplines is not easy for teachers and also that integration can be undertaken in many forms (Hurley, 2001; Bybee, 2013) depending on the desired outcomes. In this research, based on the teachers' knowledge and experience, such as their insufficient content knowledge about the brain and stomach and having had no practice in EDP, I carried out activities in separate course hours. Furthermore, the integration of life science units into STEM practices tends to be difficult for teachers (Guzey, Moore and Harwell, 2016). In addition, I inserted a new design program 'Solidworks' in the course to develop their competencies and abilities with technology-based instructions and to teach the importance of new technological tools. Even though the teachers developed their competencies and were motivated to learn new technologies, more and simple activities related to technology should be integrated into STEM practices. Finally, it was concluded that elementary school teachers need more practice (NRC, 2013; Radloff and Guzey, 2017), especially including different forms of integration.

Conditions in Schools to Apply STEM

To assess whether the teachers believe that STEM perceptions are appropriate for implementation in elementary schools, during an interview, the teachers were asked a question concerned with STEM applicability in the classroom. Generally, the teachers held positive beliefs and perceptions about STEM. However, they offered suggestions for better practices, which included improving the learning environment, more materials, revised curriculum, need for teacher mentoring, reducing the number of students in the classroom, and increasing the time for practice. Data from the teacher's verbatim comments are as follows: **Serra:** *STEM will be beneficial, but the creativity of teachers and attitude of school administration are important*. **Nagi:** *The professionality of teachers about both constructive approach and content knowledge and practices should be taught over the long term for the effectiveness of STEM*. **Danny:** *Mathematic teachers and science teachers should plan activities together and math teachers should take STEM education* and *insufficient materials may be a problem in my class, but I believe that I can apply with simple materials.* **Serra**: *The curriculum should be regulated to sustain integrated STEM* (she also referred to time constraints). **Lisa**: *I couldn't apply STEM without a mentor and without the support of an advisor.* (She also pointed out the needs for advisors to be present during STEM practice in the class.). **Jenny**: *If teachers are alone in the class with a large number of students, STEM applications will not possible and how could I evaluate so many students with the observation or rubric?* In keeping up with the findings in the literature, the teachers in the current study referred to the following issues concerning the difficulties of implementing STEM in the classroom: time restrictions (Czajka and McConnell, 2016; Guzey, et al., 2014; Lee and Strobel, 2010; NRC, 2013), the number of students in the classroom (Douglas et al., 2004), materials (Eslinger, et al., 2008; Fraser,1998; Krajcik and Delen, 2017; Metz, 2004; Puntambekar and Hubscher, 2005; White and Frederiksen, 1998; Wolf and Fraser, 2008), the need to modify the curriculum taking account of integrated STEM, the professionality of teachers consisting of their content knowledge level (Czajka and McConnell, 2016, Guzey et al.,

2014; NRC, 2013), their creativity, and the provision of a mentor or advisor provided with the support of the school administers (Dorp et al., 2011)

Benefits of STEM Education for Students

About the outcomes of STEM, the teachers referred to better job opportunities, increased creativity, long-term learning, and the development of critical thinking. They also emphasized that they may have made different career choices if they had known about STEM during their education period: **Aida:** *If I had learned the solidword program before, I would have been a designer, but now I will use the program to design toys to avoid paying more for imported toys.* **Jenny:** *If I knew that I could do engineering, I would prefer to be a mechanical engineer and my dreams of being a pilot could come true.* **Serra:** *If I learned STEM in secondary or high school years, I would be an engineer.* **Nagi** was surprised about her abilities concerning EDP and the realization of her creativity abilities; thus, she commented, *If I had realized that I was creative and could completely implement EDP, I would have chosen to work in the area of materials science*. **Lisa** gave her opinion of the possible effects of STEM on children in the early grades: *if STEM was practiced in kindergarten, I believe that it would have developed their* [children's] *creativity, thinking skills and attitude towards science and mathematics.* **Nagi** also added that EDP would support the development of creativity and problem-solving abilities of young students. STEM practices improve the creativity of both students (Morrison, 2006) and teachers. One of the outcomes of the implementation of STEM education with children is the development of their problem-solving abilities becoming "problem-solvers—able to frame problems as puzzles and then able to apply to understand and learning to these novel situations (argument and evidence)" (Morrison 2006, p. 2). Nagi also commented on long-term learning: *for example, like me, they* [the students] *will never forget centrifugal force or brain parts or the structure of stomach with STEM activities, which provide long-term learning,* and referring to the students' self-confidence, she commented on her own experience stating, *if I had developed self-confidence, I could have chosen other jobs*. **Serra** mentioned the effects of STEM on the improvement of the critical thinking abilities of a student when she was implementing EDP. As found in the literature, Serra recognized that STEM education affects the students, allows them to realize their abilities, such as creativity and critical thinking (Bybee, 2010; Dugger, 2010; Guzey et al., 2014; Mann et al., 2011; Rogers and Porstmore, 2004) and consider different occupational areas (NGSS, 2013). Their perceptions and awareness of STEM also motivate them to apply practices of STEM (Wang, 2012; Czajka and McConnell, 2016).

Discussion, Conclusion and Recommendations

This research examined the prerequisites for elementary school teachers before STEM practices with their students within a 13-week education program. Depending on the research questions and multiple data sources, understanding STEM, instructional gains of STEM education for teachers, instructional prerequisites of teachers to apply STEM with students, benefits of STEM for students and conditions of schools to apply STEM were the themes in the research results. According to Stohlman et al. (2012), effective STEM education is vital for the future success of students. The preparation and support of teachers for integrated STEM education are

essential (p. 32). Therefore, there is a need for much practice with elementary school teachers to learn integration of STEM practices, improvement of teacher pedagogical competencies consisting of content knowledge, contextualization of problems with real life, improvement of technology usage in their lectures, and producing assessment tools. Although elementary school teachers did not know the meaning of the letters in STEM, after theoretical and practical education, we can say that they learned disciplines in STEM and their integration depending on results. However, similar to many studies, they had difficulties in conceptualization and planning integration of STEM disciplines. We can ask many questions and debate about the integration of STEM disciplines. For example, how integration will be done, which one will be the focus on discipline, how many disciplines should be included at least, should literature and history be added, is the technology discipline or product? The answers to these questions and argumentations about effective integration have been examined (Dugger, 2011; English, 2017; Honey et al., 2014; Sanders 2012; Wang, 2012; Wells, 2013). Bryan et al. (2015) explained that integration is not the teaching of two disciplines or using one of them as a tool to teach another. They pointed out the consideration of content and context. In this case, to produce integrated STEM activities depending on the curriculum, teachers can dominate both content knowledge and contextualization of STEM disciplines. Unfortunately, insufficient content knowledge of elementary school teachers in science was declared many years ago (Chaney, 1995; Darling-Hammond, 2000; Druva and Anderson, 1983), it is again one of the major problems in STEM education (Czajka and McConnell, 2016; Guzey et al., 2014; NRC, 2013) and one of the results of this research is again dealing with the content knowledge of teachers in life-STEM unit examining the contents brain and stomach. The reasons were similar to the results of much research. In Turkey, the reasons could be explained by the teachers' insufficient science background and curriculum of elementary school teacher education programs. Levitt (2002) reported that when provided with useful models, teachers tend to be open to modifications in their teaching. The need for and influence of effective models of STEM teaching provided the motivation for our K–6 teacher STEM professional development (p.3). Therefore, in elementary education, there will be a need for interdisciplinary lectures practicing inquiry-based, problem-based and project-based learning enriched with scientific content. For example, STEM practices could be done in lectures with Science Laboratory Applications or Science Teaching Lecture. Radloff and Guzey (2017) and NRC (2013) was also denoted the need for much practice of integration. Debiase (2016) mentioned the same requirement and also Bencze (2010) explained the relation between content knowledge with self-efficacy to practice STEM. During practicing of two activities, elementary school teachers who were participants in this research indicated that their self-belief and self-confidence levels increased to apply activities dealing with science and they also realized their need to learn science concepts and content knowledge. Similar to Nadelson et al. (2013), it is advised that elementary school teachers need additional theoretical education about STEM disciplines during STEM teaching programs. In the other case, participants in this research know the learning approaches, methods and techniques, but they have limited abilities to transfer their knowledge into STEM implementations. Furthermore, they indicated

their need to practice EDP and to have mentors. Therefore, during their undergraduate education or in-service training, they need more practice of learning approaches, methods and techniques to plan and apply STEM education. Also, teachers and teacher candidates need practicing of STEM activities to learn integration in STEM education (Aslan-Tutak, Akaygun and Tezsezen, 2017; Becker and Park, 2011; Cinar, Pirasa, Uzun and Erenler 2016; Corlu and Robert, 2014). When participants are preparing lesson plans, their incompetence about the production of assessment tools was detected. They just produced rubrics similar to samples given during activities. They also need to be presented with many samples of assessment tools, which measure different purposes of STEM education (Dorp et al., 2011; Lee and Strobel, 2010; NRC, 2011; NRC, 2013). The EDP activities motivated the teachers to learn about STEM and improved their communication and collaborative working, which was expressed as teamwork. From this point, we can conclude that elementary school teachers experienced the outcome of STEM education with improved 21st-century skills. The requirements to apply effective STEM activities in schools were also defined by participants. In addition to curriculum revisions, tools in the learning environment, time, need to mentor and the number of students were mentioned as being factors restricting STEM education in schools. This was also indicated in the research of Eroglu and Bektas (2016). Implementing STEM education in the early grades is more effective in developing people who are creative, problem-solvers, and innovative; therefore, elementary school teacher education is key to achieving the expected outcomes of integrated STEM education over the long term.

As a result of the research, we recommend that during the STEM education program of elementary school teachers both theoretical and application should be considered. In the beginning of education, there is a need to determine insufficient knowledge and skills to plan effective STEM education in the other ways, so action research is required. Furthermore, long-term education with many practice sessions, including the production of lecture plans, assessment tools and implementations from professionals in this area to guide them are recommended.

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İlkokul Öğretmenlerinin Öğrencilerle Fen, Matematik, Mühendislik, Teknoloji (STEM) Eğitimi Öncesi Gereksinimleri; Durum Çalışması

Atıf:

Aydin, G. (2020). Prerequisites for elementary school teachers before practicing stem education with students: A case study. *Eurasian Journal of Educational Research 88*, 1-40. DOI: 10.14689/ejer.2020.88.1

Özet

Problem Durumu: İlkokul düzeyindeki STEM öğretiminde en önemli unsur doğal olarak ilkokul öğretmeninin STEM eğitimine ne kadar hazır olduğudur. Başta ABD olmak üzere birçok ülkede bu konuda öğretmen eğitimleri, kısa dönemli sertifika veren kurslara katılım, yüksek lisans programları, ulusal veya uluslararası projeler kapsamında eğitimlerle gerçekleştirilmektedir. Öğretmenlerle yapılan eğitimlerde genel olarak yaşanan sorunlar, geliştirilmesi gereken yeterlilikler ve eğitimlerle ilgili öneriler şu şekilde sıralanmaktadır: Öğretmenlere uzun süreli içeriğinde bol pratik uygulamaların olduğu eğitimler verilmesi, STEM entegrasyonunu anlama ve uygulamada sorunlar yaşadıkları, mühendisliği ayrı bir konu olarak algıladıkları, Mühendislik tasarım süreçleriyle ilgili uygulamalara ihtiyaçları olduğu, STEM alanları konu içerik bilgilerinde eksiklikleri olduğu, teknoloji yeterliliklerinin zayıf olduğu, zamanın yetersizliği ve müfredatın STEM entegrasyonunu içerecek şekilde düzenlenmesi gerektiği, öğretmenlerin öz inanç kendine güvenlerinin yetersizliğinin öğrenmelerini ve isteklerini etkilediği okullarda uygulamalar için gerekli malzemelerin olmayışı ve ölçme değerlendirme araçlarına ihtiyaçları olduğudur.

Bu araştırmada ise ilkokul öğretmenlerine STEM eğitim süreci içinde ortaya çıkan ihtiyaçları doğrultusunda planlanan 13 haftalık teorik ve uygulamalı eğitimlerle öğretmenlerin STEM eğitimini anlama ve STEM öğretimi için ihtiyaçlarını belirlemek amaçlanmıştır. Araştırmanın problemleri ise;

a- İlkokul öğretmenlerinin STEM eğitimini anlamadaki değişimleri nelerdir?
b- STEM eğitimin öğretimsel süreçte hangi boyutlarda katkısı olmuştur?
c- STEM öğretini gerçekleştirmek için gereksinimleri nelerdir?
d- STEM eğitimin faydalarıyla ilgili görüşleri nelerdir?

Araştırmanın amacı: MEB (2018) yılından itibaren yürürlüğe giren Fen Bilimleri programın kazanımlarında yer alan mühendislik ve tasarım becerileri uygulamaları ilkokul 3. sınıftan itibaren programda yer almıştır. Bu nedenle bu araştırmada teorik ve pratik uygulamalarla gerçekleştirilen STEM eğitiminin ilkokul öğretmenlerinin STEM eğitimini öğrencilerle uygulamadan önce gereksinimleri belirlenmeye çalışılmıştır.

Araştırmanın Yöntemi: Araştırma örnek olay yöntemiyle bir öğretmen hariç 6 ilkokul öğretmenliği yapmakta olan katılımcılar 13 haftalık yüksek lisans dersinde uygulamalı eğitimle gerçekleştirilmiştir. Dersin başlangıçtaki planında öğretmenlerin açık uçlu

ön-test sorularına verdikleri yanıtlar ve süreç içindeki ihtiyaçları göz önüne alınarak değişikliklere gidilmiştir. Buna göre; STEM nedir? STEM entegrasyonu nedir?, PISA, TIMSS nedir, örnek sorular ve ülkelerin son durumu açıklanmıştır. STEM uygulamalarında kullanılan öğrenme yaklaşımları, modelleri uygulamalarla gerçekleştirilmiştir. Daha sonra Mühendislik nedir ve Mühendislik Tasarım Süreci (MTS) basamakları nelerdir, uzay mekiği örnek uygulaması gerçekleştirilmiştir. Daha sonra eklerde (EK-2) Türkçe ve İngilizcesi yer alan Beyin ve Kask, Yapay Mide etkinlikleri gerçekleştirilmiş ve öğretmenlere yazılım mühendisi tarafından çizim programı olan Solidword programı kullanım eğitimi verilmiştir. Öğretmenler kask veya yapay mide tasarımlarını bu programda çizmiş daha sonra prototipleri 3 D yazıcı aracılığıyla üretilmiştir. Daha sonra Fen Bilimleri öğretim programında yer alan bir konuyu seçerek ders planı hazırlamaları istenmiş ve tüm öğretmenlerin ders planları incelenerek düzeltme ve önerilerde bulunulmuştur. Yine ders planlarına göre değerlendirme ölçeklerini nasıl hazırlayacakları, değerlendirme de nelere dikkat etmeleri gerektiği, rubrikler, açık uçlu sorular, test soruları gibi birçok örnekle açıklanmış ve ders planları için ölçme değerlendirme araçları hazırlamaları istenmiştir. Son olarak hazırladıkları tüm ölçme değerlendirme araçları öneriler verilerek değerlendirilmiştir. Veri kaynakları ön-son test olarak kullanılan açık uçlu sorular, tüm süreç boyunca elde edilen araştırmacı ve öğrenci günlükleri, ders planları, çalışma kâğıtları görüşme formları ve ölçme değerlendirme örnekleri çoklu veri olarak kullanılmıştır. Veriler araştırmacı ve alanda iki uzman yardımıyla açık ve çapraz kodlama ile kodların oluşturulması çoklu kontroller sonunda temaların oluşturulmasıyla tematik analizle değerlendirilmiştir.

Araştırmanın Bulguları: Çoklu veri analizleri sonucu STEM nedir anlama, öğretimsel olarak kazanımlar, öğretmenlerin STEM öğretimi için gereksinimleri, okulların STEM öğretimi için gereksinimleri ve STEM eğitiminin öğrenciler üzerinde faydaları başlıklarında temalar elde edilmiştir. STEM nedir temasında, başlangıçta dört öğretmenin STEM kelimesindeki harflerin açılımını bilmemelerine rağmen eğitimler sürecinde öğrendikleri, ancak STEM entegrasyonu olarak çizdikleri şekiller sonucu tam olarak anlayamadıkları tespit edilmiştir. Yine Teorik STEM eğitimi sırasında STEM eğitiminde kullanılan öğrenme yaklaşım ve modelleriyle ilgili öğretmenlerin ön testte probleme dayalı öğrenme, araştırma sorgulamaya dayalı öğrenme, proje tabanlı öğrenme, beyin fırtınası, soru sorma, yaparak öğrenme yanıtlarını verirken uygulamalar sırasında öğrenme yaklaşımları, öğrenme modelleri, yöntem ve teknikleri karıştırdıkları, aralarındaki farkları açıklayamadıkları ve öğrenme yaklaşımlarını pratiğe aktaramadıkları tespit edilmiştir. Öğretmenlik eğitim programlarının tümünde yer alan öğrenme kuramları, modeli öğretim strateji, yöntem ve teknikleri konusunda lisans mezuniyetini yeni tamamlamış iki öğretmen ezbere doğru yanıt vermiş olmasına rağmen pratik uygulamaları öğretmenlerin tümü gerçekleştirmede zorlanmışlardır. Ayrıca problem cümlesi oluştururken soru sorarken günlük hayattan örneklendirme konusunda zorlanmışlardır. Bunların dışında öğretmenlerin Mühendislik tasarım süreçlerini bilmemelerine rağmen bu çalışma ile deneyimledikleri ancak daha çok pratiğe ihtiyaç duydukları eğitimin sonunda yapılan görüşmelerde belirtilmiştir. Öğretmenlerde öğretimsel olarak gelişen kazanımlar ise, iletişim, takım çalışması ve teknoloji kullanım becerilerinin yanında,

mide ve beyin konu içerik bilgisi, MTS ve beyin fırtınasının uygulamalardaki etkilerini görerek problem çözmede ve tasarım kararını vermede önemini anlamaları ve yine teknolojileri öğrenme ve derslerini teknolojiyi kullanma konusunda sahip oldukları özgüven ve negatif inançlarının etkinliklerde olumlu yönde geliştiği söylenebilir. Araştırmanın problem cümlesinden biri olan İlkokul öğretmenlerinin STEM öğretimi için gereksinimleri nelerdir sorusuna verilen yanıtlar öğretmenlerin ihtiyaçları ve uygulama için okullardaki gereksinimler olarak temalara ayrılmıştır. Burada öğretmenler STEM entegrasyon pratikleri, ölçme değerlendirme araçları ve mühendislikte problem oluşturmada günlük hayatla bağlam kuramama ve daha çok pratiğe ve örnek uygulama içeren kaynaklara ihtiyaç duyarken okullardaki uygulamalarda, öğrenci sayısı, araç gereç, zaman, öğretim programının sınırları ve danışman ihtiyacı öne çıkmıştır. Ancak ilkokul öğretmenlerinden STEM eğitimin öğrenciler üzerinde faydalarıyla ilgili veriler analiz edildiğinde kendi deneyimlerinden yola çıkarak uzun süreli öğrenme, eleştirel düşünme, problem çözme, soru sorma, yaratıcılık, meslek seçimi kodlarının oluşumunu sağlayan veriler elde edilmiştir.

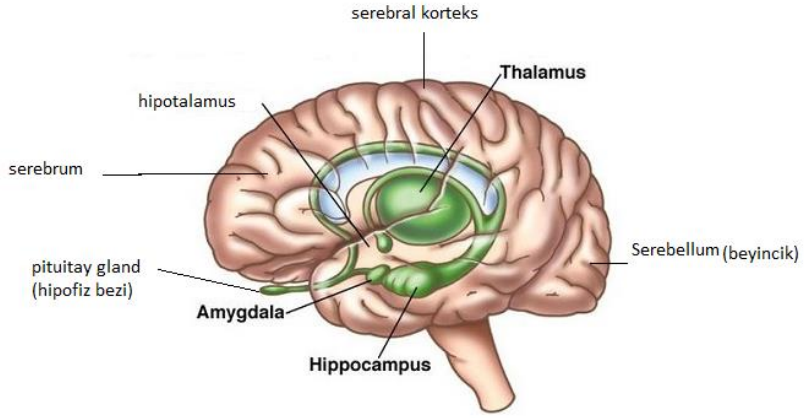
Araştırmanın Sonuçları ve Önerileri: İlkokul öğretmenlerine 36 saatlik teorik ve uygulamalı gerçekleşen STEM eğitimini içeren bu araştırmayla, öğretmenlerin etkili STEM öğretimi için öğretmenlerin STEM entegrasyonu, MTS, STEM öğretimi uygulamaları için gereken öğrenme kuramları ve modellerini daha uzun süre ve çok sayıda uygulama içeren eğitimlere ihtiyaç duydukları, konu alan bilgilerinin STEM etkinlikleriyle geliştirilmesine, teknoloji kullanımını pratik uygulamalarla gerçekleştirdiklerinde öz yeterliliklerinde gelişimler olduğu, STEM eğitiminin ilkokul öğretmenlerinde takım çalışması, beyin fırtınası, eleştirel düşünme, problem çözme becerileri gibi diğer derslerde de kullanabilecekleri yeterliliklerinde olumlu yönde katkı sağladığı ve STEM eğitiminin öğrencilerin eleştirel düşünme, meslek tercihi, uzun süreli öğrenme, problem çözme, soru sorma ve yaratıcılıklarına katkı sağlayacağını kendi deneyimleri üzerinden belirtmişlerdir. En çok zorlandıkları kısım ise STEM entegrasyonu, öğretim programındaki konuyu günlük hayatla bağlamlaştırarak soru sorma, mühendislik problemi oluşturma, ölçme değerlendirme araçları üretme olmuştur. STEM eğitiminin okullarda uygulanması için öğretim programı, materyal ihtiyacı, danışman desteği ve öğrenci sayısı engeli ortaya konulmuştur. İlkokul öğretmenleriyle yapılacak STEM eğitim programlarının eylem araştırması modelinde uzun süreli, teorik ve farklı STEM entegrasyonlarını içeren çok sayıda uygulamayı içeren ve Fen, matematik, mühendislik ve teknoloji alanında teorik eğitimi kapsayan bir içerikte verilmesi önerilir.

Anahtar Sözcükler: STEM eğitimi, İlkokul öğretmen eğitimi, Biyoloji-STEM, Mühendislik tasarım süreci, tematik analiz

APPENDIX

BRAIN AND HELMET

Henry Gustav Molaison, or H.M., known for his pioneering work based on modern neuropsychology. The story of the case. Henry Gustav Molaison was born on 26 February 1926 in Hartford, USA. After an accident with the bicycle, his epilepsy becomes life-threatening; his family applies to the city hospital. Unexpected and sudden electrical discharges of the central nervous system cells result in a seizure. Generally, it takes a few minutes and then passes. If this condition repeats more than once, it is called seizure disorder or epilepsy. There are approximately 40 million epileptic patients in the world. This number is around 700 thousand in our country. William Beecher Scoville, who was examined H.M being a neurosurgeon, was taken a radical decision to perform an experimental surgery to end epilepsy seizures. At the end, this surgery saved H.M.'s life but left behind an unexpected permanent illness. H.M. could not success to form any memory after the day of surgery. He could not keep new data in his mind for more than a few minutes. Although he read any magazine, he kept reading again and again without any cognition even he initially read it. In the case mentioned above, use the following picture below to investigate which part of the brain may have been removed or damaged during H.M. surgery.



Try to find the damaged part of HM surgery on the sheep brain in your dissection cups and mark the parts you find out?

Each group should answer the question, depending on the marked part in your brain sample.

Which kinds of symptoms will be seen in a person if the **marked part** (A, B, C, D) of your brain sample is damaged?

(Depending on the cognitive level of students, you can add or simplify questions. For example, you can add the following questions)

Why can babies not walk before one year old?

Does the adolescence's brain parts change physically? Which part does it change? What is the name of this change in scientifically?

Write the names of structures in your skull to protect the brain parts?

Note: If you are examining this activity with prospective teachers, you can ask them to find the steps of 5 E-learning model in the activity plan.

BIO-MEDICAL ENGINEERING

People who create tools, devices, systems or processes to find solutions or compensate a requirement to a specific problem are called engineers. The main tasks of an engineer are to design, operate, examine, improve and develop the product under different conditions. The new branches of engineering have emerged and diversified with the increasing and complexity of the problems to be solved in daily life. One of these engineering disciplines is bio-medical engineering, which has grown rapidly in the last fifty years. The main focus of biomedical engineering is to understand the systems of the human body, which is a complex system, and to develop the necessary tools, devices, and systems for the solution by identifying the functional disorders. Therefore, individuals who will become bio-medical engineers they attend to science, human anatomy, physiology, basic and applied mathematics, system modeling and analysis methods, basic knowledge about materials, electronics, control and computer, theoretical and practical knowledge about design and production of medical products and devices. Electronic devices such as ECG and MRI used for diagnosis, cautery, catheters, dialysis machines, robotic surgical systems, hearing aids, bone and vascular prostheses, heart valves, etc. and their developments are produced by biomedical engineers. In conclusion, bio-medical engineering works closely with the discipline of biology, a branch of science. This integration is formed by combining different disciplinary knowledge of engineers and doctors and aids to solve real problems in the human body.

The reasons for Epilepsy in TURKEY

In a nationwide survey conducted in Turkey, epilepsy in children between 0-16 years old was found in a ratio of 0.8%. The overall prevalence of epilepsy in Turkey is approximately between 7-12.2 / 1000. Almost 134,000 men in military age are suffering from epilepsy. In general, the reasons for epilepsy cannot be found, but it is known that some factors which often occur in childhood bring to disorder. The reasons may be brain deprivation or injury during labor, chromosome mutations, enzyme deficiency which results from labor or inflammation of the brain membranes (meninges) as a result of meningitis, or tumors in the brain. In addition to these, diseases during pregnancy or alcohol, cigarette, or drug usage of the expectant mother may lead to epilepsy. However, the effects of the head on hard ground (traffic

accidents, skiing, falling on concrete floors, violent trams) and feverish referrals are among the leading causes of epilepsy in children aged 0-16 years.

IDENTIFY- INVESTIGATE

Imagine yourself as a biomedical engineer, and what kind of helmet would you produce to protect the children wouldn't have epilepsy if they fell while cycling? In daily life, the helmet is used to minimize injuries to the athlete, especially during sporting events. The first helmets were made by leather in 1970. The use of helmets in transport and traffic aims to minimize the potential risk of life at the time of an accident in many countries, where helmets are easily available. Motorcycle riders are required to wear helmets. Bike riders also commonly use helmets. Since the 1990s, helmets are made of fiber- reinforced and lightweight resin and plastic. Helmets used in bicycle today are shown below. Foam has been used frequently in helmet production from past and today.

IMAGINE- PLAN

Write your problem statement?

In the last lesson, we examined the structure, functions, and parts of the brain that could be damaged in case of an accident. Now imagine that you are a biomedical engineer, and how would you design a helmet to solve the problem given to you? Why is that? Draw the parts of the helmet you will create and write the necessary materials by reading the limitations.

(Draw your helmet by using solid word)

CREATE

Now create the helmet you designed. At this stage, make sure that the helmet that you design in accordance with your imagination is thick, durable, safe, cost effective and ergonomic.

(Produce your prototype by using 3 D printer)

Limitations:

You can use up to 5 kinds of materials (except glue, scissors)

Thickness of your helmet is less than 10 cm

Maximum weight of your helmet is between 500gr and 1 kg

When your helmet hits the ground hard, the paintball inside will not break.

The cost of your helmet does not exceed 20 TL.

Your helmet can be used in accordance with human anatomy without disturbing the ears, neck and neck.

TEST

Thickness Score

Calculate the material thickness of the helmet you designed with a caliper.

If the thickness is less than 10 cm, you can proceed to the testing phase.

Score		Our score
3	Helmet thickness less than 3 cm	
2	Helmet thickness is between 3 and 6 cm	
1	Helmet thickness greater than 6 cm	

Weight Score

Calculate the weight of your helmet

…….

Score		Our score
3	If the helmet weight is less than 50 gr	
2	Helmet weight is between 50 g-100 g	
1	Helmet weight heavier than 100 g	

Safety Score

Secure a small plastic bag containing one paint ball to the top of the model head. Place your helmet onto the model head, drop the head to the floor, and inspect the paint ball.

Score		Our score
3	The paint ball is not damaged at all.	
2	The paint ball has cracked or leaked	
1	The paint ball is smashed	

Cost

Add up the total cost of materials you used.

……..

Score		Our score
3	Cost is less than 10 pounds	
2	Cost is in the range of 10-20 pounds	
1	Cost is over 20 pounds	

ERGONOMICS……..

Score		Our score
3	The head can be turned right and left.	
2	When using a helmet the ears do not feel discomfort.	
1	The head does not remain in the cavity or does not feel compressed.	

IMPROVE

Redesign the helmet with aspects that can address the challenges you face during helmet making, or can be improved to get a better result.

RETEST

Thickness score:

Weight score:

Our security Score:

Our ergonomics score:

Our cost score:

Your total score

COMMUNICATE

During the showcase, you'll get to share information about your engineering challenge with other teams. What are some things you might want to tell them about engineering helmets, and your design in particular?

Score		Our score
3	The head can be turned right and left.	
2	When using a helmet the ears do not feel discomfort.	
1	The head does not remain in the cavity or does not feel compressed.	

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Personal and Professional Readiness of In-service Teachers of English for Culturally Responsive Teaching

Mehmet Galip ZORBA[1]

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ABSTRACT

Purpose: The aim of this study was twofold. First, it investigated the extent to which in-service teachers of English were personally and professionally ready to carry out culturally responsive teaching (CRT). Second, it aimed to understand teachers' perceptions of CRT.

Research Method: This study was carried out in a sequential explanatory mixed methods design. Accordingly, first quantitative data were gathered in the first phase through administering CRT readiness scale. In the second phase, qualitative data were gathered through semi-structured interviews to gain detailed insights about their perceptions. A total number of 415 in-service teachers of English participated in the quantitative phase of the study, and 12 teachers participated in the semi-structured interviews.

Findings: Quantitative findings showed significant differences between teachers' personal and professional readiness, novice and experienced teachers, and graduates of ELT departments and graduates of ELL and ACL departments. Qualitative findings showed that experience alone was a distinguishable factor for CRT and also underlined the necessity for and the importance of culture-oriented courses in undergraduate English language teacher education.

Implications for Research and Practice: Accordingly, enriching undergraduate English language teacher education programs with culture-oriented courses is a need. Such courses should cover both theoretical and practical sides of multicultural education and CRT. There is also a need to provide more opportunities for teacher candidates to execute teaching practices in real and culturally diverse classrooms. Furthermore, the need for studies focusing on field-specific competencies and real classroom settings are also underlined.

[1] Akdeniz University, Antalya, TURKEY, e-mail: galipzorba@hotmail.com
ORCID: https://orcid.org/0000-0002-0100-2329

Introduction

The 21st century is mostly associated with globalization, information, technology and digitalization. These burgeoning phenomena are reshaping today's world in which people have "access to knowledge and information through multiple and varied media and sources" (Porto, 2010, p. 45). In addition, these media and sources provide a plethora of cultural exchanges in which not only messages and knowledge, but cultures are also transmitted without spatial distance (Aigrain, 2012; Hossain & Aydin, 2011; Koc-Damgacı & Aydin, 2018; Krisneepaiboon, 2015; Siapera, 2006). All these developments have consequently paved the way for dramatic changes in the role and nature of culture, making it a dynamic and multi-faceted concept. As Kramsch (2014) underlines, such a postmodern space has deterritorialized culture, by suggesting that the term culture no longer means "shared membership in one singular community of like-minded individuals" (p. 250). Accordingly, multiculturalism, cultural hybridity, shifting, and multiple identities are now social facts of "our everyday life, evident on a daily basis in educational, vocational, and recreational" contexts (Tan, 2008, p. 146).

As Lendis (2014) argues, educational goals should be accommodated to meet current societal and global demands, and thus students must be equipped with the necessary tools and skills to get by in today's world. Considering rapidly diversifying demographic make-up of today's schools and classrooms, multicultural education is a fact and need to which educational policy-makers, administrators and practitioners need to pay regard. Accordingly, multicultural education can be considered the reflection of multiculturalism in educational contexts (Bagceli Kahraman & Onur Sezer, 2017; Tonbuloglu, Aslan & Aydin, 2016). Based on such tenets as equity, social justice, understanding, and respect for differences (Akinlar & Dogan, 2017), multicultural education is described as the amalgamation of an idea, an educational reform movement, and a process whose ultimate aim is to provide "an equal opportunity to learn in school" for all students "regardless of their gender, social class, and ethnic, racial, or cultural characteristics" (Banks, 2010, p. 3). Holding this view, it is clear that traditional teaching practices would fail in such culturally diverse settings even if educational policies, national curricula, syllabi and coursebooks are re-framed concerning multicultural education because it is still the teacher who actualizes all these plans on paper in the classroom (Richards, 2001). However, not all teachers know what to do and how to do in order for actualizing the requirements of multicultural education. Therefore, culturally responsive teaching (hereafter CRT) is proposed to fill this gap.

Culturally Responsive Teaching

CRT is considered the extension of multicultural education in the classroom as multicultural education is mostly related to plans, ideas, and organizations on paper. CRT is also anchored in the assumptions that pedagogy must cater to academic success, provide students with opportunities "to develop and maintain cultural competence" and cultivate "critical consciousness" so that students perceive, criticize, and challenge social inequalities (Ladson-Billings, 1995, p. 160). When academic

knowledge and skills are given in appropriate contexts involving students' real experiences and cultural backgrounds, they become more meaningful, appealing; and thus, are learned and internalized more easily (Au & Kawakami, 1994; Bishop & Berryman, 2006; Ladson-Billings, 1995; Sleeter & Owuor, 2011; Villegas & Lucas, 2002). Holding these assumptions as primary tenets, Gay (2000) proposes CRT "with a stronger focus on teachers' strategies and practices that is, the doing of teaching" (Muniz, 2019, p. 9), and defines CRT as "using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (Gay, 2000, p. 29). Echoing Gay (2000, 2002), Siwatu (2007) also argues that the primary function of CRT is to provide students with essential knowledge and skills so that they can act in harmony with mainstream culture while keeping their unique cultural identities and native languages.

Various conceptual frameworks have been proposed for CRT by many researchers. Gay (2002) postulates five main elements for CRT; (1) developing a knowledge base about cultural diversity, (2) proliferation of ethnic and cultural diversity content for culturally relevant curricula, (3) demonstrating cultural caring, (4) building learning communities and communicating with ethnically diverse students, and (5) responding to ethnic diversity in the delivery of instruction (p. 106). Siwatu (2007) regards CRT as an approach to teaching and learning that requires specific competencies such as integrating students' cultural backgrounds and learning preferences with curriculum, creating a culturally compatible classroom atmosphere, using various assessment techniques, and fostering cultural enrichment. In a similar vein, Aceves and Orosco (2014) identify six themes of CRT including (1) instructional engagement, (2) culture, language, and racial identity, (3) multicultural awareness, (4) high expectations, (5) critical thinking, and (6) social justice, and underline that teachers should;

- integrate students' cultural knowledge with the course content,
- understand how students' cultural, linguistic, and racial identities develop along with their impacts on learning,
- use multicultural awareness skills to observe and reflect on their own cultural values, beliefs and perceptions, and to overcome cultural stereotypes and prejudices,
- hold high expectations of academic success, and help students to reach their potential through using challenging and engaging exercises,
- instill the ways for critical thinking into students by merging their cultural and linguistic experiences with challenging learning experiences (pp. 9-12).

Despite many studies presenting practical suggestions and empirically revealed positive outcomes of CRT, it should also be underlined that implementation of CRT is not flawless; on the contrary, it is not executed beyond the superficial level, and this paves the way for a little or no room for adapting teaching to the needs of culturally diverse students (Abacioglu et al., 2019).

CRT and English Language Teaching

Holding a global status, the English language has already become the medium of interaction among many non-native speakers (Crystal, 2003; McKay, 2002) which has led to diminishing the role of native speakers in ELT pedagogy (Byram, 2008; Graddol, 2000; Matsuda, 2006; McKay, 2002). This paradigm shift has culminated in that one of the ultimate aims of ELT is preparing students to communicate effectively and appropriately in various settings where speakers' world of linguistic and cultural origins are mostly diverse (Deardorff, 2006; Kiczkowiak, 2019; Schreiber, 2019; Seidlhofer, 2011) and "to which each speaker brings their own cultural frames of reference" (Matsuda, 2017, p. xiii). From this standpoint, ELT pedagogy "goes beyond acquisition of linguistic, non-linguistic etc. knowledge" (Porto, 2010, p. 46) and incorporates integrating students' own culture into course content (Cortazzi & Jin, 1999), revising culturally inappropriate materials (Matsuda, 2012; Piątkowska, 2015), valuing cultural diversity (Chlopek, 2008; Corbett, 2003), creating culturally tolerant classroom atmosphere (Brown, 2007), tolerating different ideas, contrasts between these new ideas and students' prior beliefs and values along with reconciliation (Porto, 2010; Tseng, 2002) along with using various language learning strategies and assessment types (Gu, 2012; Oxford, 2017). These are considered the current tenets of ELT pedagogy which are also akin to those proposed by CRT.

There is an increasing body of literature on CRT practices in language classrooms and English language teacher education. Recent studies carried out with in-service teachers of English have provided insights about to what extent teachers apply CRT in the classroom (Rhodes, 2013), how effectively they address cultural diversity (Chen & Yang, 2017) along with the effects of such practices (Heineke, 2014; Lin, 2015) and teachers' competency on CRT (O'Keeffe, 2019; Smith, 2020). Many of such studies encapsulate the need for teaching English in a culturally and linguistically responsive way and research investigating CRT practices of in-service teachers of English.

CRT in Turkey's Case

Despite myriad studies on CRT in the international literature (e.g. Aceves & Orosco, 2014; Gay, 2002; Hsiao, 2015; Muniz, 2019; Siwatu, 2007; Siwatu et al., 2016; Sleeter & Owuor, 2011; Villegas & Lucas, 2002), our national literature offers a limited amount of studies whose focus is solely on CRT and in-service teachers. Findings of Karatas and Oral's (2015) study showed that teachers found themselves "inadequate to actualize" CRT in their classrooms due to "their personal apprehension, education programs and school opportunities" (p. 54). In a similar vein, as Paksoy (2019) study revealed, Turkish teachers of English did not consider themselves ready to face the challenges stemming from cultural differences due to lack of training (p. 1167). Findings of Paksoy's (2017) study showed a similar portrait revealing that teachers paid "limited and superficial attention" to culturally different students, and they did not hold essential qualifications to respond to the expectations of culturally diverse students (p. 183). In addition, Kotluk and Kockaya's (2018) study revealed that for the majority of teachers, different cultural values held by teachers and students negatively influenced the teaching-learning process and integrating different cultural values into

education negatively impacted on social cohesion. Therefore, considering the multicultural mosaic in Turkey, Nayir and Saridas (2020) underline that there is a need for educational policies focusing on CRT in our country. Furthermore, Nayir and Taskin's (2020) study also showed that in-service teachers were not wholly insufficient as they were able to merge the conventional methods with the special ones while managing cultural diversity in their classrooms whereas some of them preferred to ignore cultural diversity as a way to cope with it. Although findings of these studies are adequate to delineate problems related to the practice of CRT in Turkey's case, they do not portray a whole picture of teachers of English in terms of CRT in the national context.

Considering the conceptual framework of CRT, it is clear that CRT assigns teachers numerous responsibilities and requires various competencies. Teachers' readiness to take these responsibilities and to perform these competencies plays a crucial role in actualizing CRT, yet national studies show that teachers are having problems performing CRT. More importantly, national studies lack showing the status of Turkish teachers of English in terms of CRT. Therefore, to what extent in-service teachers of English are ready to work in such a culturally diverse environment is still an important question waiting to be answered. Hence, the aim of this study is to focus on in-service teachers of English and seek answers to the research questions given below.

1. To what extent are in-service teachers of English personally and professionally ready to carry out their teaching practices in a culturally responsive way?
    a. Is there a statistically significant difference between professional and personal readiness of in-service teachers of English?
    b. Do teaching experience and BA degree lead to a statistically significant difference in personal and professional readiness of in-service teachers of English for CRT?
2. How do in-service teachers of English perceive multiculturalism and CRT? What kind of problems do they encounter in the classroom, and what solutions do they find to solve these problems?

Method

Research Design

This study was conducted in a sequential explanatory mixed methods design. This design is characterized by gathering quantitative data in the first phase then the qualitative data are gathered to explain and interpret the results stemming from the first data set in the second phase (Creswell, 2009, p. 211). Accordingly, these two different types of data sets were used in answering the first research question and two sub-questions (Teddlie & Tashakkori, 2009) although the priority was given to quantitative data. In addition, the qualitative data were also gathered to gain deeper insights about participants' perceptions of CRT, the problems they encountered in the classroom, and their solutions to these problems.

Sampling and Participants

In this study, the convenience sampling method was used as it allows researchers to gather "samples that are both easily accessible and willing to participate in a study" (Teddlie & Yu, 2007, p. 78). Furthermore, the sample does not represent any group apart from itself, and the aim is not to make generalizations about the wider population (Cohen, Manion & Morrison, 2007, p. 114). Hence, a total number of 415 teachers of English participated in the quantitative phase of the study. These teachers were collected from an online community of teachers that was popular in a social network site after an open invitation that informed the target population about the study. A total number of 415 teachers of English attended the quantitative phase of the study. The demographic make-up of the teachers of English is given in Table 1.

Table 1

Teachers' Demographics

		f	%			*f*	%
Sex	Female	335	80.7	School Type	State	324	78.1
	Male	80	19.3		Private	91	21.9
Age	25-29 years old	122	29.4	Teaching Experience	1-3 years	76	18.3
	30-35 years old	138	33.3		4-6 years	86	20.7
	36-39 years old	74	17.8		7-9 years	60	14.5
	40-50 years old	81	19.5		10 years +	193	46.5
Teaching Context	Primary School	121	29.2	Bachelor's Degree	ELT Dep.	277	66.7
	Lower Secondary School	179	43.1		Other Dep.*	138	33.3
	Upper Secondary School	115	27.3				
School location	Aegean Region	46	11.1	Marmara Region		80	19.3
	Black Sea Region	43	10.4	Mediterranean Region		116	27.9
	Central Anatolia Region	47	11.3	Southeastern Region		50	12.1
	Eastern Anatolia Region	33	7.9				

* Other Departments involve teachers holding BA level diplomas from English Language and Literature and American Culture and Literature departments along with the certificate of English language teaching.

Data Collection

Two different data collection tools were employed in this study. In the first phase, CRT readiness scale designed by Karatas and Oral (2017) was administrated as it is more appropriate to the Turkish context compared to the other scales developed through data generated from American pre-service teachers (see Hsiao, 2015; Siwatu, 2007). The scale used in this study incorporates 21 items designed in a 5-point Likert-type scale and categorized in personal readiness and professional readiness dimensions. The reliability of the scale was found .92 for personal readiness dimension, .87 for professional readiness dimension and .90 for the whole scale (Karatas & Oral, 2017, p. 253). In this study, the Cronbach's alpha coefficient value was found .85 for personal readiness, and .89 for professional readiness and .86 for the whole scale. The scale was re-designed in an online form then was sent to teachers via e-mail. It was administrated in Turkish and no changes were made in the scale.

In the second phase, the qualitative data were gathered through face-to-face semi-structured interviews to gain "rich and varied insights about the phenomenon under

investigation" (Dornyei, 2007, p. 126). First, a set of open-ended questions were designed, and then opinions from three different experts of culture and English language teaching were taken for the validity of the questions. Accordingly, some questions were rephrased, whereas some were excluded. A total number of 8 open-ended questions were addressed to the participants, and some follow-up questions were also asked when necessary to elicit vague responses. At the end of the quantitative data collection tool, participants were asked if they were volunteering to participate in the interviews, and a total of 12 teachers of English volunteered to participate. Of 12 interviewees, 8 were female, and 4 were male, and 7 teachers were graduates of ELT departments, whereas 5 teachers were graduates of ELL departments, holding the certificate of English language teaching. All the interviewees work in state schools in different parts of Turkey and have been teaching English for at least two years. The open-ended interview questions were put to the respondents in Turkish by the researcher so that they could clearly understand and thoroughly respond to each of them, and their responses were recorded and then transcribed verbatim. During the interviews, the researcher acted as a moderator. That is to say, the researcher kept the interviews to the point, asked the open-ended questions neutrally and formally, and added some follow-up questions to elicit responses (Cohen et al., 2007; Patton, 2015).

Data Analysis

Quantitative data were analyzed through the Statistical Package for Social Sciences (SPSS) edition 23. Mean scores were used for answering the first research question. For answering the two sub-research questions, data were first analyzed in terms of normality to decide parametric or non-parametric tests would be applied. Descriptive statistics were employed to test the normal distribution of the data set. This method pays regard to skewness and kurtosis values generated from the data set to test normality (Tabachnick & Fidell, 2013). As presented in Table 2, skewness and kurtosis values were found between ± 2, which was considered the evidence of the normal distribution (George & Mallery, 2010). Accordingly, for answering the first and second sub-research questions, parametric tests were employed. Table 2.

Table 2

Descriptive Statistics

Scale and Dimensions	*Skewness*	*Kurtosis*
CRT Readiness Scale	-.099	.256
• Personal Readiness Dimension	-.294	-.108
• Professional Readiness Dimension	.132	-.453

Qualitative data were analyzed by employing thematic analysis. In this process, the procedure proposed by Braun and Clarke (2013, pp. 202-203) was followed. Accordingly, audio recordings were first transcribed into a Word 2010 document, and then these documents were imported to Atlas.ti, a qualitative data analysis software. The transcriptions were exposed to multiple readings in order for familiarization and generating codes and themes as no pre-determined codes or themes were used. Then,

the transcriptions were reviewed for double check by another expert to increase reliability.

Findings

Findings Related to the CRT Readiness Scale

Findings related to the personal readiness dimension showed that teachers of English who participated in the study found themselves personally ready to teach in a culturally responsive way (M=4.21). As shown in Table 3, the highest mean scores attached to the attributes of not allowing any discrimination (M=4.78) and enjoyment in interacting with culturally different people (M=4.53). These were followed by taking students' own culture into consideration while teaching (M=4.49) and having personal curiosity about different cultures (M=4.42). Surprisingly, the lowest mean scores were related to teachers' preferences in teaching in places where cultural diversity was most observable (M=3.55) and being able to teach anywhere in Turkey considering such cultural diversity (M=3.70).

Table 3

Means and Standard Deviations of Personal Readiness Dimension

Items		*M*	*SD.*
5.	In my classroom, I don't allow my students to discriminate against one another due to their cultural differences.	4.78	.494
4.	I enjoy interacting with culturally different people.	4.53	.604
3.	I know I need to consider my students' cultural values while I guide their learning.	4.49	.585
2.	I am curious about the cultural values that my students have.	4.42	.647
9.	In my opinion, students should be encouraged to give specific examples related to their own cultures during class time.	4.40	.581
10.	I think that students' academic success will increase if teaching is carried out considering their cultural environment in which they grew up.	4.28	.700
12.	I think that our education system –from preschool to university– should be re-shaped to represent cultural diversity in Turkey.	4.19	.795
6.	In my opinion, it's fun to teach in a culturally diverse classroom.	4.10	.830
8.	Both inside and outside the classroom, I would like to increase interactions with my students who are not native speakers of Turkish by learning words and sentences from their native languages.	4.07	.864
1.	I'm ready to teach in a culturally diverse classroom.	3.99	.906
7.	Considering cultural diversity, I can teach anywhere in Turkey.	3.70	1.09
11.	I prefer to teach in a place where there are culturally different people than me.	3.55	1.01
	Personal Readiness Dimension TOTAL	4.21	.476

Similarly, when the professional readiness of the teachers is considered, it is seen that these teachers were not certain about being professionally ready to teach in a

culturally responsive way (*M*=2.89). As shown in Table 4, the highest mean score attached to teachers' awareness of using students' own cultures as a tool was found 4.07 followed by the teachers' awareness of cultural diversity being raised during their undergraduate education under the influence of their lecturers'/professors' personalized narratives and experiences was found 3.15.

The lowest mean scores were mostly related to their undergraduate programs. Accordingly, many teachers of English thought that the textbooks studied in their undergraduate education courses were not adequate for involving knowledge about cultural diversity in Turkey (*M*=2.34). Similarly, their undergraduate programs were not found sufficient for raising awareness of cultural diversity (*M*=2.47). Finally, they did not gain much information about different cultures in Turkey throughout their undergraduate education (*M*=2.62).

Table 4

Means and Standard Deviations of Professional Readiness Dimension

Items		*M*	*SD.*
18.	I'm aware that students' cultural lives should be used as a tool to fulfill their learning objectives.	4.07	.651
21.	I raised awareness of cultural diversity thanks to my lecturers/professors who included their personal lives and experiences in our courses.	3.15	1.17
14.	I think that the compulsory courses I took throughout my undergraduate education have contributed to me in terms of sensitivity to cultural values.	3.00	1.23
16.	Throughout my undergraduate education, I raised awareness of cultural diversity in Turkey.	2.81	1.11
13.	Throughout my undergraduate education, my lecturers/professors raised awareness of cultural diversity in Turkey.	2.77	1.18
20.	I think that the electives I took throughout my undergraduate education have contributed to me in terms of sensitivity to cultural values.	2.74	1.13
17.	Throughout my undergraduate education, I gained knowledge about different cultures in Turkey.	2.62	1.09
15.	I consider my undergraduate program adequate for raising awareness of cultural diversity in Turkey.	2.47	1.03
19.	I consider the textbooks studied in undergraduate education courses adequate for involving knowledge about cultural diversity in Turkey.	2.34	.982
	Professional Readiness Dimension TOTAL	2.89	.819

In order to seek answers to the first sub-research question, the paired samples t-test was conducted. As shown in Table 5, findings showed that personal readiness scores of teachers of English were higher than those related to professional readiness, and the paired samples t-test results revealed that this difference was statistically significant (p<.01).

Table 5

Paired Samples T-test Results

	Paired Differences					
	M	*SD*	*St. Error Mean*	*t*	*df*	*Sig (2-tailed)*
Personal Readiness Professional Readiness	1.32	.862	.042	31.212	414	.000*

*p<.01

These results are in line with those revealed in Ozudogru's (2018) study which shows a similar statistically significant difference between participants' personal readiness for CRT scores and their professional readiness scores. Considering the focus of the items given in the professional readiness dimension, it can be deduced from these results that undergraduate teacher education programs in Turkey have problems in preparing teacher candidates for teaching in a culturally responsive way.

In order to seek answers to the question that if teaching experience leads to a statistically significant difference in personal and professional readiness of teachers of English for CRT, the One-Way ANOVA test was conducted, and results are given in Table 6.

Table 6

One-Way ANOVA Test Results

		Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
Personal Readiness	Between Groups	2.456	3	.819		
	Within Groups	91.481	411	.223	3.667	.012
	Total	93.937	414			
Professional Readiness	Between Groups	18.221	3	6.074		
	Within Groups	259.532	411	.631	9.618	.000*
	Total	277.753	414			

*p<.01

As shown in Table 6, results revealed that there was not any statistically significant difference among groups in terms of personal readiness (p>.01). However, statistically significant differences were found between teaching experience and teachers' professional readiness (p<.01). Accordingly, Gabriel post-hoc test was conducted as the significance value of Levene's test of homogeneity of variances was found .562, and the group sizes in teaching experience were not equal. As shown in Table 7, Gabriel post-hoc test results indicated that teachers who had 1 to 3 years of teaching experience (M=3.32) had higher mean scores than teachers who had 4-6 years of teaching experience (M=2.86), teachers who had 7 to 9 years of teaching experience (M=2.70), and teachers who had 10 years of teaching experience and more (M=2.78), and these differences were found statistically significant.

Table 7

Gabriel Post-Hoc Test Results

Teaching Experience (I)	*Teaching Experience (J)*	*M. Dif. (I-J)*	*Std. Error*	*Sig.*
1-3 years	4-6 years	.45859	.12511	.002*
	7-9 years	.61608	.13723	.000*
	10 years and more	.53253	.10761	.000*

*p<.01

The second sub-research question aimed to reveal if teachers' undergraduate programs led to a statistically significant difference in personal and professional readiness for CRT. The independent samples t-test was conducted, and the results are given in the table below. As shown in Table 8, although ELT graduates had lower scores (M=4.17) than the graduates of English Language & Literature (ELL) and American Culture & Literature (ACL) departments (M=4.29), when the personal readiness dimension of CRT is considered, this difference was not statistically significant. Similarly, ELT graduates had lower scores (M=2.79) than the graduates of ELL and ACL departments (M=3.07) in terms of professional readiness for CRT, yet the t-test results showed that this difference was statistically significant.

Table 8

Independent Samples T-test Results

		Mean Dif.	*Std. Error Dif.*	*t*	*df*	*Sig. (2-tailed)*
Personal Readiness	Equal variances assumed	-.12562	.04931	-2.548	413	.011
Professional Readiness	Equal variances assumed	-.28187	.08431	-3.343	303.379 413 258.748	.001*

*p<.01

In a nutshell, quantitative data showed that the personal readiness of teachers of English was high for CRT although participating teachers were not professionally ready for teaching in a culturally responsive way. In terms of the teaching experience, results showed that teachers of English with 1 to 3 years of experience had higher scores of professional readiness than those who had 4 years or more of classroom experience. The results also showed that graduates of ELT departments had lower scores in professional readiness compared to graduates of ELL and ACL departments.

Findings Related to Semi-Structured Interviews

Qualitative findings showed that almost all of the interviewees thought they were personally ready to teach in culturally diverse classrooms. When their reasons were interrogated, it came to the surface that openness to different cultures, having cultural tolerance, and regarding cultural diversity as richness were the leading markers. A male teacher's response clearly portrays this:

T7: "*I can say that I'm personally ready to teach in culturally diverse classrooms because I've always been open to different cultures and never had prejudices against them. I think cultural diversity cultural richness rather than a problem. I'm trying to reflect this mindset to my job.*"

Almost all of the interviewees stated that they did not think they were professionally ready due mainly to a lack of experience and in-service education related to CRT. A female teacher underlined that "*I don't think I'm professionally ready as I'm not an experienced teacher. Although I gradually develop myself about teaching in culturally diverse classrooms, I still need more experience to say I'm ready*" (T4). In a similar vein, another female teacher stated:

> T5: "*I can't say I'm professionally ready to do so because I have not attended any in-service seminars or workshops about it. But I'd love to as the number of culturally diverse students increases day by day, and as teachers, we need to learn what to do.*"

Interviewees were also asked to state the differences between personal readiness and professional readiness. Findings revealed that most of the teachers drew a dichotomy between personal and professional readiness. Accordingly, personal readiness for CRT required a culturally tolerant and open mindset along with acceptance of different cultures, whereas professional readiness required knowledge, skills and experience. More importantly, although teachers drew a distinction between personal and professional readiness, a great majority of them underlined that personal readiness must be amalgamated with professional readiness in order to teach in culturally diverse classrooms. A female teacher summarized the importance of both type of readiness as follows;

> T5: "*I don't think a teacher who isn't culturally tolerant can teach in such a way* [CRT]. *That's why I think personal readiness is the must-be requirement of professional readiness. Professional readiness involves knowledge and skills, and it also refers to the difference between what you should do and what you are doing in the classroom. Therefore, the most important thing is merging them.*"

In order to gain detailed insights about quantitative findings related to teaching experience, interviewees were asked to explain to what extent experience was important to teach in a culturally responsive way. All teachers highlighted the importance of experience, yet they also stressed that the quality of the experience had a more critical role.

> T1: "*Yes, experience is important, yet for vocational development, knowing what to do and how to do is also important, especially if the case is cultural issues.*"

> T4: "*Although experience is one of the most important elements, it is not enough… If experience is not supported with knowledge and skill, it just refers to saying I have been teaching English for 3 years or 5 years.*"

> T9: "*In my opinion, experience is always important, especially if the matter is teaching in a culturally diverse classroom. But experience does not mean how long you have been teaching English; it is related to increasing knowledge, developing skills and practice.*"

One of the important findings of this study was the statistically significant difference between the graduates of ELT departments and the graduates of ELL and ACL departments in terms of professional readiness for CRT. In order to seek explanations to this finding, interviewees were asked to explain what contributions their undergraduate program made for teaching in a culturally responsive way. ELT graduates underlined that their undergraduate education was well-designed and instructional to learn all the essentials related to language teaching, yet it was not sufficient to prepare them for teaching in a culturally diverse classroom due mainly to the lack of courses focusing on CRT and multicultural education, and the lack of teaching practices in real and culturally diverse classrooms.

T1: "*…all those lesson plans, activities and micro-teachings were designed to teach in flawless classrooms. I only experienced two different classrooms while doing my teaching internship, so most of us don't know what is going on in real classrooms or what problems occur in culturally diverse classrooms…*"

T11: "*I can say that my undergraduate education was instructional… But I can't say the theoretical part of it was not helpful because I didn't take any courses about culture or cultural issues. I wasn't trained to teach in culturally diverse classrooms...*"

T12: "*I can't say that my undergraduate education prepared me to teach in culturally diverse classrooms. Culture was a part of some of our courses, but it was only limited to superficial elements related to British or American cultures, and unfortunately, there were no culture-oriented courses.*"

Graduates of ELL departments pointed out that although they had shortcomings in language teaching and needed more practice and experience, their undergraduate education helped them increase their knowledge about cultural issues and also increase their cultural understanding and sensitivity.

T6: "*There were only 2-3 courses related to English language teaching … but I think my undergraduate education helped me better understand other cultures as there were many courses directly related to culture*."

T8: "*ELL departments don't aim to train English teachers. That's why I still have some deficiencies in practice… There were many courses about culture in my undergraduate program, and they helped me increase my knowledge and understanding of different cultures.*"

In order to seek answers to the last research question, interviewees were asked questions about their perception of multiculturalism and CRT, the problems they encountered, and the strategies they used to solve these problems. Qualitative findings showed that multiculturalism was mostly associated with cultural and linguistic diversity, ethnicity and acceptance of such differences whereas CRT was mostly associated with teaching paying regard to all kind of cultural differences along with teaching against marginalization and discrimination.

T2: "*I think multiculturalism refers to a society which consists of different ethnic groups and acceptance of them as richness rather than a challenge to the social order...* [CRT]

means taking cultural differences into consideration and prevention of any kind of discrimination while teaching."

T3: "*Multiculturalism is a society where linguistically or culturally various ethnic groups live together in harmony. So, it refers to cultural diversity… I can define* [CRT] *as paying attention to students' cultural backgrounds in the classroom and create a culturally respectful classroom atmosphere so that all students feel safe.*"

When it comes to the problems related to CRT, teachers mostly encountered communication problems in the classroom due to linguistic diversity and a male teacher's responses clearly shows how teachers try to solve such problems:

T8: "*I have many linguistically diverse students and sometimes it is difficult to communicate with them. So, I use gestures and mimes, and also I learned some basic words and phrases in their native language.*"

Another problem they encountered was discrimination in the classroom due to linguistic diversity, and a female teacher described this problem and her solution as follows;

T10: "*Some students ridicule others as they speak their native language, so they feel left out. In such cases, I often tried not to overreact, communicated with those students one-to-one and explained that their behavior was unacceptable.*"

Teachers also underlined that some cultural elements in course materials were unfamiliar to their students or students' own culture was underrepresented. In such cases, they tried to give some extra examples or prepared some extra activities related to students' own culture.

T12: "*The theme of one unit is 'At the fair' but there were a lot of students who have never been to a fair, so all those words and pictures were unfamiliar to them. I tried to solve this problem by converting words and phrases about 'fair' to playground and prepared some extra activities.*"

Discussion, Conclusion and Recommendations

This study was carried out to determine to what extent in-service teachers of English were personally and professionally ready to carry out their teaching practices in a culturally responsive way. It further examined if undergraduate education and teaching experiences led to a meaningful difference in terms of teachers' readiness. Finally, the results of this study revealed how teachers perceived multiculturalism and CRT with particular attention paid to the problems they encountered in their classrooms.

Quantitative findings of this study revealed that teachers of English were personally ready to teach in a culturally responsive way. Qualitative findings also underpinned this result and explained why teachers did not think they were professionally ready for CRT due mainly to a lack of experience and in-service education related to CRT. However, two of the quantitative findings are significant to pose problems related to the personal dimension of readiness for CRT. Considering

cultural diversity, most teachers did not find themselves able to teach anywhere in Turkey, and they did not prefer to teach in places where there were culturally different people. These findings can be explained with teachers' lower scores of professional readiness, their lack of education and experience related to CRT. These findings are also in line with other findings existing in the related literature. Yildirim's (2019) study showed that classroom management problems resulting from cultural differences made teachers feel wary and anxious as they did not know how to handle such problems due to lack of training. Focusing on exemplary teachers' CRT practices, O'Keeffe's (2019) and Smith's (2020) studies revealed that these teachers attached great importance to professional development, and they effectively used peer observation and debriefing to improve their teaching. Furthermore, it should also be underlined that teachers need to approach curricula and course materials with a critical eye, reflect on their teaching practices, and re-shape them (Chou et al., 2018; Civitillo et al., 2019); and thus, CRT might be more time-consuming, overwhelming, and demanding for teachers.

When it comes to if teaching experience was one of the leading factors in the improvement of teachers' readiness for CRT, qualitative findings showed that teaching experience alone was not a distinguishable factor as teachers who had 1-3 years of teaching experience had higher scores in professional readiness dimension than the others. Qualitative findings may shed light on the reason behind this finding as interviewees clearly stated how important the quality of experience was for CRT. Accordingly, the quality of experience was mainly associated with teaching practice underpinned by increasing theoretical knowledge and developing CRT skills. The reason why novice teachers had higher professional readiness scores can also be explained with unfamiliar nature of CRT for experienced in-service teachers. CRT is "a new territory" for many in-service teachers; and thus, they are expected to have "a sense of discomfort and uncertainty" when they consider "a new paradigm or value system with regard to teaching practice" (McKoy et al., 2017, p. 59) whereas novice teachers tend to "seek out advanced training, better manage their planning, and deepen their use of community resources and family involvement" (Sobel & Taylor, 2015, p. 40).

Quantitative findings of this study also revealed that graduates of ELT departments had lower scores in professional readiness for CRT compared to graduates of ELL and ACL departments. Accordingly, a part of the qualitative phase of this study was designed to seek explanations for this finding. The results revealed that undergraduate ELT education programs were not found sufficient in preparing teacher candidates for CRT as they lacked courses focusing on CRT and multicultural education along with the problems related to teaching practices in real and culturally diverse classrooms. Likewise, there are various studies underlying that the lack of courses focusing on culture in English language teacher education program is one of the biggest problems (Diaz & Arikan, 2016; Karakas, 2012; Yavuz & Zehir-Topkaya, 2013), and more importance should be attached to teaching practices (Atay, 2007, 2008; Seferoglu, 2006). To be more specific, as Mahalingappa and Polat (2013) point out, although there is increasing importance attached to culture, it is superficial and

restricted to "the role of cultural practices and perspectives" and "cultural identity in L2 development". More importantly, "content on new instructional trends" and "methods that incorporate culturally competent pedagogy" are the significant missing parts of English language teaching education in Turkey" (p. 373). Possible impacts of these curricular problems are also evident in recent studies. Some of these studies reveal that English language teacher candidates feel not competent enough in planning, practice and assessment stages of multicultural education as their undergraduate education does not focus on multicultural education (Caliskan, 2019). Although teacher candidates appreciate the value added to the classroom by culturally diverse students, they have problems in relating the way they teach to the theories of language, learning and culture (Yuce, 2019). Furthermore, teacher candidates find their undergraduate courses insufficient in terms of their contributions to gain the 21st-century skills (Aydin, 2019, p. 92), and they also regard themselves less competent in effectively studying culturally and socially different groups and adapting to changes in different environment and roles (Aydin, 2019, p. 80).

As stated before, interviewees associated multiculturalism mostly with cultural and linguistic diversity, ethnicity and acceptance of social and cultural differences. From this standpoint, it can be said that teachers' perception of multiculturalism is limited as multiculturalism transcends these aspects and involves all the other differences such as "sexual orientation, disability, class status and religious/spiritual orientation" (APA, 2002, p. 10). Unlike multiculturalism, teachers' perception of CRT is more comprehensive as it incorporates the most significant aspects such as teaching paying regard to all kind of cultural differences along with teaching against marginalization and discrimination. When it comes to solutions that teachers found to overcome problems occurred in the classroom, it can be said that they tried to make learning more relevant to and meaningful for culturally diverse students (Gay, 2000) through taking ethnic or cultural diversity into consideration while teaching in the classroom (Gay, 2002), integrating students' cultural backgrounds (Siwatu, 2007) and cultural knowledge (Aceves & Orosco, 2014) into instruction, and they also tried to create a culturally congruent classroom environment by preventing any kind of discrimination in the classroom (Siwatu, 2007). However, some important aspects such as developing a knowledge base, building learning communities (Gay, 2000) or using various assessment techniques for culturally diverse students (Siwatu, 2007) still remain outside. There is a predominant 'go and teach' approach imposed on in-service teachers and "little supervision and career assistance" are provided for them (Ozturk & Aydin, 2019, p. 196). Considering all these and the problems related to teachers' undergraduate education, it is encouraging that teachers try to implement CRT as much as they can.

In conclusion, the quantitative and qualitative findings of this study portrayed the strengths and weaknesses of in-service teachers of English in CRT. In the light of these findings, it is suggested that undergraduate English language teacher education programs should be enriched with culture-oriented courses covering both theoretical and practical sides of multicultural education and CRT as any expectation for "establishing relationships among cultural groups" requires "an understanding and

change in teachers' notions of culture" (Arikan, 2011, p. 236). In addition, more opportunities should be provided to teacher candidates so that they can execute teaching practices in real and culturally diverse classrooms. In this way, they can also transfer their knowledge and skills related to multicultural education and CRT into practice (Siwatu et al., 2016). As for in-service teachers, seminars and workshops about CRT practices should also be arranged. Yet, as Arikan (2019) underlines, traditional professional development activities still remain problematic in terms of effectiveness; and thus, there is a need for platforms of language teacher communities where teachers can "reify and concretize the abstract, on-paper experiences" (p. 12).

This study has three major limitations. First, the CRT readiness scale scores may not reflect in-service teachers' actual readiness as the scale relies on self-reporting. Second, because the scale focuses on teachers' preparedness for CRT, it is neither competence- nor field-specific. Third, data gathered from semi-structured interviews may not reflect the experiences of other in-service teachers. Accordingly, future studies on CRT should focus on field-specific competencies, especially by using a wealth of qualitative data gathering tools such as classroom observations, keeping diaries and field notes to deepen our understanding of CRT practices. Furthermore, there is also a need for studies aiming to evaluate curricula, course syllabi or course materials in relation to CRT.

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İngilizce Öğretmenlerinin Kültürel Olarak Duyarlı Öğretime Yönelik Kişisel ve Mesleki Hazırbulunuşlukları

Atıf:

Zorba, M. G. (2020). Personal and professional readiness of in-service teachers of english for culturally responsive teaching. *Eurasian Journal of Educational Research 88,* 41-66. DOI: 10.14689/ejer.2020.88.2

Özet

Problem Durumu: 21. yüzyıl ile birlikte küreselleşme, bilgi, teknoloji ve dijitalleşme gibi olgular yaşadığımız dünyayı değiştirmiş ve çokkültürlülük, kültürel melezlik ya da çoklu kimlik gibi kavramları günlük yaşantımızın bir parçası haline getirmiştir. Alanyazında da belirtildiği gibi eğitimsel amaçların mevcut sosyal ve küresel ihtiyaçlara uyması gerekmektedir. Dolayısıyla, öğrencilere onları günümüzün çokkültürlü dünyasıyla bütünleştirecek gerekli becerilerin kazandırılması esastır. Günümüz okullarında ve sınıflarında artmakta olan kültürel çeşitlilik göz önüne alındığında, çokkültürlü eğitim karar alıcıların, yöneticilerin ve uygulamacıların dikkate alması gereken bir gerçek ve ihtiyaçtır. Çokkültürlü eğitim, cinsiyet, sosyal sınıf, etnik köken, ırk veya kültürel özelliklerine bakılmaksızın her öğrenciye gerekli eğitimi alması için eşit fırsat sunulmasını amaçlamaktadır. Ancak eğitim politikaları, öğretim programları ve ders kitapları çokkültürlü eğitim çerçevesinde yeniden şekillendirilse bile, kâğıt üstünde kalan tüm bu planları sınıf ortamında gerçekleştirenin öğretmenler olduğu unutulmamalıdır. Öğretmenlerin çokkültürlü eğitimi sınıf ortamına yansıtabilmeleri için neyi nasıl yapmaları gerektiğini bilmeleri oldukça önemlidir. Kültürel olarak duyarlı öğretimin amacı öğretmenlerin sınıf

içerisinde kullandıkları stratejilere ve uygulamalara odaklanarak öğrencilerin sahip oldukları kültürel farklılıkların akademik başarılarını engellenmesi önlemek ve öğrencilere kendi kültürel kimliklerini ve ana dillerini korurken hem ana akım kültürle hem de tüm dünya ile uyum içinde hareket edebilmeleri için gerekli olan temel bilgi ve becerileri sağlamaktır. Sınıf içerisine odaklanan kültürel olarak duyarlı öğretim pek çok farklı yeterliliği ve sorumluluğu kapsamaktadır. Bu nedenle, öğretmenlerin tüm bu yeterlilikleri başarılı bir şekilde uygulayabilme ve gerekli sorumlulukları alabilme konusundaki hazırbulunuşlukları kültürel olarak duyarlı öğretimin etkin bir biçimde uygulanabilmesi için oldukça önemlidir.

Araştırmanın Amacı: Ulusal alanyazın öğretmenlerin kültürel olarak duyarlı öğretimi uygulama konusunda yaşadıkları problemleri genel hatlarıyla ortaya koysa da, İngilizce öğretmenlerinin kültürel olarak duyarlı öğretim açısından ne derece hazır olduğuna ve ne çeşit sorunlarla karşılaştıklarına odaklanan çalışmaların sayısı oldukça azdır. Bu bağlamda, bu çalışmanın amacı İngilizce öğretmenlerinin kültürel olarak duyarlı öğretime kişisel olarak ve mesleki olarak ne derece hazır bulunduklarını incelemek ve İngilizce öğretmenlerinin kültürel olarak duyarlı öğretimle ilgili algılarını, sınıfta ne tip sorunlarla karşılaştıklarını ve bunlara nasıl çözümler ürettiklerini irdelemektir. Bu bağlamda bu çalışmanın cevap aradığı araştırma soruları şunlardır: (1) İngilizce öğretmenleri kültürel olarak duyarlı öğretime kişisel ve mesleki olarak ne derece hazırlardır? (1a) İngilizce öğretmenlerinin kültürel olarak duyarlı öğretime kişisel olarak hazırbulunuşlukları ile mesleki olarak hazırbulunuşlukları arasında istatistiksel olarak anlamlı bir fark var mıdır? (1b) Öğretmenlik deneyimi ve mezun olunan lisans programı açısından İngilizce öğretmenlerinin kişisel ve mesleki olarak hazırbulunuşluklarında anlamlı bir far var mıdır? (2) İngilizce öğretmenleri çokkültürlülüğü ve kültürel olarak duyarlı öğretimi nasıl algılamaktadır? İngilizce öğretmenleri kültürel olarak duyarlı öğretimle ilgili ne tip sorunlarla karşılaşmakta ve bunlara nasıl çözümler üretmektedirler?

Yöntem: Bu çalışmada çalışmanın amacı doğrultusunda belirlenen araştırma sorularına cevap aramak için ardışık açıklayıcı karma yöntem kullanılmıştır. Bu yöntemde veriler iki farklı aşamada toplanmaktadır. Birinci aşamada nicel veriler toplanırken ikinci aşamada nitel veriler birinci aşamada ortaya çıkan bulguları açıklamak ve yorumlamak için toplanmaktadır ve ağırlık nicel verilerde olsa da araştırma sorularının cevaplandırılmasında her iki veri tipi de kullanılmaktadır. Çalışmanın nicel kısmında uygunluk örnekleme yöntemi kullanılmış ve Türkiye'nin farklı illerinde görev yapmakta olan 415 İngilizce öğretmeni katılmışken nitel kısmına ise 12 İngilizce öğretmenli katılmıştır. Nicel verilerin toplanmasında Karataş ve Oral (2017) tarafından geliştirilen kültürel olarak duyarlı öğretim hazırbulunuşluk ölçeği kullanılırken nitel veriler sekiz adet açık uçlu yarı-yapılandırılmış mülakat soruları ile toplanmıştır. Nicel verilerin analizinde SPSS 23 programı kullanılmıştır. Verilerin normal dağıldığı basıklık ve çarpıklık değerleri doğrultusunda tespit edildikten sonra parametrik testlerden sırasıyla eşleştirilmiş örneklemler t-testi, tek yönlü ANOVA testi ve bağımsız örneklem t-testi uygulanmıştır. Nicel verilerin analizinde ise Braun ve Clarke (2013) tarafından önerilen tematik analiz yönteminin adımları uygulanmıştır. Önce nitel veriler yazıya aktarılmıştır. Ardından, önceden belirlenen kodlar ve temalar

kullanılmadığından çoklu okuma yöntemiyle kodlar ve temalar belirlenmiştir. Son olarak da güvenirliği arttırmak için veriler başka bir nitel araştırma uzmanı tarafından kontrol edilmiştir.

Bulgular: Nicel bulgular çalışmaya katılan İngilizce öğretmenlerinin bireysel hazırbulunuşlukları ile mesleki hazırbulunuşlukları arasında anlamlı bir fark olduğunu göstermiştir. Nicel bulguların ortaya koyduğu başka önemli bulgu ise 1-3 yıl deneyime sahip olan İngilizce öğretmenlerinin, 4 yıl ve daha üzeri deneyime sahip olanlardan mesleki açıdan kültürel olarak duyarlı öğretime daha hazır olmalarıdır. Son olarak İngilizce öğretmenliği bölümünden mezun olan İngilizce öğretmenlerinin İngiliz Dili ve Edebiyatı ile Amerikan Kültürü ve Edebiyatı bölümlerinden mezun olan İngilizce öğretmenlerine kıyasla kültürel olarak duyarlı öğretime mesleki olarak daha az hazır olduklarını da nicel bulguların ortaya koyduğu bir başka önemli sonuçtur. Nitel bulgular ise deneyimin tek başına kültürel olarak duyarlı öğretim için ayırt edici bir unsur olmadığını, İngilizce öğretmenliği lisans programlarında çokkültürlülüğü ve kültürel olarak duyarlı öğretimi de kapsayan kültür temelli derslere oldukça ihtiyaç olduğunu göstermiştir. Bunlara ek olarak, nitel bulgular İngilizce öğretmenlerinin kültürel olarak duyarlı öğretimi öğrencilerin tüm farklılıklarını dikkate alarak ötekileştirmeye ve ayrımcılığa karşı durarak öğretim yapmak ile özdeşleştirdiklerini göstermiştir.

Sonuç ve Öneriler: Sonuç olarak İngilizce öğretmenlerinin kültürel olarak duyarlı öğretime ilişkin hazırbulunuşluklarına odaklanan bu çalışma çalışmaya katılan öğretmenlerin mesleki hazırbulunuşluklarında sorunlar olduğunu ve bu sorunların öğretmenlerin lisans programlarında aldıkları eğitimin yanı sıra kültürel olarak duyarlı öğretimle ilgili bilgi, beceri ve deneyim eksikliğinden kaynaklandığını ortaya koymuştur. Bu bağlamda, İngilizce öğretmenlerinin kültürel olarak duyarlı öğretim ile ilgili bilgi, beceri ve deneyimlerinin artmasına odaklanan seminer ve çalıştaylar gibi çeşitli hizmet içi eğitimlerle birlikte öğretmenlerin deneyimlerini, karşılaştıkları sorunları ve çözüm önerilerini somutlaştırarak paylaşabilecekleri platformlara oldukça ihtiyaç vardır. Bunlara ek olarak, İngilizce öğretmenliği lisans programlarında da çokkültürlülüğün ve kültürel olarak duyarlı öğretimin hem kuramsal hem de uygulama kısımlarını kapsayan kültür odaklı derslere oldukça ihtiyaç olduğu da çalışmanın önerileri arasındadır.

Anahtar Kelimeler: Çokkültürlü eğitim, kültürel olarak duyarlı öğretim, hazırbulunuşluk, İngilizce öğretimi, İngilizce öğretmenleri.

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8th Grade Students' Positioning Skills on the Map

Huseyin EROL[1]

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ABSTRACT

Purpose: Events that occur around the world may cause a global impact in a short time. Therefore, it is important to not only understand the underlying causes and analyze their relationship but also know the location where they arise. This study investigated whether eighth-grade students have the ability to position Turkey and the neighboring countries on the map.

Method: This study was designed on a descriptive scanning method basis. In this study, 206 students in the eighth grade of three private and three public schools comprised the study sample. A question form developed by the researcher was used to collect the data.

Findings/Results: The findings obtained in this study showed that the eighth-grade students had positioning skills on the map at a low level. It was determined that some of the students participating in this study could not locate the country they live in on the map. It was found that the least known country was the location of Armenia on the map. One of the striking results that emerged in this study was that most of the students participating could not locate the Turkish Republic of Northern Cyprus and Azerbaijan, which have intense commercial, social, cultural and political relations with Turkey.

Implications for Research and Practice: In this study, the geolocating skills of the male students, the students educated in the public schools, the students whose parents got higher education levels, whose family had higher monthly income, and the students with atlas were higher. To develop the positioning skills of students, maps should be used frequently in social sciences and the Turkish Republic Revolution History and Kemalism courses. Maps in interactive boards can be used effectively. Students can be assigned to draw maps as homework. The number of activities related to maps in textbooks can be increased.

[1] Adıyaman University, TURKEY, e-mail: herol@adiyaman.edu.tr
ORCID: https://orcid.org/0000-0002-4707-5152

Introduction

The human aspiration to explore and be acquainted with the surrounding constitutes the starting point of geographical information. It is possible to make various generalizations regarding social life and culture using geographical information and experience obtained throughout life (Sagay, 2007). Human beings can benefit the environment as much as they recognize it. Geography, which helps us to recognize the earth better, has a crucial role in our understanding of the world's culture more comprehensibly regarding the resolution of problems in our environment and allows us to look at the changing world from different aspects (Efe 1997; Maxim, 1999). Learning about geography is significant for both individuals and nations. Thus, geography should be taught to students as of early ages (Unlu, 2001). With the beginning of the educational life, the geographic information, which has been laid with the teaching of ground-direction concepts at primary school, continues in the following years with the changes in the course contents and the development periods of the students. In the secondary school 5th, 6th and 7th grades, the students have a broader understanding of the geographical phenomena from a close perspective to the world. All pupils who reach the elementary school period have to know, perceive their environment and know where they belong. Students learn about these in social studies class and in social sciences in their primary education (Sonmez, 2010). Students become able to question geographic events through the geography class, which is among the important disciplines that constitute the main backbone of the social studies course that constitutes a unique study area by filtering various branches of science in social sciences. Geographical information is necessary for acquiring patriotism, strengthening citizenship bonds and position finding, comparing countries, having knowledge about world problems, comprehending events with new formations in the world, even war (Turoglu, 2003; Guner, 2007; Ozturk & Alkis, 2009).

All courses include materials that help teachers and students. The main material of the social studies course is the maps. Tables, graphs, and maps summarize information that can be provided as longer expressions in a shorter and clearer way (Koc, 2008). Maps are also important data and image transfer tools (Lobben, 2004). Children's tendency to discover and perceive develops thanks to the maps (Ozturk & Dilek, 2002). Nature and people are in constant interaction. To be able to make enough use of nature, make the right moves where necessary and create plans for the future in this direction is realized by reading the maps well (Kartal, 2016). People should know the location of the geography-based events so that they can understand the relationships between events and their results (Tuna, Demirci & Gultekin, 2012). An individual should develop map skills to calculate location, natural and human characteristics, and the distance of any place to another (Unlu, 2011). Regarding the map skills, there are various classifications in the literature, although they have basically common points. The Ministry of National Education classified map skills as positioning, transferring information to map, selecting an appropriate map, making calculation by use of map, perceiving spatial distribution, interpreting the map accurately, creating a draft map (MEB, 2005). Mcclure (1992), categorized map skills as understanding and interpreting symbols on the map, profiling, direction finding, calculating distance and space,

measuring inclinations, positioning, using a scale, creating a map draft, defining physical characteristics, reading and interpreting the map. Weeden (1997), classified map skills under four categories; using a map, drawing a map, reading and interpreting a map.

The acquisitions on the map subject in the fourth grade of primary school and fifth, sixth, and seventh grades of the secondary school are provided in the social studies program. In many studies about map skills, it was seen that the competency levels of these skills and the problems experienced in gaining map skills were determined. If these studies are to be mentioned, Chiodo (1993), tried to examine the preservice teachers' map literacy levels with a map drawing activity. In another study, Chiodo (1997), tried to measure the place of the map in geography education with an experimental study. In the study, the effect of mind maps on learning geographical details was examined. Demiralp (2008), investigated the place of using a map and sphere and the place of geographical skills in geography training. Demirkaya (2009), tried to determine the geography literacy levels of university students; Gunes (2016), investigated social studies teacher candidates' skills in using map and map symbols in geography. Incekara and Kanturk (2010), examined social studies teacher candidates' map perceptions, map usage, and their opinions about maps. Kartal and Koc (2017), investigated the map literacy levels of secondary education students. Kizilcaoglu (2007), mentioned about some activities to improve students' map skills. Sonmez (2010), investigated map skills in teaching social sciences. Tuncel (2002), tried to identify the skills of locating Islamic countries on students' mind maps. Uzumcu (2007), investigated the effect of map reading skills on the success of sixth-grade students in the social sciences course through the activities prepared with active learning methods. Kuscu (2011), investigated the secondary school students' skills of positioning and coordinating. Akkus and Kuzey (2012), examined 8th-grade students' having map and location skills and their ability to relate these skills to real life.

The aim of the study is to find out the position finding skills level of eighth-grade students regarding Turkey and its neighbors. Answers to the following questions were sought.

1. Does the position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by gender?
2. Does the position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by school type?
3. Does the position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by mothers' education levels?
4. Does the position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by fathers' education levels?
5. Does position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by possessing an atlas?

6. Does the position finding skills level of eighth-grade students regarding Turkey and its neighbors differ by family's income level?

Method

Research Design

This is a descriptive survey method-based study. The descriptive scanning method was used as this study investigated eighth-grade students' skills in positioning Turkey and the neighboring countries. The descriptive survey method is appropriate for the studies aiming to describe an existing situation as is (Karasar, 1999).

Population and Sample/ Study Group/Participants

The sample of this study consisted of eighth-grade students in Adiyaman province of Turkey in the 2018-2019 academic year. The sample consisted of eighth-grade 206 students enrolled in three private and three public schools in Adiyaman city center (Table 1). The schools were selected based on non-random purposive sampling criterion. The eighth-grade students were included in this study as they were believed to have all information provided about geography in social sciences and the skills that might be related to positioning on the map.

Table 1

Demographical Information of the Students

Gender	***f***	***%***
Female	99	48.05
Male	107	51.95
Total	206	100

As indicated in Table 1 above, of the participants, 51.95% were male, and 48.05% were female students. Of the students, 105 were entitled in public schools and 101 were entitled in private schools. Those schools were determined based on the information obtained from the Adiyaman Provincial Directorate of National Education. The reason that both private and public schools were included in the study is to determine whether the family's socio-economic level and parents' education levels have an effect on students' positioning on map skills.

Data Collection Tools

A question form, which was developed by the researcher and consisted of 13 questions regarding Turkey and its neighbors (Balkans, Middle East and Caucasus countries), was used. A detailed survey was carried out on the topic before the questions were prepared. The acquisitions from the social sciences curriculum regarding the research topic were examined. The secondary school fifth, sixth and seventh-grade geography-related course books were examined. Geographical skills that are included in the curriculum were considered while preparing the question form. Among these skills, map literacy and position analysis skills were prioritized.

To ensure the validity and reliability of the questionnaire, opinions of two social sciences teachers working in Adiyaman were taken and then, submitted to the opinion of one lecturer at Adiyaman University and one lecturer in Siirt University. A pilot study was conducted in a classroom of eighth-grade 36 students. Two questions were removed from the form based on the results. A problem was detected in one of the removed questions, so another question was prepared. In the other removed one, a new question was prepared to correct confusion caused by the map, and the form was finalized.

Data Collection

This study was conducted in the first half of the 2018-2019 academic year in January, which was approved by the school administrators and teachers. The students were given 40 minutes to refill their personal information and answer the questions.

Data Analysis

The data were analyzed descriptively by carrying out an analysis of answers given to each question by the students. Descriptive survey models are widely used in most of the quantitative studies regarding the education field (Cohen & Manion, 2007). Descriptive studies are generally used to illuminate a given situation, carry out an evaluation in accordance with the standards, and show possible relationships between events (Cepni, 2005). In this study, the students who answered correctly and incorrectly in the descriptive analysis were determined and the obtained data were interpreted by giving frequency and percentile values. Subsequently, all answers provided by the students were analyzed and the results were given in tables. Each question was evaluated on a score of 7.70 and the maximum score was 100. The students who scored between 0 and 33 were deemed as low level, between 34 and 67 were medium level, and between 68 and 100 were high level. Finally, the students' mean scores were calculated, and their levels were determined.

Findings

Table 2 shows the answers given by the students for the questions regarding positioning on the map.

Table 2

Answers Given by the Students for the Questions Regarding Positioning Countries on the Map

Question	***f***	**%**
1	119	57,76
2	121	58.73
3	8	3.88
4	68	33.00
5	177	85.92

Table 2 Continue

Question	*f*	*%*
6	32	15.53
7	48	23.30
8	71	34.46
9	73	35.43
10	21	10.19
11	57	27.66
12	54	26.21
13	32	15.53

In the first question, the students were asked to show on the map Syria which has enormously immigrated to Turkey in recent years. This question was correctly answered by 119 students (57.76%). In the second question, they were asked to show on the map Turkish Cypriot State (Turkish Republic of Northern Cyprus) that is called as foster land of Turkey. This question was correctly answered by 121 students (58.73%). In the third question, they were asked to show on the map Armenia with which Turkey has very poor political, economic, and cultural relationships. Of them, only 8 students (3.88%) answered the question correctly. In the fourth question, they were asked to show on the map Greece, where Mustafa Kemal Ataturk was born, and which was dominated by Ottoman Empire for long periods, and has a border with Turkey with a river, called as Evros River. Of them, 68 students (33%) answered the question correctly. In the fifth question, they were asked to show Turkey on the map. Of them, 177 students (85.92%) answered this question correctly. In the sixth question, they were asked to show on the map Azerbaijan whose population is almost all Muslims, which is called as two states but one nation along with Turkey and has a critical potential of petroleum. This question was correctly answered by 32 students (15.53%). In the seventh question, they were asked to show on the map İran, which has important petroleum and natural gas sources, whose mother language is Persian and capital is Teheran. This question was correctly answered by 48 students (23.30%). In the eighth question, they were asked to imagine they were given the task to draw the petroleum pipelines that will be set up in Turkey over the Mediterranean as of Egypt and to show on the map Egypt which is the starting point of this project. This question was correctly answered by 71 students (34.46%). In the eighth question, they were asked to show on the map of Saudi Arabia if the family elders should want them to point the country to go on pilgrimage. Of them, 73 students (35.43%) answered this question correctly. In the tenth question, they were asked to show on the map Palestine, where locates Jerusalem, hosting the first Qibla of İslam and deemed sacred to Muslims, Christians and Jews. Of them, 21 students (10.19%) answered this question correctly. In the eleventh question, they were asked to show on the map Iraq where

Kut Al Amara victory took place, the Turkish population is dense in its Mosul and Kirkuk cities, and which is rich by petroleum. Of them, 57 students (27.66%) answered this question correctly. In the twelfth question, they were asked to show on the map Bulgaria, an important Balkan country, whose capital is Sofia, and was a Turkish territory during the Ottoman Empire. Of them, 54 students (26.21%) answered this question correctly. In the thirteenth question, they were asked to show on the map Georgia, located on the Baku-Tbilisi-Ceyhan (BTC) petroleum pipeline, a neighboring country of Turkey, and whose population is Christian mostly. This question was correctly answered by 32 students (15.53%). It can be said that most students do not know Turkey's neighboring countries and the ones in close relationship with Turkey.

Table 3 shows the mean scores of the students on positioning Turkey and the neighboring countries on the map.

Table 3

Locating Turkey and Nearby Countries on the Map Average Skill Points of Students

Level	***f***	***%***
Low	133	64.56
Medium	51	24.75
High	22	10.67

Of the students, 64.56% had a score between 0 and 33, 24.75% had a score between 34 and 67, 10.67% had a score between 68 and 100. More than half of the students had a low mean score, which indicated that eighth-grade students' positioning on the map skills were at a low level.

Table 4 shows the mean scores of the students regarding their school type.

Table 4

Students' Mean Scores based on School Type

School Type	***Average Score***
State Schools	38.12
Private Schools	34.60

The average number of the students in public schools (38.12), was found to be higher than that of the private school students (34.60), considering the effects of the school type on students' positioning skills. It is expected that the students getting educated in the private schools should have higher average scores considering that the possibilities that a private school provides are more than those that a state school can provide. However, the obtained findings show that the students getting educated in state schools have high-level skills than those getting in private schools in terms of the skill of locating countries on the map.

Table 5 shows the mean scores of the students regarding their gender.

Table 5

Score Averages of the Students based on Gender

Gender	Average Score
Female	23.26
Male	24.03
Average of all students	23.66

Considering students' positioning skills based on gender, it is clear that male students have a higher mean score (24.03), than that of female students (23.26). The slight difference between students' mean points shows that gender has not a significant effect on positioning skills.

Table 6 shows the mean scores of the students regarding their mothers' education level.

Table 6

Students' Mean Scores based on their Mothers' Education Levels

Education Level	*f*	*%*	*Average Score*
İlliterate	10	4.85	25.40
Primary School	37	17.96	29.54
Secondary School	23	11.16	21.42
High School	69	33.49	31.80
Undergraduate	65	31.55	37.66
Postgraduate	2	0.97	69.25
Total	206	100	

The positioning skills mean scores of the students whose mothers had a master's degree (69.25) were higher than the students whose mothers were not literate (25.40), are primary school graduates (29.54), were secondary school graduates (21.42), were high school graduates (31.80), and had a bachelor's degree (37.66). Map skills of students increased as the education level of the mother increased. Higher mean scores of secondary and above school graduate mothers are indicators that they can help their children in academic works more than mothers who are graduates of primary school.

Table 7 shows the mean scores of the students regarding their fathers' education level.

Table 7

Students' Mean Score based on their Fathers' Education Levels

Education Level	***f***	***%***	***Average Score***
Illiterate	-	-	-
Primary School	18	8.73	17.92
Secondary School	28	13.59	24.19
High School	57	27.66	28.76
Undergraduate	102	49.51	39.32
Postgraduate	1	0.48	38.50
Total	206	100	

Positioning on the map skills scores of the students whose fathers had a bachelor's degree (39.32) or master's degrees (38.50) were higher than those who were primary school graduates (17.92), secondary school graduates (24.19), and high school graduates (28.76). The increase in students' positioning on the map skills scores as fathers' education levels increase was an indicator of the effect of fathers' education levels on their children.

Table 8 shows the mean scores of the students regarding their family income level.

Table 8

Level of Income of the Students' Parents

Level of Income	***f***	***%***	***Average Score***
1000-1999	7	3.39	17.60
2000 - 2999	38	18.44	17.22
3000 - 3999	35	16.99	23.10
4000 - 4999	26	12.62	31.06
5000 - 5999	13	6.31	39.64
6000 and above	87	42.23	42.04
Total	206	100	

The study findings indicated that the positioning skills of the students with a family income level of 6000 TRY and above were higher than those with a lower income level. The socio-economic status of the family can provide a positive effect on the increase in the academic achievement of the student in the provision of ease of access to the information that the child wants outside of the school, and the ability of the family to meet the many needs of the material supply.

Table 9 shows the mean scores of the students regarding their ownership of an atlas.

Table 9

Not having an Atlas

Having Atlas (maps) or not	*f*	*%*	*Average Score*
Yes	167	81.06	35.54
No	39	18.93	26.65
Total	206	100	

The students who had an atlas obtained higher scores on positioning on the map skills (35.54) than those who did not have one (26.65). This finding indicated the importance of atlas in promoting students' map skills.

Discussion, Conclusion and Implications

In this study, the secondary school 8th-grade students' skills in locating Turkey and the surrounding countries on the map were examined. In this study, students' locating skill levels were examined in three categories. According to this, it was determined that 64.56% of the students were at a lower level, 24.75% at medium-level and 10.67% at a high level. The obtained results show that the 8th-grade students have the locating skills mostly at a lower level. The use of maps and spheres in geography and history classes of the social sciences facilitates establishing a spatial relationship with the subject (Demircioglu & Akengin, 2012). Considering that the most widely used material in social sciences and Turkish Republic Revolution History and Kemalism courses in the eighth grade is the map, the result of this study should be taken into consideration. It is important that individuals have map and direction skills to better understand the environment and the world they live in. Therefore, students should be trained as having basic map and direction skills. Students should be able to show their place of residence and other places at different points on a map (Altinbilek & Sanalan, 2005). In the literature, there are studies conducted on different groups that support the results of this study and reach different results. In their study in which the spatial skills of the sixth-grade students were examined, Ocal (2007), determined the mean scores of 70% of the students to correctly know the neighboring countries of Turkey is 5.5. The mean scores of the students to correctly locate these countries on the map is 4.2. Half of the students have a medium level of knowledge about positioning and one-third of them have top-level knowledge. Soydabircan (2011), determined that the mean score of the students on locating skills on the map was 55. Based on this result, the researcher stated that students' locating skills were at a medium level. Uker (2009), found that secondary school students' map positioning skills were medium level. Tas (2019), found that fifth-grade students had difficulty distinguishing maps. Kaya (2012), found out that students showed near places on the map more precisely than remote countries. In the study conducted by Ertugrul (2008), it was found out that 6th-grade students had medium level map using skills. Akkus and Kuzey (2012), found that 52.2% of secondary school students accurately show the latitude and longitude of a

desired location on the map. The researchers concluded that the students gained the locating and coordinating ability on the map and were successful in transferring these to real life. Akbas and Toros (2016), reported that most of the teacher candidates were not successful in correctly positioning continents and the countries located on these continents. Also, the teacher candidates made many mistakes showing continents and countries in their mind maps. Incekara and Kanturk (2010), found that social sciences teacher candidates had low skills in showing their districts on a blank map. The study conducted by Tuna, Demirci and Gultekin (2012), indicated that direction finding and positioning skills were very low in the public.

This study indicated that students were not well-skilled in positioning Turkey and the neighboring countries. Turkey was the country in which the 8th-grade students had the most success in locating countries. 85.92% of the students surveyed were able to locate Turkey in the right way in the blank map. It was determined in the study conducted by Tuna, Demirci and Gultekin (2012), related to geographical skills that 20% of the participants did not show the location of Turkey correctly on the blank map. Considering this result from different perspectives, there are students who cannot show the country they live in should be considered as a subject to be considered. Armenia was the country that the students surveyed had the least success in locating (3.88%). The minimum level of political, economic, cultural, and commercial relationships between Turkey and Armenia may have had an effect on this.

Another striking finding is that only 58.73% of the students can position the Turkish Republic of Northern Cyprus that is called foster land and enshrines in the heart of Turkey and the Turkish nation. The location of Azerbaijan, which has intense relations with Turkey and is known as "two states, one nation" is known by 15.53% of the students. 57.76% of the students know correctly the location of Syria from which Turkey has been allowing immigrants for the last seven years and which has been on the front burner of printed and visual media. 35.43% of the students know the location of Arabia correctly, where millions of Muslims make a pilgrimage every year. 33% of the students correctly show the location of Greece, 26.21% of them know the location of Bulgaria, 27.66 % Iraq, 23.30% Iran, 15.33% Georgia, 34.46 Egypt, 10.19% Palestine on the map. Besides that, nearly half of the students could not show on the map some countries, including Greece, Syria, and Azerbaijan that are Turkey's neighbors. In his study on mind maps of Turkish students, In the study conducted on mind map of Turkish students, Tuncel (2002), stated that it was negative for students not to remember the Turks living in the Western Thrace, and very few students could remember Turkish Republic of Northern Cyprus. This finding was frightening considering geopolitical importance of these regions. The study conducted by Kaya (2012), on primary school students' positioning skills showed that their mean success rate in positioning both remote and close countries was 37.32%. Ertugrul (2008), found out that 15% of sixth grade students did not know any country neighboring Turkey. The number of students who answered almost all the questions was very low. The researchers determined that students have location knowledge of where they live but they do not have enough information about Turkey's location.

Factors, such as facilities offered by the school, the number of students in the class, diversity of materials used in the course as well as social capital of the school, effective leadership, effective teacher, occupational development and organizational commitment, may positively affect student success (Gokce & Kahraman, 2010). Hardware, equipment and physical properties of the school are important as regards the implementation of teaching programs (Alkan, Deryakulu & Simsek, 1995). Private schools can be advantageous with all these contributing aspects compared to public schools. The students enrolled in private schools were expected to have higher mean scores before the data were collected. However, the mean score of the students in public schools was 38.12, whereas the mean score of those in private schools was 34.60. This result shows that students' internal motivation has a significant role in their academic success. Social and economic opportunities of families make accessible any kind of supportive factors that may contribute to the success (Sarier, 2016). The quality of the private schools in Adiyaman, included in the sample of the study, may have had an effect in this result as it is among the last of 81 provinces of Turkey concerning the socio-economic situation. Comparing map skills of the students in private schools and public schools, some studies found that students in private schools had better results than those in public schools (Aksoy, Kilicoglu & Ablak, 2015; Sonmez, 2010, Ertugrul, 2008).

In this study, map locating skill scores of male students (24.03) was higher than female students (23.26). It can also be said that the difference is not very significant. From this result, it can be stated that gender has no distinct effect on the map positioning skills. Some studies indicated that female students had more positioning skills than males (Ocal, 2007), while other studies indicated vice versa (Koc, Aksoy & Cifci, 2017; Koc & Cifci, 2016; Kartal, 2016; Dikmenli, 2015; Merc, 2011). However, there are studies indicating that gender did not have a significant effect on students' map skills (Goksel, 2007; Ertugrul, 2008; Kartal & Koc, 2017). Boys always play different games than girls, and a variable that is seen as the biggest cause of gender differences in adult cognition is fun activities in early games (Baenninger & Newcombe, 1989).

In this study, it was found that education levels of students' parents affected their positioning skills. The mean scores of the students whose parents had a bachelor's and master's degree were higher than the students whose parents had lower education levels. These results suggest that parental education levels positively affect students' positioning on the map skills. In contrary to the findings, Kartal (2016), suggested there was no significant relationship between map literacy of ninth-grade students and their parents' education levels, but the students whose parents had different education levels had similar scores regarding map literacy rates. The results suggest that the increase in parents' education levels have a positive effect on students' understanding of symbols, navigating and directing, drawing a map in a place visited for the first time, drawing and recognizing land forms of their residential places, distance measuring skills, and fraction scale skills (Kuzey, 2016).

This study indicated that mean scores of the students with a family income level between 1000 and 5999 TRY were lower than those with a family income level of 6000 TRY and above. This result indicates that students' positioning skills increase as the

students' income level increases. Kuzey (2016), found that the increase in the family's economic income has a positive effect on the student's ability to read and interpret maps, to read location and landforms, to draw and read sketches and to identify and to know and determine the location and coordinate skills. In the study, which examines the effect of income level on the level of benefiting from educational opportunities, socio-economic levels of the families directly affect students' education environment (Onur 2013; Ciftci & Caglar, 2014). This study indicated that the mean scores of the students who had an atlas were higher than those who did not have one. The atlas should be used to have skills on positioning on the map, understanding symbols, determining a direction, distance measuring, and drawing a map. Textbooks should direct students to atlases for teaching certain concepts regarding maps (Girgin, Erturk, Sever & Guner, 2001).

Based on the results obtained from this study, the eighth-grade students could not achieve geographical skills provided in the social sciences program. Map, which is one of the main materials of social sciences, is not regarded as a fundamental reference resource by the students. The students in this study did not exactly learn basic map skills and direction skills. The students mostly could show the position of the country where they live, but they did not point exactly to the neighboring countries, which shows that they have problems with geographical knowledge. The school type has no vital role about geographical skills. Gender also has no vital role in position and direction finding and position skills. The effects of parents on their child's academic success are an undeniable fact. The results of this study also support this concept. Children of families who have a higher education level are more successful. Children of families with higher socio-economic levels obtained better results than others. The importance of atlas, which is one of the most important materials of geography lessons, has come into prominence. Mean scores of the students who had an atlas were higher than those who did not have one. There are some suggestions based on the findings of this study: Maps can be widely used in the social sciences and Turkish Republic Revolution History and Kemalism courses to develop the positioning skills of students. Teachers can encourage every student to have an atlas. Teachers can also give homework to students to draw a map to support their map skills.

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8. Sınıf Öğrencilerinin Haritada Konumlandırma Becerileri

Atıf:

Erol, H. (2020). 8th-grade students' positioning skills on the map. *Eurasian Journal of Educational Research 88,* 67-86. DOI: 10.14689/ejer.2020.88.3

Özet

İnsanın yasadığı dünyayı tanıma ve bilme isteği coğrafi bilginin başlangıç noktasını oluşturur. Öğrenim hayatının başlamasıyla birlikte ilkokulda yer-yön kavramlarının öğretilmesiyle temeli atılan coğrafi bilgiler ilerleyen yıllarda ders içeriklerine ve öğrencilerin gelişim dönemlerine göre değişim göstererek devam eder. Ortaokul 5., 6. ve 7. sınıfta yakın cevreden dünyaya doğru geniş bir bakış açısıyla öğrenciler coğrafi olayları anlama ve kavrama konusunda daha fazla bilgi sahibi olurlar. Tüm derslerde öğretmen ve öğrencilere yardımcı olan materyaller bulunur. Sosyal bilgiler dersinin ana materyallerinin basında haritalar gelmektedir. Haritalar önemli veri ve görüntü aktarma araçlarıdır (Lobben, 2004). Doğadan yeteri kadar yararlanabilmek, gerekli olan yerde doğru hamleleri yapabilmek yine bu doğrultuda geleceğe dair planlamalar oluşturabilmek haritaları iyi okuyabilmekle gerçekleşir (Kartal, 2016). İnsanoğlunun yeryüzünde meydana gelen coğrafi kaynaklı olayların birbirleriyle ilişkilerini ve ortaya çıkan sonuçlarını anlayabilmesi için bu olayların yeryüzündeki konumunu bilmeleri gerekmektedir (Tuna, Demirci & Gültekin, 2012). Bir yerin konumu, doğal ve beşeri özellikleri, bir yere olan uzaklığının hesaplanabilmesi için bireyde harita becerilerinin gelişmiş olması gereklidir (Unlu, 2011).

Araştırmanın Amacı: Literatürde harita becerileriyle ilgili yapılan çalışmalar incelendiğinde ortaokul öğrencilerinin haritada konum belirleme beceri düzeylerini inceleyen bir çalışmanın yapılmamış olmasından yola çıkılarak öğrencilerdeki bu becerinin var olan durumunu ortaya çıkarmak amacıyla bu çalışmanın yapılmasına karar verilmiştir. Yapılan bu çalışma ile 8. sınıf öğrencilerinin haritada "konum bulma" beceri düzeyleri ortaya çıkarılarak bir durum tespiti yapılmış olacaktır.

Yöntem: Bu çalışma, tarama modelinde betimsel bir araştırmadır. Bu çalışmada 8. sınıf öğrencilerinin haritada Türkiye ve yakın çevresini konumlandırma becerileri incelenmeye çalışıldığı için betimsel tarama modeli kullanılmıştır. Tarama modelleri varolan bir durumu olduğu sekliyle betimlemeyi amaçlayan çalışmalara uygun bir modeldir (Karasar, 1999).

Bulgular: Öğrencilerden 0-33 puan aralığına girenlerin oranı %64.56, 34-67 puan aralığına girenlerin oranı %24.75, 68-100 puan aralığına girenlerin oranın ise %10.67 olduğu tespit edilmiştir. Araştırmaya katılan öğrencilerin yarıdan fazlasının puan ortalamasının alt düzeyde olması 8. sınıf öğrencilerinin haritada konum belirleme beceri düzeylerinin alt düzeyde olduğunu göstermektedir. Öğrenim görülen okul turunun öğrencilerin haritada konum belirleme beceri düzeylerine etkisine bakıldığında devlet okullarında öğrenim gören öğrencilerin (38.12) ortalamasının özel

okullarda öğrenim gören öğrencilerden (34.60) daha yüksek olduğu görülmektedir. Araştırmadan elde edilen bulgular devlet okulunda öğrenim gören öğrencilerin haritada konumlandırma açısından daha üst düzey beceriye sahip olduklarını göstermektedir.

Cinsiyet değişkeninin öğrencilerin haritada konum belirleme beceri düzeylerine etkisine bakıldığında erkeklerin (24.03) puan ortalamasının kızlardan (23.26) daha yüksek olduğu görülmektedir. Öğrencilerin puan ortalamaları arasındaki farkın çok az olması cinsiyetin haritada konum belirleme konusunda belirleyici etkisinin olmadığını göstermektedir. Bu araştırmada öğrencilerin ebeveynlerinin eğitim düzeyinin onların haritada konumlandırma beceri düzeylerini etkilediği ortaya çıkmıştır. Araştırmaya katılan öğrencilerden anneleri ve babaları lisans ve lisansüstü eğitim alanların ortalama puanlarının anneleri ve babaları daha alt düzey eğitim almış olanlara göre daha yüksek olduğu ortaya çıkmıştır. Bu sonuçlar ebeveynlerin eğitim seviyesinin öğrencilerin haritada konum bulma beceri düzeylerini olumlu şekilde etkilediğini ortaya koymaktadır. Ailesinin aylık geliri 6000 lira ve üzeri olan öğrencilerin haritada konum belirleme beceri puanlarının araştırmaya katılan ve aylık geliri daha düşük olan diğer bütün öğrencilerden daha yüksek olduğu görülmüştür. Bu araştırmada atlası olan (35.54) öğrencilerin haritada konum belirleme beceri puanlarının atlası olmayan (26.65) öğrencilerden daha yüksek olduğu tespit edilmiştir. Araştırmadan elde edilen bu bulgu öğrencilerde harita becerilerinin geliştirilmesinde atlasın önemini göstermektedir.

Tartışma, Sonuç ve Öneriler: Araştırmada öğrencilerin konumlandırma beceri düzeyleri 3 kategoride incelenmiştir. Buna göre; öğrencilerin %64.56'si alt düzeyde, %24.75'i orta düzeyde, %10.67'sinin ise üst düzeyde konumlandırma becerisine sahip oldukları ortaya çıkmıştır. Elde edilen sonuçlar 8. sınıf öğrencilerinin büyük ölçüde alt düzeyde konumlandırma becerisine sahip olduklarını göstermektedir. Sosyal bilgiler dersinde ve 8. sınıf Türkiye Cumhuriyeti İnkılap Tarihi ve Atatürkçülük dersinde en fazla kullanılan materyalin harita olduğu düşünülürse sonucun bu şekilde çıkması üzerinde düşünülmesi gereken bir konu olarak göze çarpmaktadır. Bu araştırmada öğrencilerin Türkiye'nin komşuları ve yakın çevresindeki ülkeleri haritada konumlandırma açısından yeterli beceriye sahip olmadıkları ortaya çıkmıştır. 8. sınıf öğrencilerinin konum belirlemede en fazla başarılı oldukları ülke Türkiye olmuştur. Araştırmaya katılan öğrencilerin %85.92'si Türkiye'nin yerini dilsiz harita doğru bir şekilde gösterebilmişlerdir. Ortaya çıkan bu sonuç farklı açıdan değerlendirildiğinde yasadığı ülkeyi haritada gösteremeyen öğrencilerin olması üzerinde düşünülmesi gereken bir konu olarak değerlendirilmelidir. Araştırmaya katılan öğrencilerin Türkiye'nin komşuları arasında yerini en az bildikleri ülke Ermenistan (%3.88) olmuştur. Türkiye ile Ermenistan arasında siyasi, sosyal, kültürel ve ticari ilişkilerin uzun yıllardır minimum düzeyde olması sonucun bu şekilde çıkmasında etkili olmuş olabilir. Araştırmada ortaya çıkan bir diğer ilgi çekici sonuç ise Türkiye'nin ve Türk milletinin gönlünde ayrı bir yeri olan, "yavru vatan" olarak adlandırılan Kuzey Kıbrıs Türk Cumhuriyetinin konumunun öğrencilerin %58.73'u tarafından bilinmesidir. Türkiye ile çok yoğun ilişkiler içerisinde bulunan, "iki devlet bir millet" olarak bilinen Azerbaycan'ın yeri öğrencilerin %15.53'u tarafından bilinmiştir. Son 7 yıldır

Türkiye'nin yoğun göç aldığı, sürekli yazılı ve görsel medyanın gündeminde olan Suriye'nin yerini araştırmaya katılan öğrencilerin %57.76'si doğru bilmiştir. Her yıl milyonlarca müslümanın hac ibadetini yapmak için gittiği Arabistan'ın konumunu öğrencilerin %35.43'ü doğru bilmiştir. Araştırmaya katılan öğrencilerin %33'u Yunanistan'ı, %26.21'i Bulgaristan'ı, %27.66'si Irak'ı, %23.30'u İran'ı, %15.53'u Gürcistan'ı, %34.46'si, Mısır'ı, %10.19'u Filistin'inin yerini haritada doğru göstermiştir. Bu araştırmada veri toplama aşamasındaki beklenti özel okullarda öğrenim gören öğrencilerin ortalama puanlarının daha yüksek çıkacağı seklindeydi. Araştırmada devlet okullarında öğrenim gören öğrencilerin ortalaması (38.12) özel okullarda öğrenim gören öğrencilerin ortalamasından (34.60) yüksek çıkmıştır. Ortaya çıkan bu sonuç içsel motivasyonun öğrencilerin başarılarında belirleyici bir yerinin olduğunu göstermektedir. Araştırmanın örneklemini oluşturan Adıyaman şehir merkezindeki özel okulların niteliği, ayni zamanda şehrin sosyoekonomik açıdan Türkiye'de 81 il içinde son sıralarda olması bu sonucun ortaya çıkmasında etkili olmuş olabilir. Bu araştırmada erkek öğrencilerin (24.03) harita konumlandırma beceri puanları kadın öğrencilerden (23.26) yüksek çıkmıştır. Ortaya çıkan farkın çok fazla anlamlı olmadığı da söylenebilir. Bu sonuçtan hareketle cinsiyetin harita konumlandırma becerisinde belirgin bir etkiye sahip olmadığı ifade edilebilir. Bu araştırmada öğrencilerin ebeveynlerinin eğitim düzeyinin onların haritada konumlandırma beceri düzeylerini etkilediği ortaya çıkmıştır. Araştırmaya katılan öğrencilerden anneleri ve babaları lisans ve lisansüstü eğitim alan öğrencilerin ortalama puanlarının anneleri ve babaları daha alt düzey eğitim almış olanlara göre daha yüksek olduğu ortaya çıkmıştır. Bu sonuçlar ebeveynlerin eğitim seviyesinin öğrencilerin haritada konum bulma beceri düzeylerini olumlu şekilde etkilediğini ortaya koymaktadır. Araştırmaya katılan öğrencilerden ailesinin aylık geliri 1000 ile 5999 lira olan öğrencilerin ortalama puanın ailesinin gelir düzeyi 6000 lira ve üzeri olan öğrencilerden daha düşük olduğu ortaya çıkmıştır. Bu sonuç gelir düzeyi arttıkça öğrencinin konumlandırma beceri düzeyinin de aynı şekilde arttığını göstermektedir. Bu araştırmada atlası olan öğrencilerin ortalama puanı atlası sahibi olmayan öğrencilere göre daha yüksek çıkmıştır. Haritada konum bulma, sembolleri anlama, yön tayini yapma, mesafe hesaplanması ve harita çizimi gibi becerilerin kazandırılmasında atlaslardan yararlanılmalıdır. Araştırmadan elde edilen bulgulardan yola çıkılarak bazı öneriler geliştirilmiştir: Öğrencilerde konum becerisinin gelişmesi için sosyal bilgiler dersinde ve Türkiye Cumhuriyeti İnkılap Tarihi ve Atatürkçülük dersinde sık sık harita kullanılabilir. Her öğrencinin atlas sahibi olması konusunda öğretmenler teşvik edici olabilir. Öğrencilerin harita becerilerinin geliştirilmesi amacıyla harita çizme ödevleri verilebilir.

Anahtar Kelimeler: Ortaokul, öğrenci, sosyal bilgiler, konum.

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Schema of Analogical Reasoning - Thinking Process in Example Analogies Problem

Kristayulita KRISTAYULITA[1], Toto NUSANTARA[2], Abdur Rahman AS'ARI[3], Cholis SA'DIJAH[4]

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ABSTRACT

Purpose: Analogical reasoning has been studied using a variety of tasks that generally required consideration of the relationship between the object and its integration to conclude an analog schema. The aim of this study was to describe the model of analogical reasoning schema based on some analogical problems.

Research Method: In this study used a qualitative research approach with design research is the case study. Data were taken from 16-year-old high school students, West Nusa Tenggara Indonesia. The researcher selected 4 students who answered two analogical problems correctly and used in analyzing qualitative data.

Findings: The findings showed that there is a difference in the schema. The first type is that students can directly map between target problem and source problem, followed by structuring, applying, and verifying. The second type is that the student can not directly map between the target problem with the source problem, but the student needs to do a representation of the target problem so as to find a form of problem that has similarities with the source problem. Then the student can map between target problem with source problem, followed by doing the process as the first schema type.

The Implication for Research and Practice: Findings of this study may have an impact on the way teachers teach mathematics on the analogical problems they use. Teachers can consider mathematical problems used in learning so that students easily understand the theory from the concepts being taught. And then, teachers need to develop an analogical problem that can develop critical and creative thinking to enhance the creativity of high school students with their analogical reasoning.

[1] Universitas Islam Negeri Mataram, Fakultas Tarbiyah dan Keguruan, Tadris Matematika, INDONESIA, e-mail: kristayulita@uinmataram.ac.id, ORCID: https://orcid.org/0000-0001-7066-8063
[2] Universitas Negeri Malang, Fakultas Matematika dan IPA, Pendidikan Matematika, INDONESİA, e-mail: toto.nusantara.fmipa@um.ac.id, ORCID: https://orcid.org/0000-0003-1116-9023
[3] Universitas Negeri Malang, Fakultas Matematika dan IPA, Pendidikan Matematika, INDONESİA, e-mail: abdur.rahman.fmipa@um.ac.id, ORCID: https://orcid.org/0000-0002-4959-0043
[4] Universitas Negeri Malang, Fakultas Matematika dan IPA, Pendidikan Matematika, INDONESIA, e-mail: cholis.sadijah.fmipa@um.ac.id, ORCID: https://orcid.org/0000-0002-0264-8578

Introduction

Analogical reasoning Allows one to make connections to transfer solutions from known problems to new problems of unknown solutions (Gentner & Loewenstein, 2002; Trench, Oberholzer, & Minervino, 2009). Additionally, resolving target problems needs to see the similarity between target problems and source problems. Holyoak & Hummel (2001) say that the similarities of the specific problems between the source and the target problems that can be identified by students through analogical reasoning targets help students solve problems. A reasoner should look at the similarity of the relational structure between known problems (source problems) and the new problems (target problems); namely "alignment structure" or "mapping" between two problems to be found (Bassok, 2001; Gentner, Holyoak, & Kokinov, 2001).

Problem-solving using analogical reasoning applies to certain cases. Gentner (1983) argues that analogical reasoning applies to certain cases such as a case known to be used to inferring new information about the case at hand. Someone did analogical reasoning has the purpose of obtaining a new conclusion or knowledge by comparing between analogical objects or with pre-existing knowledge (Amir-Mofidi, Amiripour, & Bijan-Zadeh, 2012).

DiMaggio (1997) describes a pattern of thought or behavior that organizes categories of information and the relationships among them. It can also be described as a mental structure of preconceived ideas, a framework representing some aspect of the world, or system of organizing and perceiving new information. Schema of analogical reasoning describe the pattern of thought or behavior of a person associated with the analogical reasoning process in solving an analogical problem.

Analogical reasoning in solving analogies problems concerns the existence of adaptation, memory, and reasoning (Gust, Krumnack, Kühnberger, & Schwering, 2008). Magdas (2015) said that the schema of analogical reasoning in solving the problem occurs: (1) recognition is the process of recognizing target problems to source problems, and (2) analogical reasoning. Magdas (2015) made a schema of analogical reasoning that uses analogical problems. Furthermore, Magdas stated that in order to solve the target problem, it is necessary to recognize the source problem. A source problem that has similarities to target problems. Solving source problems is known resolution steps need to be added with new completion steps to resolve the target issue. Schema of analogical reasoning illustrated by Magdas is adding source problems solving step with a new step to target problems that can be seen in Figure 1.

In schema Figure 1, to solve the target problem (problem P), through recognition, we identify an analogue, marked as source problem (basic problem BP), solved previously. Solving steps 1, 2, 3, ..., n of basis problem BP through analogy are transformed in the analogue steps 1, 2, ..., n for solving target problem P. However sometimes we need to add new steps 1, 2, ..., k for solving target problem P (Magdas, 2015). Target problem-solving steps being faced are hardly sufficient only by using source-solving steps but needing additional knowledge. This means that at every step of solution, the source problem needs to add a new step to solving the target problem.

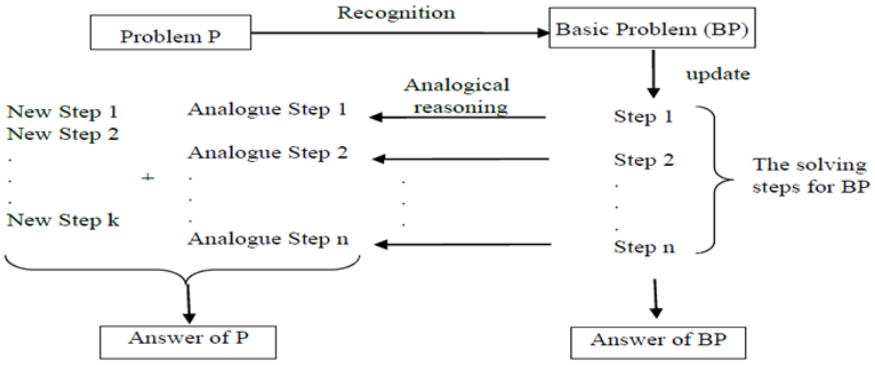


Figure 1. *Scheme of an Analogical Reasoning to Solve Problems (Magdas, 2015)*

A source problem with target problems can be similar or very different. Similar source problems with target problems can directly use solve source problem procedure to resolve target problem. However, the different source problem with target problem, resolving source problem cannot be used directly in resolving the target problem. Some researchers use analogical problem in their research. The researchers who used the analogy problem were English (2004), Bernardo (2001), and Assmus, Forster, & Fritzlar (2014). English (2004) in research, used analogical problems about Algebra and Combinatorics. Bernardo used analogical problems about statistics concepts is conjunction with problems with independent events. While Assmus et al. used analogical problems about Algebra concepts is Arithmetic series. There is a similarity between analogical problems used by the researchers, namely (1) analogical problems consists of source problem with target problems, (2) the problem used between source problem with target problem is the same, and (3) solve procedure between source problem with target problem is the same.

This study uses two analogical problems. The first problem is analogical problems that have similarities between source problems with the target problem. This problem used in this study has characteristics such as analogical problems used by English, Bernardo, and Assmus, at al. This first analogical problem is adapted from analogical problems used (Bernardo, 2001).

The second analogical problem is a problem developed by the researcher. This analogical problem is an analogical problem different from that used by previous researchers. Analogies problems used in this research has characteristics such as (1) mathematical concepts between source problem with target problem are different; (2) procedures in solving source problem are used to solve target problem; and (3) theory mathematics context of source problem with target problem is different.

The schema of analogical reasoning described by Magdas is based on examples of solving geometric problems theoretically. But empirically, the schemes produced by students in solving the problem cannot be explained. In addition, Magdas does not explain analogical reasoning stages in the schema of analogical reasoning he made.

While, the process of resolving analogical problems using analogical reasoning components are structuring, mapping, applying, and verifying (Ruppert, 2013). Structuring: identify every mathematical object that exists on the target problem by encoding its objects or characteristics and making conclusions from identical relationships between source problem with target problem. Mapping: Looks for identical linkages of character codes between source problem and target problem then builds conclusions from the similarity/identity relationship of character codes between source problem and target problem, then the resulting relationship is mapped to the target problem. Applying: resolving target problem based on source problem-solving steps. Verifying: checking the answer of the target problem by checking the suitability of the target problem with source problem.

This research will describe the schema of analogical reasoning appear empirically based on the answer of the student in solving two analogical problems. Analogies' problem consists of source problems with the target problem. In this research given two problems are a similar source problem with the target problem and different source problems with the target problem. How does the schema of analogical reasoning based on the answers from two problems analogy given to the students? Do both of the given analogy problems have the same or different schemas?

Method

Research Design

This study aims to describe the schema of analogical reasoning based on analogies problem. In this study, researchers explore processes and activities students analogical reasoning in solving analogies problems. This study applies the descriptive qualitative approach. Creswell (2013) said that such research is qualitative research with research design is a case study. Case study research involves a detailed description of the setting or individuals, followed by an analysis of the data for themes or issues.

Subject

Subjects of the study were taken from 16-year-old high school students in Mataram city, West Nusa Tenggara, Indonesia. All subjects haven't completed the probability theory learning. Then, all subjects have completed algebraic lessons on quadratic equations at the first level and have not completed learning on trigonometric equations.

Research Instruments

There are two analogical problems used in this research: (1) similar analogies problem between source problem with target problem and (2) different analogies problem between source problem with target problem. The first problem relates to the problem of conjunction with independent events. The second problem are the quadratic equations problem with trigonometric equations problem. Instruments have been declared valid and reliable by mathematicians and mathematics educators. Analogies problem in this research there are on Table 1 and Table 2.

Table 1

Conjunction with Independent Events Problems

Source problem	***Target problem***
There are 76 books in the Science section of the library, six of which are new. In the History section, there are 120 books, 15 of which are new. The principal randomly picks a book from each of the two sections. What is the probability that the principal picks a new book from both sections?"	There are 24 schools in District A, 8 of which are public schools. In District B, there are 32 schools, 12 of which are public schools. For each district, a school is randomly chosen to host the district sports fest. What is the probability that a public school is chosen to host the sports fest in both districts?

(Bernardo, 2001)

Table 2

Quadratic Equations Problem and Trigonometric Equations Problem

Source problem	***Target problem***
Find the roots of the quadratic equation $x^2 + 5x + 6 = 0$	Find the value of x that satisfies $\cos 2x + 6 \sin x + 7 = 0$

(Saleh et al., 2017)

Data Collection

The subject was worked the problem individually. The subject was asked to carefully read the instructions and answer all questions about the task. Steps of data collected: (1) the subject is working on source problem; furthermore, the results of source problem answers are taken and collected from the students, (2) the subject is working on target problem; and then the results of target problem answers are taken and collected from the students as well, (3) selecting student answer sheets that answer correctly from source problem with target problem, and (4) checking answers to students.

Then, data of the research result analyzed to know the occurrence of analogical reasoning. Based on the results of the analysis and student answers of the analogical problems is described and described schema of analogical reasoning that occurred.

Results

The first analogies problem, the source problems, 18 students gave true answers and 17 students gave false answers. While the target problems, 15 students gave true answers and 20 students gave false answers. The second analogies problem, the source problems, 26 students gave true answers and 9 students gave false answers. While the target problems, 16 students gave true answers and 19 students gave false answers. Based on the answer sheets and the interviews found 12 students using analogical

reasoning to answer conjunction with independent events problem. While there are 10 students using analogical reasoning to answer quadratic equation problems and trigonometric equation problems

This study aimed to describe the model schema of analogical reasoning based on some analogical problems. To describe the schema of analogical reasoning on the first analogical problem is represented by subject S1 and subject S2. While describing the schema of analogical reasoning on the second analogical problem is represented by subject S3 and subject S4.

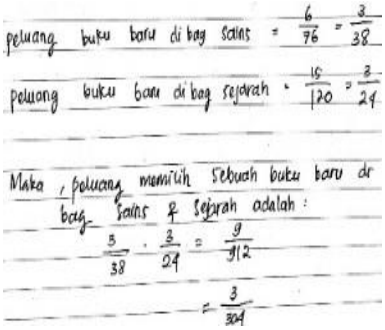
Conjunction with Independent Events Problems

The results showed that 12 students did analogical reasoning. The student answers the source problem correctly and uses the solution of source problem to resolve the target problem. Furthermore, the completion steps used in source problems are directly applied for the target problem. This can be seen from the result of 2 student's answers in solving the source problem with the target problem seen in Figure 2(a), Figure 2(b), Figure 3(a), and Figure 3(b).

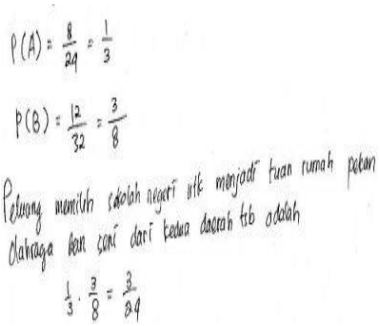
Based on Figure 1(a) with Figure 1(b), subject S1 identifies for resolving source problem. Then subject S1 starts by identifying what is known from problems. subject S1 to write the probability of a new book in the Science section $\frac{3}{38}$ and the probability new book in the History section $\frac{3}{24}$. Then the subject S1 determines to the probability chosen a new book from Science with History section obtained $\frac{3}{304}$. Next, subject S1 completes target problems. Subject S1 does the mapping process from the target problem to the source problem. Furthermore, in the structuring process, subject S1 identifies the problem as it did in resolving source problem. The subject S1 identifies the target problem by stating that the selected the probability a public school in area A is $\frac{1}{3}$ and area B is $\frac{3}{8}$. In the applying process, subject S1 solves the target problem equally by resolving the source problem. In the verifying process, the answer to the target problem like that result of the source problem answer. The answer to the target problem is $\frac{3}{24}$.

Based on Figure 2(a) and 2(b), the subject S2 identifies for resolving source problem. The subject S2 starts by identifying what is known from problems. The subject S2 to write the probability of a new book in the Science section $\frac{3}{38}$ and the probability of a new book in the History section $\frac{1}{8}$. Then the subject S2 determines to choose a new book from the Science and History section obtained $\frac{3}{304}$. Next, the subject S2 completes the target problem. The subject S2 does a mapping process from the target problem to source problem. Furthermore, in the structuring process, subject S2 identifies the problem as it did in resolving source problem. The subject S2 identifies the target problem by stating that the probability chosen a public school in area A is $\frac{1}{3}$ and area B is $\frac{3}{8}$. In the applying process, subject S2 solves the target problem equally

by resolving source problem. In the verifying process, the answer to the target problem like that result of the source problem answer. The answer to the target problem is $\frac{1}{8}$.



2(a)



2(b)

The probability that a new book from the Science section = $\frac{7}{76} = \frac{3}{38}$.

The probability that a new book from History section = $\frac{15}{120} = \frac{3}{24}$.

Then, the probability that chosen a new book from Science and History section is

$$\frac{3}{38} \times \frac{3}{24} = \frac{9}{912} = \frac{3}{304}$$

$$P(A) = \frac{8}{24} = \frac{1}{3}$$

$$P(B) = \frac{12}{32} = \frac{3}{8}$$

The probability that chosen a public school to host the sportsfest from A and B districts is

$$\frac{1}{3} \times \frac{1}{8} = \frac{3}{24}$$

Figure 2(a). *Source Problem with Target Problem Answered the Subject S1.*
Figure 2(b). *Source Problem with Target Problem Answered the Subject S2*

Based on the work of the subject of S1 and the subject of S2, solving analogical problems begins by recognizing the similarity between target problems and source problems. Then, they do the mapping of target problems to source problems. Source problems solving steps are mapped one-to-one to problem-solving step that starts with structuring, applying, and verifying processes. An analogical problem-solving process between target problems and source problems using analogical reasoning stages can be seen in Figure 4.

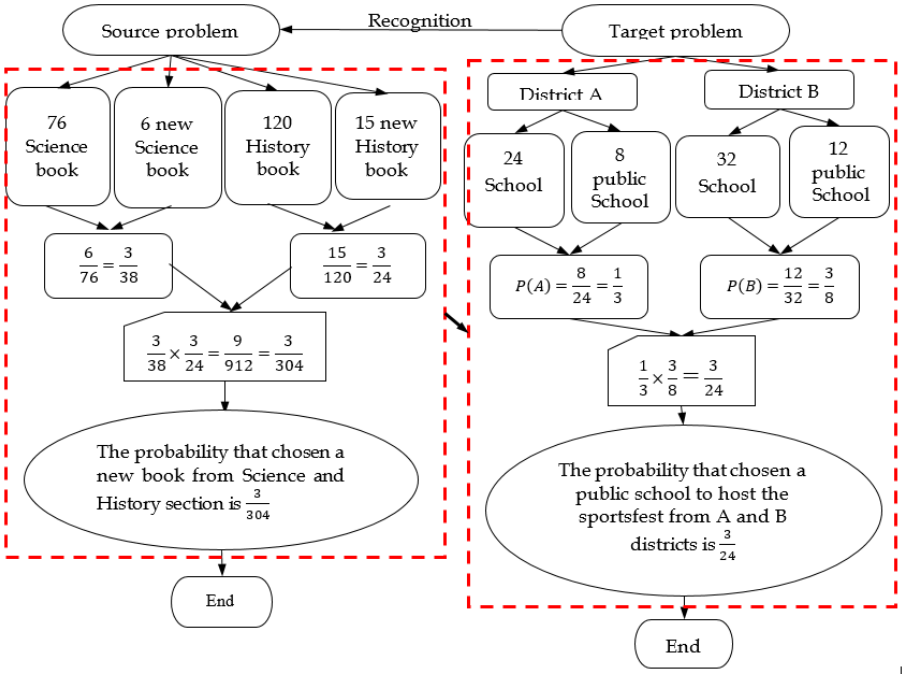


Figure 4. *Process of Analogical Reasoning in Analogical Reasoning in Solving of Conjunction with Independent Events Problems*

Description of the coding on the process of analogical reasoning in solving of the conjunction of independent events problems Figure 4 can see Table 3.

Tabel 3

Description of the Coding on the Process of Analogical Reasoning in Solving of Conjunction of Independent Events Problems

Term	***Code***
Start/End	
Structuring process	
Mapping process	
Applying process	
Verifying process	
Activity process	

The source problem has been answered. Then students are given a similar target problem as the previous source problem. In solving the target problem, students use analogical reasoning stages. Structuring process: (a) students identify problems targets, (b) the students see the similarities between the properties of target problem

and source problems, (c) the students make the assumption that the target problems have a common with source problems. Mapping process: the student declares that solving the target problem equals solving the source problem. Applying process: students solving target problems equals solving source problems. Verifying process: the student checks the solution of the target problem by observing the source problem. In general, the schema of analogical reasoning in solving analogical problem-related conjunction with independent events problems based on the Magdas scheme can be illustrated in Figure 5.

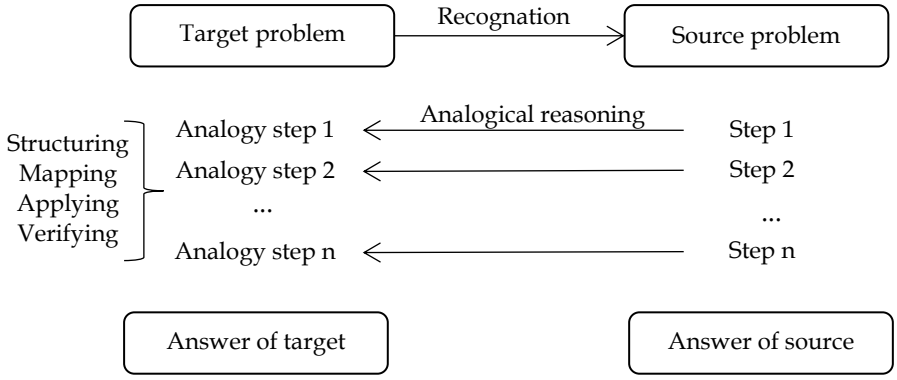


Figure 5. *Schema of Analogical Reasoning for the First Analogical Problem*

Glossary

⟶ : Process of analogical reasoning

Quadratic Equation Problems and Trigonometric Equation Problems

The results showed that 10 students did analogical reasoning. The student answers source problems correctly and uses the concept of source problem to solve the target problem. Furthermore, some of the solving steps used in source problems; students apply to target problems. This can be seen from the result of the student's answer on source problem with the target problem seen in Figure 6 and Figure 7.

Based on Figure 6, the subject S3 solves quadratic equations problems (source problems) by using factorization and obtaining correct answers. Furthermore, the subject S3 solves trigonometric equations problems(target problems) beginning with a change $\cos 2x = 2\cos^2 x - 1$. The subject S3 substitutes $\cos 2x = 2\cos^2 x - 1$into the trigonometric equation so that obtain $\cos^2 x - 12\cos x - 13 = 0$. The subject S3 performs the mapping process by making the conclusion that new trigonometric equations obtain is a form of a quadratic equation on trigonometric equations. That is a process of solving target problems using the solving process by way of solving quadratic equation problems. Structuring process, the subject S3 identifies the problem as it did in resolving source problem. Applying process, the subject S3 solves

trigonometric quadratic equation problems like solving quadratic equation problems (source problems). And finally, the verifying process, the subject S3 finds the value of x that satisfies for the value $\cos x = -1$so that the subject S3 obtains the value $x = 180$.

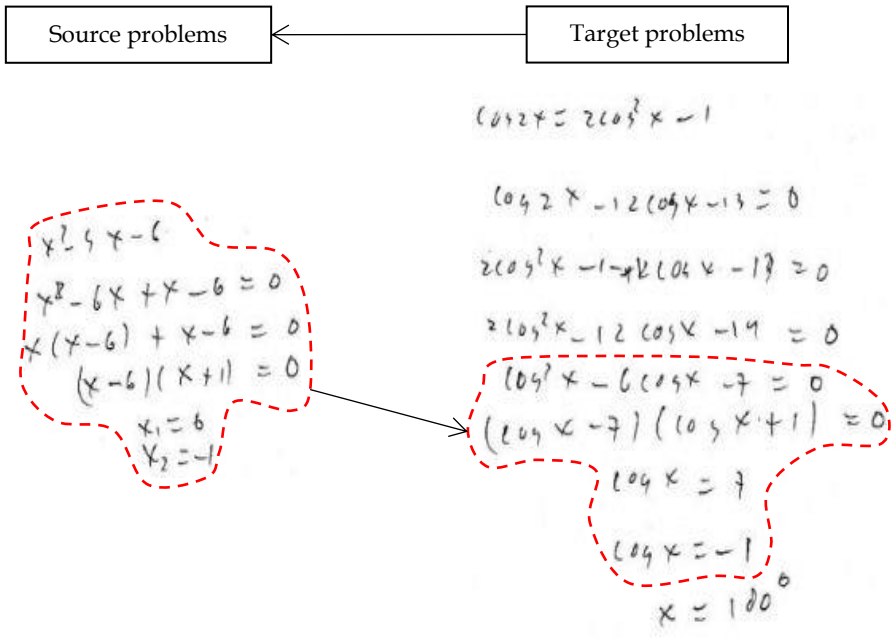


Figure 6. *Source Problem with Target Problem Answered the Subject S3*

Glossary

⟶ : Process of analogical reasoning

Based on Figure 7, the subject S4 solves quadratic equations problems (source problem) by using factorization and obtaining correct answers. Furthermore, the subject S4 solves trigonometric equations problems (target problem) beginning with a change $\cos 2x = 2\cos^2 x - 1$. The subject S4 substitutes $\cos 2x = 2\cos^2 x - 1$ into the trigonometric equation, so that obtain $2\cos^2 x - 12\cos x - 14 = 0$ then $\cos^2 x - 6\cos x - 7 = 0$. Then, the subject S4 gives $\cos x = A$ obtained $A^2 - 6A - 7 = 0$. The subject S4 performs the mapping process by making the conclusion that the new trigonometric equation obtained is a form of a quadratic equation on trigonometric equations. And then, the subject S4 obtains a new quadratic equation. That is a process of solving target problems using the solving process by way of solving quadratic equation problems. Structuring process, the subject S4 identifies the problem as it did in resolving source problem. Applying process, the subject S4 solves trigonometric quadratic equation problems like solving quadratic equation problems (source problem). And finally, verifying process, the subject S4 finds the value of x that satisfies for the value $\cos x = -1$. The subject S4 obtains value $x = \pi, 540, \ldots$ The subject S4 obtains the value $x = \pi$.

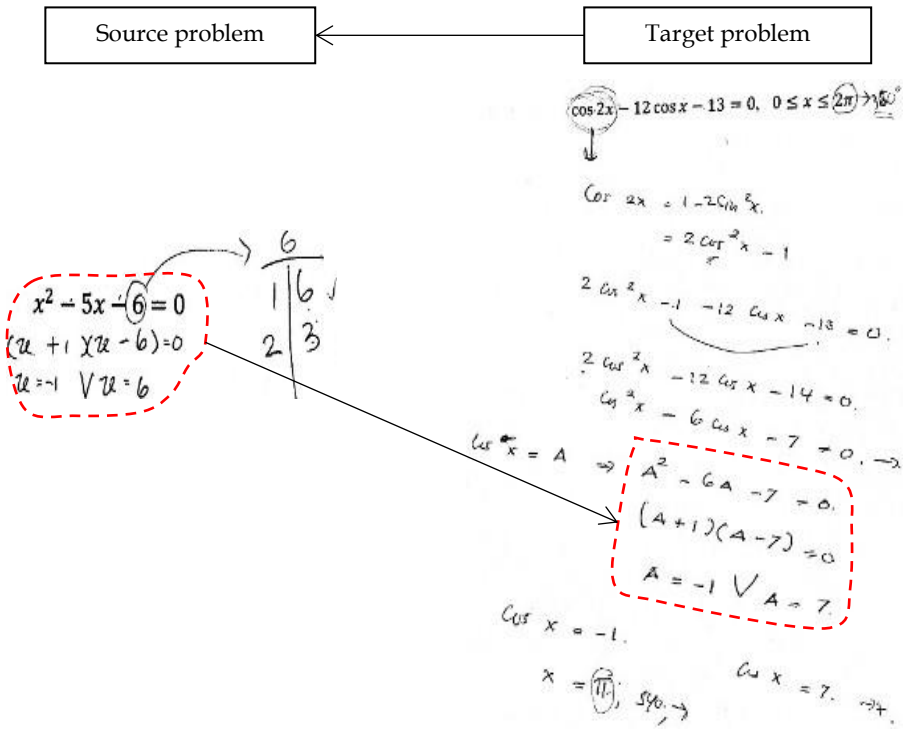


Figure 7. *Source Problem with Target Problem Answered the Subject S4*

Glossary

⟶ : Process of analogical reasoning

Based on the work of subject S3 and subject S4, solving analogical problems starts by recognizing the similarity between target problem with source problem. Target problems do not explicitly resemble source problems. Before the structuring process, target problems needs to be representation modified to form problems similar to source problems: that is, there is one stage in solving target problems is representation. The aim of changing target problems like source problems. And then, structuring proses, to identify new target problems and to find similarity with source problems, then mapping from target problem to source problem. Applying process, solving source problem steps are mapped one-to-one to problem-solving steps. And finally, the verifying process to determine the answer to target problems. An analogies problem-solving process between target problem with source problem using analogical reasoning stages there is in Figure 8.

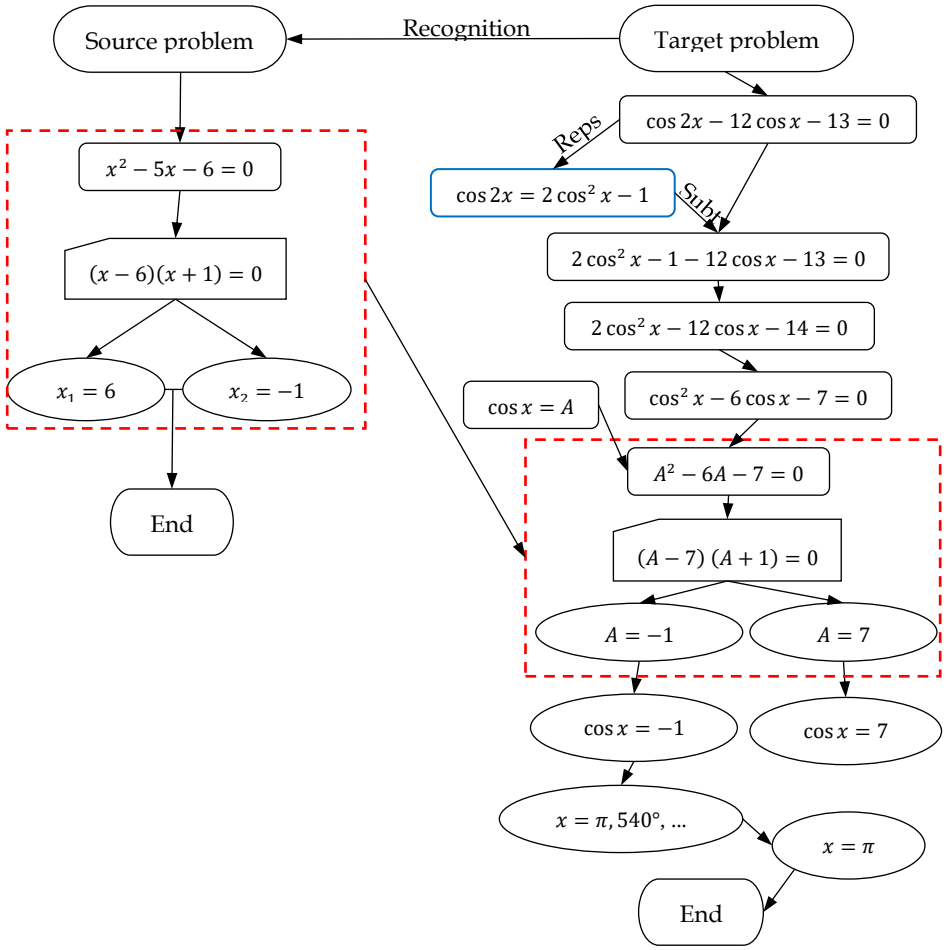


Figure 8. *Process of Analogical Reasoning in Analogical Reasoning in Solving of Quadratic Equation and Trigonometric Equation Problems*

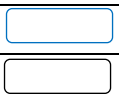
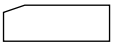
Description of the coding on the process of analogical reasoning in solving of quadratic equation and trigonometric equation problems Figure 8 can see Table 4.

Tabel 4

Description of the Coding on the Process of Analogical Reasoning in Solving of Quadratic Equation and Trigonometric Equation Problems

Term	***Code***
Start/End	

Tabel 4 Continue

Term	*Code*
Representation process	
Structuring process	
Mapping process	
Applying process	
Verifying process	
Activity process	
Representation	Reps
Substitution	Subt

The source problem has been answered. Then students are given target problem that is different from the previous source problem. In solving the target problem, students need to do representation before using the analogical reasoning stage. Representation: the student performs a representation of a target problem such as changing $\cos 2x = 2\cos^2 x - 1$. Structuring process: (a) students identify problems targets, (b) the students see the similarities between the properties of target problem and source problems, (c) the students make the assumption that the target problems have a common with source problems. Mapping process: the student declares that solving the target problem equals solving the source problem. Applying process: students solving target problems equals solving source problems. Verifying process: the student checks the solution of the target problem by observing the source problem. In general, the schema of analogical reasoning in solving analogical problem related quadratic equation and trigonometric equation problems based on the Magdas scheme can be illustrated in Figure 9.

Discussion, Conclusion and Recommendations

This research resulted in two schema model of analogical reasoning from two different analogical problems. First, schema model of analogical reasoning from two similar problems between source problem with target problem. Second, the schema model of analogical reasoning from two different problems between source problem with target problem.

A difference in the analogical reasoning process done by students in resolving the given analogical problems. In the first analogical problems, the student directly mapp source problem procedure to target problem. Students transferring analogical problems information between source problems and target problems direct. While the second analogical problem, students do not directly map procedure solve source problem to solve the target problem. Students are transferring analogical problems information between source problem with target problem indirect because the target

problem must be presented in the form of a quadratic equation. Students need one stage before using analogical reasoning in solving analogies problem.

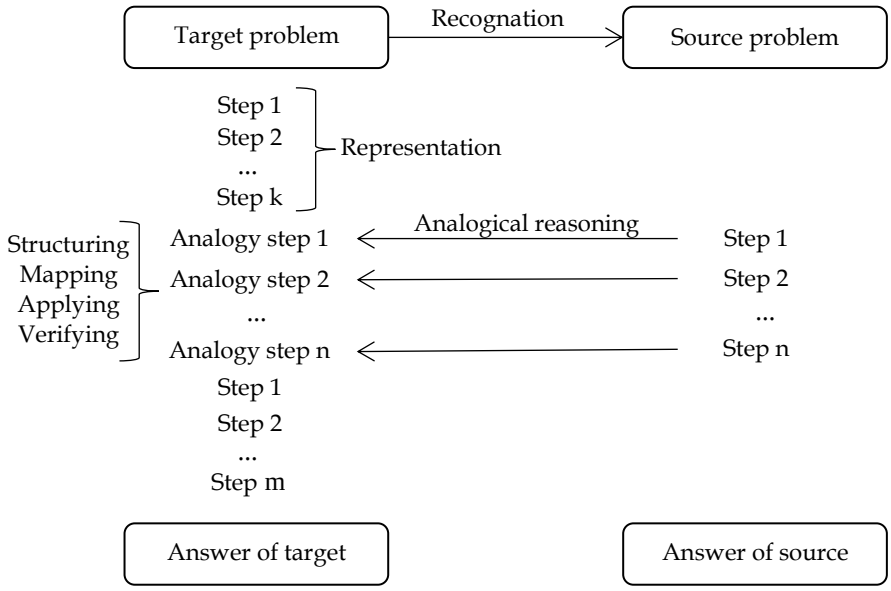


Figure 9. *Schema of Analogical Reasoning for Quadratic Equation and Trigonometric Equation Problems*

Glossary

⟶ : Process of analogical reasoning

So there is a difference between schema; the first is that students can directly map between target problem with source problem, followed by structuring, applying, and verifying. The second type is that the student can not directly map between the target problem with the source problem, but the student needs to do a representation of the target problem so as to find a form of problem that has similarities with the source problem. Then the student can map between target problem with source problem, followed by doing the process as the first schema type.

According to the results of the research, subprocesses analogical problem the first in analogical reasoning include: (1) the student identified targets problem and sought the similarity between source problem with target problem, (2) the student does one-to-one mapping features of target problem to source problem, (3) the student applies the problem-solving procedures of source problem to solve target problem, and (4) the student checked the results obtained from target problem with source problem. This analogical reasoning process is consistent with English, Thagard and Kristayulita et al. (English, 2004; Thagard, 2005; Kristayulita, et al., 2018), the analogical reasoning process in solving analogies problem. They said analogical reasoning process in

solving the analogies problem are: (1) the student identifies target problem; (2) students remembered the known source problem solution; (3) students compare between source and target problem, see relevant relation between its components; and (4) students adapting the source problem-solving steps to resolve the target problems.

In solving the second analogical problem, students do not immediately seek a one-on-one relationship between source problem with target problem. The problem faced is different from the previous analogical problem. Students need to represent target problems to a form that has a resemblance to source problems. In this case, one needs to have the ability to represent problems in order to find specific information between target problems and source problems. The ability to represent this problem is also a characteristic of mapping success between base problems and analog problems (Gentner & Markman, 1997; Markman & Gentner, 2000; Eveleth, 2016). According to the results of this study, subprocesses analogical problem the second in analogical reasoning include: (1) representation of the target problem, (2) structuring on new problems of the target problem, (3) mapping of new problems and related source problems, (4) applies the problem-solving procedures of source problems to solve new problems from target problems, and (5) verify the result based on target problems.

The Schema of analogical reasoning depicted in solving the analogical problem the first involved recognition and analogical reasoning process. This is in line with the schema of analogical reasoning described by Magdas (Magdas, 2015). However, schema of analogical reasoning in solving the second analogical problem occurs recognition, representation, and analogical reasoning process. This means that the given analogical problem can give a different schema of analogical reasoning. The more difficult an analogical problem is given, the greater the cognitive load used in solving it. Strategies that are implemented in problem-solving can be difficult because problem-solvers need to pay attention to information other than problems to be solved (target problems) (Voskoglou, 2012). Thus the solver can have no solution, either because it has never solved a similar problem before or because it fails to recognize the similarity with the previous problem. However, if the solver is aware of an analogy, the solver must know how to use it to determine the solution procedure for target problems.

By identifying similarities between different objects or situations, humans can solve new problems, learn, and form new concepts, or communicate specific ideas to others. This identification of similarities allows us to connect knowledge domains and transfer solutions that differ from domain to domain. In analogical reasoning, the similarity is usually relational, ie relating the components of an object or situation rather than to the component itself (Gentner & Holyoak, 1997; Krawczyk, 2012).

This suggests that the process of analogical reasoning can depend on the instrument used. Therefore, teachers need to provide a variety of problems to develop analogical reasoning abilities, in which the problems provided do not only bring up the first schema or the second schema. However, students need to be given analogical problems that can lead to both schemas. Furthermore, teachers need to develop an analogical problem that can develop critical and creative thinking to enhance the

creativity of high school students with their analogical reasoning. Therefore, future research should focus on developing an analogical problem-related instrument capable of enhancing creativity and critical thinking of students.

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Promoting Cognitive Strategies in Second Language Writing

Mekala SETHURAMAN[1], Geetha RADHAKRISHNAN[2]

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ABSTRACT

Purpose: Polytechnic students lack basic skills, especially the writing skill essential for their employment. They find it difficult to write emails, reports, and other technical documents required at their workplace. Although there are studies to investigate this skill-gap, there is little research to explore the possibilities for enhancing their writing skill. Hence, this study focuses on enhancing the writing skill of the polytechnic students. This study aims to employ cognitive strategies to guide the mental operations entailed in performing a writing task. The paper delineates the experimental study employing cognitive strategies to foster the writing proficiency of the students.

Research Methods: 51 pre-final year diploma students belonging to the Department of Instrumentation and Control Engineering of the autonomous polytechnic institute in Tamil Nadu was chosen as the samples for this study. The teacher-researcher imparted cognitive strategies to the students and has invigorated them to employ it in their writing tasks administered in a graded structure during the course.

Findings: The findings of the study established a strong correlation between students' cognitive strategy use and their writing. The results corroborated improvement in the students' writing skill expedited by the employment of cognitive strategies in their writing tasks.

Implications for Research and Practice: The findings obtained in this study suggest the necessity of integrating cognitive strategies in the writing skill of the ESL learners in accordance with the workplace demands of adequate proficiency in writing skills of the employees creating a desideratum for the polytechnic students to enhance proficiency in their writing.

[1] National Institute of Technology, Tiruchirappalli, INDIA, mekala@nitt.edu,
ORCID: https://orcid.org/0000-0001-9195-689X
[2] National Institute of Technology, Tiruchirappalli, INDIA, geethenglish@gmail.com,
ORCID: https://orcid.org/0000-0003-2114-8074 (corresponding author)

Introduction

Writing is a productive skill encompassing various copious processes. Many researchers assert that "attention to process is potentially very important for the teaching of writing" (Hayes & Flower, 1980). This process-oriented approach enumerates, retrieval of information relevant to the task from memory, transfer of the background knowledge into writing, generation of new ideas, formulation of goals for the successful completion of the task, the grouping of ideas in a sequential methodology. The writing process is divided into three stages: Pre-writing, writing and Re-writing comprising subcategories, including planning, goal-setting, generating, organising, translating, reviewing and editing. Zamel (1983) opines writing as a "non-linear, exploratory, and generative process whereby writers discover and reformulate their ideas as they attempt to approximate meaning" (as cited in Hyland, 2003, p.11). Hayes and Flower (1980) describe, "as a dynamic process, writing is the act of dealing with an excessive number of simultaneous demands or constraints" (p. 33). Flower and Hayes (1981) proffer, "the process of writing is best understood as a set of distinctive thinking processes which writers orchestrate or organize during the act of composing" (p. 366). Davis and McKay (1999) expound, "writing is a process which fuses language and thought" (p. 5). These elucidate the role of cognition in writing, as Hyland (2003) has insisted, "cognition is a central element of the (writing) process" (p. 13) and "writing is a sociocognitive activity which involves skills in planning and drafting as well as knowledge of language, contexts and audiences" (p. 23). As cited in Shawer, Gilmore, and Banks-Joseph (2008), "cognitive strategies are the 'steps or mental operations used in learning or problem-solving that require direct analysis, transformation, or synthesis of learning materials in order to store, retrieve, and use knowledge' (Wenden, 1986). 'cognitive strategies involve asking questions, checking, revising, self-testing' (Riding & Rayner, 1998); 'analogy, memorization, repetition, writing things down, and inference' (Hedge, 2000)" (p. 5). Accordingly, the paper proposes cognitive strategies to be employed in the ESL classroom to hone the Polytechnic students' writing skills considering the skill gap prevailing in the polytechnic students' writing skill as proffered by (Sarfo-Adu, 2015). Chaudron (2009) explains cognitive strategies as the operations that are involved in analysis, transformation or synthesis (p.113). Weinstein and Hume (1998) define cognitive strategies as "the behaviors, thoughts, or actions used by the learner in the process of learning to organize and store knowledge and skills, and to apply them easily in the future" (as cited in Pitenoee, Modaberi & Ardestani, 2017, p. 595). In congruence with this, selected cognitive strategies say, Remembering, Connecting and Generating are propounded in this paper to enhance the polytechnic students' thinking ability in recalling and transferring their background knowledge, generating ideas, connecting the ideas relevant to the topic and organising them in a coherent manner. This strategy instruction employed in the study has been identified to promote the students' thought process and equip them in achieving coherence and unity in their writing.

Literature Review

Learning Strategies. Chaudron (2009) defines learning strategies as the cognitive operations that learners apply in the classroom and learning situations (p. 109). Oxford (1989) defines language learning strategies as "the often-conscious steps of behaviors used by language learners to enhance the acquisition, storage, retention, recall, and use of new information" (as cited in Shi, 2017). However, some researchers, such as Rubin, Stern, Carver, Ellis, O'Malley et al. and Oxford, have classified learning strategies based on various components say, the process involved in learning and performance, hypothesis formation, cognition, metacognition, social and affective factors. Moreover, Cognitive Strategies have been proposed by O'Malley et al., Oxford and Wenden. While cognitive strategies have been furcated by O'Malley et al. into rehearsal, organization, inferencing, summarizing, reducing, imagery, transfer, and elaboration components, Oxford has categorized it into, enabling learners to understand and producing new language, such as reasoning, practicing, receiving and sending messages, analysing, and summarizing, and Wenden has categorized it into selecting information, comprehending, storing and retrieving information (as cited in Shi, 2017).

Table 1

Studies of Learner Strategies (Chaudron, 2009)

Study	*Class Level*	*Data Collection*
Naiman et al. (1978)	Grades 8,10,12	Classroom Observation, interviews
Bialystok & Frohlich (1978)	High School	Questionnaire
Politzer (1983)	University	Questionnaire
Politzer & McGroarty (1985)	University graduate preparation	Questionnaire
Chesterfield & Chesterfield (1985)	Preschool & grade 1	Classroom observation
Willing (1985)	Adult immigrants	Questionnaire
O'Malley et al. (1985)	High school	Interviews, classroom observation

Table 1 indicates the precursory studies that have been conducted effectuating Learning strategies in the classroom. Griffiths (2019), after analysing all the methods and learning strategies, has posited,

> Language learning strategy theory eclectically combines all the theoretical traditions, viewing learners as cognitively active individuals, operating within a social environment according to their own individual human characteristics. In addition, strategy theory retains traces of other theories, such as behaviourism (e.g. repetition), structuralism (e.g., finding grammar rules), post-structuralism (e.g. emphasizing meaning), and self-regulation (the need for learners to manage their own strategy choices) (p. 3).

Second Language Writing. Matsuda (2003) promulgates that writing has been given attention during the 1960s and has become a significant issue at the annual meetings of the Conference on College Composition and Communication (CCCC) in 1949. Only

in the late 1950s, the shift from composition studies to second language studies has been identified; TESOL (Teachers of English to Speakers of Other Languages) has been found; and L1 and L2 writing composition have been demarcated. Besides, the limitation in writing as a controlled composition has led to the development of Guided composition. In the 1980s, discourse analysis was developed and a shift from textual features to process writing has been discovered. Later, second language writing has been recognized as a legitimate field and since then, the number of studies in the field has increased. As cited in Polio (2003), the prefatory research on the writing process is conducted by several researchers (see Bosher, 1998; Zamel, 1983; Pennington & So, 1993; Whalen & Menard, 1995) focusing mainly on General process, Hall (1990) Phinney and Khouri (1993), Porte (1997) and Roca de Larios et al. (1999) have investigated the revision process of writing, Henry (1996), Intaraprawat and Steffensen (1995) have concentrated on the fluency of writing, Polio and Glew (1996) have perused the prewriting process, Cohen and Cavalcanti (1990) and Hyland (1998) have examined the benefit of written feedback. Villamil and deGuerrero (1996) and McGroarty and Zhu (1997) have assessed the peer review in writing. Besides these studies, there are studies in L2 writing that has been conducted focusing the attention towards the participants say, teachers, students/writers, raters, and professors/NES (National Evaluation Systems) teachers. Students and writers have been the pivots in some studies (see Mcgroarty & Zhu, 1997; Liebman, 1992; Kubota, 1997; Spack, 1997; Leki & Carson, 1997; Deckert, 1993; Harklau, 1999; Leki, 1995).

Cognition and Writing. Van Dijk and Kintsch (1983) delineate cognitive strategies as,

> Thinking and problem solving are well-known examples: We have an explicit goal to be reached, the solution of a problem, and there may be specific operations, mental steps, to be performed to reach that goal. These steps are under our conscious control and we may be at least partly able to verbalize them so that we can analyze the strategies followed in solving the problem (p. 68).

Ramli and Ardiana (2018) have conducted a study on tenth-grade students using cognitive strategy instruction in writing (CSIW) and have found improvement in the students' writing skills. Cognitive strategies have been investigated in contexts of writing by many researchers (see Graham & Harris, 1994; Harris & Graham, 1996; Scardamalia & Bereiter, 1986) (as cited in Shabitha, 2014). Bereiter (1980) has opined, "a complete processing model (Cognitive) would have to deal with all three of these aspects – with the cognitive moves that make up writing and their organization; with levels of processing, from the highly conscious and intentional to the unconscious and automatic; and with how processing capacity is deployed to these various functions in such a way as to enable writing to go on" (p. 103). Scardamalia and Bereiter (1986) have observed, "even relatively advantages students with years of schooling tend to exhibit strategies that are more novice- than expert like, but instruction designed on the basis of cognitive strategy models is demonstrating considerable promise" (p. 60). Besides, they explain cognitive strategies as the way, the cognitive behaviour (e.g., planning, rethinking or reproducing) is organised in writing. García and Fidalgo (2008) enunciates the predominance of cognition in the writing process as,

> The demanding nature of writing requires student engagement to develop both writing competence and skills. Writing demands a level of behavioral engagement, which incites students to exert more effort and persist longer at tasks and seek instrumental help if necessary. Moreover, writing tasks require extensive attention control and self-regulation, because skilled writing as a self-planned, self-initiated and self-sustained activity entails high levels of self-regulation (Graham & Harris, 1997; Zimmerman & Risemberg, 1997); that is to say, writing also requires students' cognitive engagement (p. 415).

The eminence and influence of cognitive strategies in the process of writing is reflected through these revelations by great experts. While these studies have focused more on the process of cognition in writing, the present study explores the effectiveness of cognitive strategies in achieving coherence and unity in the polytechnic students' writing.

Research Rationale

Writing is not used to reinforce grammar and vocabulary in modern L2 classrooms as writing is an enterprise in and of itself (Manousou, 2015). Olson (as cited in Linse, 2005, p. 98) represents that writing is gathering and working on the ideas until they are presented in a polished and comprehensible manner to the reader. In addition, he attests that the concept of writing as a process is very useful. These reports reveal the importance of writing skill to be taught as a process rather as a product. Pushpanathan (2019) asserts, "all the four skills of a language (listening, speaking, reading, and writing) are included in the curricula in order to develop the communication skills of the Polytechnic Students" (p. 6093). Although these skills are included in the curriculum, the students lack the basic skills required for employment according to Goel (2017), Deputy Director General, Department of Higher Education Ministry of Human Resource Development, Government of India, "over the years, the diploma programmes have deteriorated losing the skill components, which has resulted in their being just a diluted version of degree education. The organizations employing them have to train them all over again in basic skills" (p. 8). Madhavan (2018) explicates that the students graduating from Polytechnic colleges lack the modern talents and skills required in corporate companies. This evidences explain the lacunae of polytechnic students in basic skills. Isnin (2017) has propagated the significance of writing skills at the workplace in spite of any profession, including engineers, scientists, architects, physicians and lab technicians. A study conducted by Yasin et al. (2010) on English skill deficiencies of polytechnic students found that they lack the comprehension of technical documents, appropriate use of grammar, vocabulary and sentence structure, writing test/investigation report and questioning for clarification (as cited in Isnin, 2017). These studies emphasize the need for improvement in the writing skills of polytechnic students. Frans (2014) indicates that the effective language learning necessitates the right knowledge to cope with the complexity and demanding nature of the language, especially in writing. Sturm and Rankin-Erickson (2002) have stated that "strategy instruction is a teaching approach that help students to develop strategies for all the process of writing by dividing the writing tasks and making the

sub processes and skills much more explicit" (as cited in Pitenoee, Modaberi, & Ardestani, 2017, p. 595). In concord with this, the present study has engrossed the polytechnic students with cognitive strategies to enhance their writing skill. To identify the predominance of cognitive strategies on the polytechnic students' writing skills, the following research questions have been examined in this study.

1. How often the students have used cognitive strategies in their writing?
2. Do cognitive strategies influence the students' writing skill?
3. Is there a difference in the writing performance of control and experimental group?

Method

Research Sample and Design

The present quasi-experimental study was conducted at Seshasayee Institute of Technology (SIT), a polytechnic institution located in Tiruchirappalli, Tamil Nadu, India. Simple random sampling technique was used to select the participants (N = 73) of this study. A diagnostic test was administered to identify the proficiency level of the students and the low proficiency students were allocated to the experimental group ICE (N = 51) and the remaining students were assigned to the control group ECE (N = 22). These students were chosen for this study considering their need of project report submission in the final year and their workplace requirements of report writing, letter writing and instructions.

Research Instruments and Procedures

The pre-study questionnaire was administered in the beginning of this study to examine their social background and to analyse their awareness of cognitive strategies pertaining to the writing skill. The pre-study questionnaire exhibited that most of the students hailed from rural background, regional medium of instruction and were not aware of cognitive strategies. Pre-Proficiency test was conducted to diagnose the proficiency level of the students, which indicated their low-level of writing proficiency. A schedule of 30 classes with 60 minutes duration was conducted to the experimental group facilitating the students to employ cognitive strategies in their writing process. 20 writing tasks were administered to the students in a graded structure. At the end of the course, post-study questionnaire was administered to analyse the students' strategy use in their writing after the employment of cognitive strategies and post proficiency test was conducted to assess the improvement in the students' performance. Besides these tests, a delayed-proficiency test was conducted after three months of the course to analyse if the students have sustained their improvement.

Validity and Reliability

The reliability of the research instruments, such as Questionnaire and writing tasks, has been inspected using the reliability analysis. The Cronbach's Alpha values in Table 2 being greater than 0.8 indicate that the data are highly reliable.

Table 2

Reliability Statistics

S.No.	Group	Variable	Cronbach's Alpha	N of Items
1.	Experimental	Cognitive Strategies	0.798	9
2.	Experimental	Pre-Study Questionnaire	0.902	53
3.	Experimental	Post-Study Questionnaire	0.896	37
4.	Control	Pre-Study Questionnaire	0.804	53
5.	Experimental	Writing Tasks	0.965	20

Data Analysis

The data collected were coded and analysed using SPSS software. Significant values of Shapiro-Wilk test in Table 3, being greater than 0.05 explicate the normal distribution of the data set. Descriptive statistics were used to analyse the first research problem concerning the strategy use of the students. Further, correlation analysis was computed to examine the relation between cognitive strategy and writing skill concerning the second research problem. Moreover, paired-samples t-tests have been computed to evaluate the outcome of implementing cognitive strategies in the writing process discussing the third research problem.

Table 3

Normality Statistics of Proficiency Test

S.No.	Group	Test	Shapiro-Wilk (Sig.)
1.	Experimental	Pre	0.541
2.	Experimental	Post	0.116
3.	Experimental	Delayed	0.532
4.	Control	Pre	0.608
5.	Control	Post	0.206

Results

Descriptive Analysis of Students' Cognitive Strategy Use

The frequency of Students' Cognitive Strategy use was analysed and is tabulated in Table 4. Cognitive strategies have been classified into three major categories say, Remembering, Connecting and Generating. Flower and Hayes (1981) have classified writing stages as, "Pre-Writing is the stage before words emerge on paper; Writing is the stage in which a product is being produced; and Re-Writing is a final reworking of that product" (p. 367). Remembering strategy is used in Pre-writing stage; generating strategy is used at all the stages and connecting strategy is used in Writing and Re-writing stage. The frequency percentage in Table 4 exhibits that the students from the experimental group 'sometimes' recollected ideas from their memory, 'always' transferred their background knowledge in their writing, 'always' related their thoughts and ideas in their writing, 'sometimes' sequentially classified and grouped their ideas for clarity, 'always' consciously followed the instructions, 'sometimes' generated new words concerning contextualization, 'sometimes' were able to think in English, 'always' were able to ponder and generate new content on their own, and

were 'always' were able to be transparent and lucid in expressing their thoughts in their writing task.

Table 4

Descriptive Statistics of the Cognitive Strategies

S.No.	Cognitive Strategies	N	Always (%)	Sometimes (%)	Rarely (%)	Never (%)	Mean	S.D.
				Remembering				
1	Recollection of topics	51	26.2	47.5	6.6	3.3	3.16	0.73
2	Usage of background knowledge	51	42.6	31.1	6.6	3.3	3.35	0.79
				Connecting				
3	Relating thoughts and ideas continuously	51	41.0	34.4	6.6	1.6	3.37	0.72
4	Clarity in the statement of opinion	51	31.1	44.3	4.9	3.3	3.24	0.74
5	Careful follow-up of the task instructions	51	45.9	29.5	4.9	3.3	3.41	0.78
				Generating				
6	Compensation of new words	51	16.4	37.7	18.0	11.5	2.71	0.94
7	Ability to think in English	51	29.5	41.0	8.2	4.9	3.14	0.83
8	Ability to think and generate content	51	39.3	36.1	3.3	4.9	3.31	0.81
9	Ability to express thoughts clearly	51	41.0	34.4	4.9	3.3	3.35	0.77

Relationship between Cognitive Strategies and Second Language Writing

Correlation analysis was computed to analyse the relationship between the students' Cognitive strategy use and their writing. Table 5 explicates the students' writing that has been evaluated based on the scoring profile of Jacob et al. (1981) comprising Content, organisation, Vocabulary, Language Use and Mechanics as shown in Table 6. The p-values less than 0.05 in Table 5 indicated that there was a significant relationship between second language writing (Content, Organisation, Vocabulary, Language use, Mechanics) and Cognitive strategies (Remembering, Connecting and Generating). While there was a significant correlation between Remembering strategy and Content, Organisation, Vocabulary and Mechanics at 0.05 level, Remembering strategy and Language Use were correlated at 0.01 level. Besides, there was a significant correlation between the Connecting strategy and second language writing at 0.05 level. Further, Generating strategy and Second Language

Writing had a significant correlation at the 0.01 level. According to Chien (2012) "Students need to utilize the suitable strategies to be a professional writer because a positive correlation can be observed between writing competence and strategy use" (Pitenoee, Modaberi & Ardestani, 2017, p. 594). In concord with this, the results in Table 5 explicates that the employment of cognitive strategies has a positive influence on students' writing skill with reference to recalling the ideas stored in their memory that are relevant to the topic assigned to them, generating new ideas relevant to the topic, and connecting those ideas in sequential order for clarity and coherence in their writing.

Table 5

Correlation Analysis of Cognitive Strategies and Second Language Writing

	Cont.	*Org.*	*Voc.*	*Lang. Use*	*Mech.*	*Remem.*	*Conn.*	*Gen.*
Cont.								
Org.	0.972**							
	0.000							
Voc.	0.966**	0.990**						
	0.000	0.000						
Lang. Use	0.969**	0.987**	0.989**					
	0.000	0.000	0.000					
Mech.	0.945**	0.957**	0.968**	0.973**				
	0.000	0.000	0.000	0.000				
Remem.	0.346*	0.334*	0.324*	0.363**	0.312*			
	0.013	0.017	0.020	0.009	0.026			
Conn.	0.309*	0.291*	0.305*	0.336*	0.298*	0.601**		
	0.027	0.038	0.030	0.016	0.033	0.000		
Gen.	0.536**	0.524**	0.516**	0.551**	0.526**	0.622**	0.597**	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Note. The abbreviations in the table is expanded as the following: Cont. – Content, Org. – Organisation, Voc. – Vocabulary, Lang. Use – Language Use, Mech. – Mechanics, Remem. – Remembering, Conn. – Connecting, Gen. – Generating.

Table 6

Jacob et al.'s (1981) Scoring Profile

ESL Composition Profile			
Student:		*Date:* *Topic:*	
Score	*Level*	*Criteria*	*Comments*
Content	30-27	EXCELLENT TO VERY GOOD: • Knowledgeable • Substantive • thorough development of the thesis • relevant to assigned topic	
	26-22	GOOD TO AVERAGE: • some knowledge of the subject • adequate range • limited development of the thesis • mostly relevant to topic, but lacks detail	
	21-17	FAIR TO POOR: • limited knowledge of the subject • little substance • inadequate development of the topic	
	16-13	VERY POOR: • does not show knowledge of subject • non-substantive • not pertinent • OR not enough to evaluate	
Organisation	20-18	EXCELLENT TO VERY GOOD: • Fluent expression • Ideas clearly stated/supported • Succinct • Well-organized • Logical sequencing • cohesive	
	17-14	GOOD TO AVERAGE: • somewhat choppy • loosely organized but main ideas stand out • limited support • logical but incomplete sequencing	
	13-10	FAIR TO POOR: • non-fluent • ideas confused or disconnected • lacks logical sequencing and development	
	9-7	VERY POOR: • does not communicate • no organization • OR not enough to evaluate	

Table 6 Continue

ESL Composition Profile			
Student:		Date: Topic:	
Score	Level	Criteria	Comments
Vocabulary	20-18	EXCELLENT TO VERY GOOD: • Sophisticated range • Effective word /idiom choice and usage • Word form mastery • Appropriate register	
	17-14	GOOD TO AVERAGE: • Adequate range • Occasional errors of word/idiom form, choice, usage but meaning not obscured	
	13-10	FAIR TO POOR: • Limited range • Frequent errors of word/idiom form, choice, usage • Meaning confused or obscured	
	9-7	VERY POOR: • Essentially translation • Little knowledge of English Vocabulary, idioms, word form • OR not enough to evaluate	
Language Use	25-22	EXCELLENT TO VERY GOOD: • Effective complex constructions • Few errors of agreement, tense, number, word order/function, articles, pronouns, prepositions	
	21-18	GOOD TO AVERAGE: • Effective but simple constructions • Minor problems in complex constructions • Several errors of agreement, tense, number, word order/function, articles, pronouns, prepositions but meaning seldom obscured	
	17-11	FAIR TO POOR: • Major problems in simple complex constructions • Frequent errors of negation, agreement, tense, number, word order/function, articles, pronouns, prepositions and/or fragments, run-ons, deletions • Meaning confused or obscured	
	10-5	VERY POOR: • Virtually no mastery of sentence construction rules • Dominated by errors • Does not communicate • OR not enough to evaluate	

Table 6 Continue

ESL Composition Profile			
Student:		Date: Topic:	
Score	Level	Criteria	Comments
Mechanics	5	EXCELLENT TO VERY GOOD: • Demonstrates mastery of conventions • Few errors of spelling, punctuation, capitalization, paragraphing	
	4	GOOD TO AVERAGE: • Occasional errors of spelling, punctuation, capitalization, paragraphing but meaning not obscured	
	3	FAIR TO POOR: • Frequent errors of spelling, punctuation, capitalization, paragraphing • Poor handwriting • Meaning confused or obscured	
	2	VERY POOR: • No mastery of conventions • Dominated by errors of spelling, punctuation, capitalization, paragraphing • Handwriting illegible • OR not enough to evaluate	
Total score	Reader	Comments	

Students' Writing Performance

The Paired-samples t-test was computed among the pre-, post-, and delayed proficiency tests to analyse the difference and improvement in the students' writing skill. In Table 7, p-value greater than 0.81 indicated that there was no significant difference between the performance of control and experimental group in their pre-proficiency test though the mean value 3.36 exhibits the proficiency level of the control group, slightly higher than the experimental group. Moreover, p-values less than 0.05 indicated that there was a significant difference between the experimental and control group in the post proficiency test. This finding suggests that the control group students who have been able to do fairly well in the pre-proficiency test could not excel in the post-proficiency test, as they have not been subjected to the pedagogical intervention. Besides, the results indicate that there is a significant difference between pre and post proficiency; post and delayed proficiency test performance of the experimental group.

Cohen classified effect sizes as small ($d = 0.2$), medium ($d = 0.5$), and large ($d \geq 0.8$) (Sullivan & Feinn, 2012). The effect size values greater than 0.8 for Post-Proficiency test of Control and Experimental group, and for pre and post-proficiency test of Experimental group in Table 7 implies a 'large' difference between the variables. The mean values and Effect size values of pre, post and delayed proficiency test performance of the experimental group denote that there is an adequate improvement in Pre-, Post- and delayed proficiency test performance of students belonging to the experimental group.

Table 7

Paired-samples t-test

		Mean	*SD*	*T*	*P*	*Effect Size*
Pre-Proficiency	Experimental	3.05	3.89	0.25	0.81	0.1
Pre-Proficiency	Control	3.36	4.20			
Pre-Proficiency	Experimental	2.52	3.09	-9.14	0.00	1.6
Post-Proficiency	Experimental	14.19	9.58			
Post-Proficiency	Experimental	12.95	9.49	2.81	0.01	0.8
Post-Proficiency	Control	6.70	4.61			
Post-Proficiency	Experimental	14.19	9.58	-2.36	0.02	0.3
Delayed-Proficiency	Experimental	17.28	12.61			

Table 8 presents the results of the Paired-samples t-test of Experimental group comprising the components the students have been tested, such as Reading Comprehension, Note-Making, Report Writing, Letter Writing, Transcoding, Writing Instructions, Visual Inference/Process Description and Paragraph writing. The p-value of less than 0.05 indicates a significant difference between pre and post proficiency test performance of the Experimental group students. The Mean Values and the large effect size values in Table 8 indicate the improvement level of the experimental group in each component.

Table 8

Paired-samples t-test of Experimental Group

Components		*Mean*	*SD*	*T*	*P*	*Mean Difference*	*Effect Size*	
Reading Comprehension	Pre	0.86	0.79	-6.913	0.000	1.06	1.1	Large
	Post	1.92	1.14					
Note Making	Pre	0.14	0.43	-8.772	0.000	1.36	1.6	Large
	Post	1.50	1.14					
Report Writing	Pre	0.17	0.52	-6.236	0.000	1.86	1.2	Large
	Post	2.03	2.09					
Letter Writing	Pre	0.37	1.18	-3.422	0.001	0.86	0.6	Large
	Post	1.24	1.82					
Transcoding	Pre	0.21	0.65	-7.893	0.000	2.38	1.6	Large
	Post	2.59	2.06					
Instructions	Pre	0.46	0.80	-5.135	0.000	0.88	0.9	Large
	Post	1.34	1.10					
Visual Inference/ Process Description	Pre	0.13	0.42	-5.214	0.000	0.89	1.1	Large
	Post	1.02	1.11					
Paragraph Writing	Pre	0.15	0.36	-7.929	0.000	2.40	1.5	Large
	Post	2.55	2.23					

The results in Table 7 and 8 explain that the writing skill of the experimental group students has exhibited a remarkable improvement in comparison with the control group, which suggest that prescribing cognitive strategies to the experimental group students have improved their thinking ability to recall and generate ideas, and sequentially write on their own, whereas the control group without the awareness of cognitive strategies are not able to exhibit improvement in their writing.

Discussion, Conclusion and Recommendations

The analysis of results suggests that cognitive strategies may have an impact on students' writing skill. The cognitive strategy use has guided the students to achieve consistency in their writing. It is deduced from Table 4 that the students belonging to the experimental group have started using cognitive strategies. These strategies have equipped the students in their memory retrieval process and have enhanced their cognitive use in the process of writing. In addition, strategy use has promulgated their cognition to achieve proficiency in written communication. The students' cognitive strategy use has augmented their attentiveness towards writing, interpretation of background knowledge, creation of new ideas, planning, grouping and compilation of ideas into a coherent paragraph. These cognitive strategies have been effective in guiding and assisting the students in Pre-writing, writing and Re-writing stages.

According to Hadley (1993) "Writing requires composing, which implies the ability either to tell or retell pieces of information in the form of narratives or description, or to transform information into new texts, as in expository or argumentative writing" (as cited in Pitenoee, Modaberi, & Ardestani, 2017, p. 594). Celce-Murcia (1996) has asserted, "Cognitive strategies enable the learners to manipulate the language material in direct ways, i.e., through reasoning, analysis, note-taking, summarizing, synthesizing, outlining, recognizing information to develop stronger schemas, knowledge structure, practicing in naturalistic settings, and practicing structures and formulas" (as cited in Khoshnevis & Parvinnejad, 2015). These statements indicate the interrelatedness of cognitive strategies and writing.

In congruence with this, results in Table 5 suggest that the cognitive strategies have a positive correlation with students' writing skills. This implies that cognitive strategy use influences the students' writing skill with reference to planning, goal-setting, retrieving and transferring information, eliciting new ideas, comparing and relating the ideas in relevance to the topic provided, and systematizing and compiling the ideas. The employment of cognitive strategies in the classroom has instigated the students' cognition and has capacitated them to be proficient in their writing.

The Pre-Proficiency test has been conducted to estimate the students' proficiency level in writing and the Post-Proficiency test has been conducted to analyse the improvement level of experimental group students after the employment of cognitive strategies in the writing process. The Delayed Proficiency test has been conducted to examine the sustenance level of students' proficiency in their writing. These test results have emphasised the improvement of experimental group students after their exposure to the cognitive strategies, as exhibited in Tables 7 and 8.

The control group students without the knowledge of cognitive strategies have sustained a low level of proficiency in their Post-Proficiency test. The large difference in the Pre-Proficiency and Post-Proficiency performance of experimental group students indicates the major impact of cognitive strategies in the enhancement of their writing skills. Cognitive strategies are effective in strategizing the knowledge retrieval and improving the thinking ability of the students.

Writing is a predominant skill used widely for academic and professional purposes. It is a cyclic and a composite process necessitating logical and cogent thinking. The changing global workplace environment necessitates the students to communicate clearly and concisely in their writing. Thus, to capacitate the students with effective writing skills and achieve proficiency in their writing, this study has proposed cognitive strategies to be imparted to the polytechnic students in their English classroom. Cognitive strategies say, 'Remembering', 'Connecting' and 'Generating' have been facilitated to the students in the classroom under the guidance and observation of the teacher-researcher. The results of the study have evinced the positive effect and influence of these strategies in achieving coherence and unity in the students' writing besides capacitating and regulating the students' thought process.

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Comparative Cross-Cultural Study in Digital Literacy*

Nazire Burcin HAMUTOGLU[1], Orhan GEMIKONAKLI[2], Clifford De RAFFAELE[3], Deniz Mertkan GEZGIN[4]

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ABSTRACT

Purpose: Due to the distinctive characteristics of developed countries differentiating them from the developing countries, it is expected that there may be differences between developed and developing countries' levels of digital literacies. Considering the cultural differences and approach to the gender problem, it is important to see how these differences manifest themselves when genders are considered. Therefore, this study aimed to investigate comparatively the level of digital literacy of university students in three culturally different countries.

Method: The study was based on descriptive survey research and consisted of 430 university students, studying on technological programs in three different countries: the first one was the United Kingdom (UK), a well-developed member of the European Union (EU), the second one was Malta, a less developed EU member, and the third one was the Republic of Turkey, a developing country and a candidate for EU membership. The data were collected through the Digital Literacy Scale. In the analysis of data, descriptive statistics and multivariate analysis of variance (MANOVA) test were used.

Findings: The only difference in the findings is in the technical sub-dimension of digital literacy; male students' average scores for this sub-dimension are higher than that of female students across three countries. The findings also indicated significant differences in terms of cognitive and social-emotional sub-dimensions of digital literacy between countries. Accordingly, participants studying in Turkey had a lower score than participants studying in Malta in terms of cognitive sub-dimension and had a higher score than the UK participants in the social-emotional sub-dimension. Moreover, it was found that neither gender nor country had any significant effect on the sub-dimensions of digital literacy.

Implications for Research and Practice: The findings of the study reveals that the participants from Turkey scored lower than other countries in the cognitive skills needed for digital literacy. This may well lead to a recommendation for improving digital literacy in different countries.

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[1] Corresponding Author: Dr., Eskisehir Technical University, The Center for Teaching and Learning Excellence, 26555, Tepebası/Eskisehir, TURKEY, nbhamutoglu@eskisehir.edu.tr, 0000-0003-0941-9070

[2] Prof. Dr., School of Science and Technology, Middlesex University, London, UNITED KINGDOM, o.gemikonakli@mdx.ac.uk, o.gemikonakli@gmail.com, 0000-0002-0513-1128

[3] Dr., Middlesex University, MALTA, c.deraffaele@mdx.ac.uk, 0000-0002-7081-702X

[4] Assoc., Dr., Computer and Instructional Technology Education, Trakya University, Edirne, TURKEY, mertkan@trakya.edu.tr, 0000-0003-4688-043X

Introduction

The latest figures from the International Telecommunications Union (ITU) shows the extent the world is covered with networks of connected devices (ITU, 2016) and the use of the Internet. According to these statistics, while 47% of the world's population is using the Internet, this number reaches 65%, and 79.1% for the Americas, and Europe respectively. Technological advancements and the increasing access to the Internet has rapidly changed not only teaching and learning but also the way people access information, communicate, collaborate, and socialize. The implication of this is that new knowledge and literacy skills beyond traditional literacy and even computer literacy have become a necessity to enable finding, evaluating and communicating information. The use of networked devices such as computers, smartphones, tablets etc. means that it is no longer sufficient to understand the software and hardware aspects of the use of computers but also an understanding of the underlying network is important. Again, the new literacy is not limited to knowledge and skills in using networked devices. The presence and wide acceptance of social networks such as Facebook®, Twitter®, and various other groups bring into question their behavioural protocols and ethical norms. All these put together forms the digital literacy; the knowledge, skills, and behaviours used in networked digital devices.

Since online access to information as well as social networks has become an essential part of daily life, digital literacy has consequently ingrained within every walk of life; teaching and learning, employment, leisure, commerce, production, creativity, social life and so on. Considering the role of online systems in education, social life, economy and so on, the importance of digital literacy shows itself as an undeniable fact. As put in (Europe's Information Society Thematic Portal, 2007), to participate and take advantage, citizens must be digitally literate -equipped with the skills to benefit from and participate in the digital society. This includes both the ability to use new ICT tools and the media literacy skills to handle the flood of images, text and audio-visual content that constantly pour across the global networks.

It should be noted that digital literacy can only build on literacy as it is traditionally understood. Sparks et al. prefer the term Digital Information Literacy (DIL); generally defined as the ability to obtain, understand, evaluate, and use information in a variety of digital technology contexts (Sparks et al., 2016). In their review, they stress the importance of this skill for success in higher education as well as in the global networked economy, highlighting the necessity to administer and use results from valid assessments of DIL. It should also be emphasised that digital literacy is essential in preventing plagiarism.

Gender is one of the most important variables affecting the access to and use of information and communication technologies (Basturk Akca & Kaya, 2016). Research shows that in developing countries, the percentage of women using technology is significantly less than that of men. Antonio and Tuffley (2014a) relate this to the role of women in society and the established socio-cultural behaviours. However, research shows that despite this belief, as women's interaction increases, individuals, families, and society all benefit from its outcomes (Antonio & Tuffley, 2014b). Hibert (2011)

argues that digital technologies have the potential of helping women to overcome the inequality between the genders through the provision of access to low-cost health services and education as well as employment opportunities to help increase income. Especially, social media can help women to increase their social capital, which can then be used in favour of individuals, family and society. Hence, access to technology, the conscious use of technology and a good level of digital literacy can all merit women. Trusts are established worldwide to offer digital literacy education to women (Women's Annex Foundation, 2014). These trusts provide digital literacy education to women and children in many countries. These activities aim to empower women for the development of sustainable economies for themselves and their families. Digital literacy education for women can be an enabling factor in eliminating gender differences (Antonio & Tuffley, 2014a). Developed and developing countries differ in the use of the Internet and the ownership of mobile subscriptions (Bal, Kalayci & Artan, 2015). Especially the English-speaking countries have an advantage in accessing ICT (Bal, Kalayci & Artan, 2015). The Report on the United Nations Development Program (2005) states that developed and developing countries do not differ much in literacy. However, despite this, developed countries have an advantage over the rest in terms of investment into ICT education and integration of ICT enabled projects into education (ITU, 2015). In this context, it is expected that in the UK and Malta where English is the official language (English is official Language in Malta alongside Maltese and is spoken by 88% of the population) and technology integration in education is effectively implemented, it is expected that digital literacy levels are high (Camilleri, Aquilina, Carabott & Seguna, 2018). It is fair to say that there is a lack of quantitative research comparing developed and developing countries in terms of digital literacy. Another developing country, Turkey, influenced by globalization and led by governmental policies, has an increasing acceleration in the use of ICTs. Several projects initiated by the Ministry of National Education can be given as examples. These are Basic Education, Accessing the Internet, No School without Computers, Collaboration in Education, and the latest one, The Movement of Increasing Opportunities and Improving Technology (FATIH) projects. (Islamoglu, Ursavas & Reisoglu, 2015). It is important to assess the gender factor in digital literacy and any differences in digital literacy from the viewpoint of cultural differences. This may well lead to a recommendation for improving digital literacy in different countries.

Educational institutions have witnessed, within the last decade, a relentless growth in the development and implementation of computing systems as educational technologies (Dabbagh et al., 2016). As stakeholders within the domain are seeking to adopt these platforms to facilitate their undertaking, technology has been morphing computer systems into interconnected portable and personal devices with an evermore enriched and diverse availability of information (Williams, 2002). As these platforms became the de facto standard for the attainment of information (Forsyth, 2001), the popularisation of social networking and open educational resources have consequently led users to directly share information and knowledge in synchronous and informal interactions (De Raffaele et al., 2015).

Alas, albeit the vast availability of information resources that is made available to educational stakeholders, it is becoming ever more challenging for users to find the right type of information and the time spent in retrieving the required knowledge is consistently increasing (Sopan et al., 2016). Consuming the presented data is considered an increasingly intimidating task, leading technology-enabled stakeholders to quickly end up being overloaded with information and unable to keep abreast with its rapid advancement (Chen et al., 2012). These challenges have led academia to recognise that the emergence of a suitable technological solution for education demands not only the availability of resources but also a well-designed study plan to aptly integrate and exploit the brought over advantages (Takahashi et al., 2015).

In the context of higher education institutions (HEIs), these advancements dictate that rather than delivering literacy content in the form of knowledge and data, the primary objective of educators is to provide the basic skills and competencies for students to progress through data and obtain the intended knowledge from available repositories (Jones & Sallis, 2013). This demand correlates closely with the definition of digital literacy as expressed by Gilster (1997), which characterises the need to understand and use information in multiple formats from a wide variety of computerised sources via the Internet. Articulated more specifically by the US Educational Testing Service (ETS) within the context of HEIs, digital literacy is defined as; "the ability to use digital technology, communication tools and/or networks appropriately to solve information problems". Thus, this presents HEIs with the demand that rather than being the recipient of data, students need to be educated into how to directly engage with the presented data and further their exposure in a dynamically meaningful manner (Sun et al., 2015). Consequently, this implies that from an educator's perspective, teaching with a technological context becomes a far more process-driven approach, in stark contrast to the knowledge transferring exercise which traditional lecture delivery used to provide (Vu et al., 2015).

Adopting modern technologies successfully within HEIs however, results in a transition period for both students and faculty members alike, during which new digital literacy skills and techniques may need to be developed and applied (Johnson et al., 2015; Ungerer, 2016). The importance of properly developing academic members of staff is essential for the successful integration of educational technology in a pedagogical manner within the curriculum (De Raffaele & Galea, 2014). Amongst the challenges, a contentious effort must be made in understanding the current digital literacy skills of the stakeholders, and nourish confidence in adopters by providing the necessary instruction and guidance (Casey & Haillissy, 2014). From the students perspective, developing digital literacy necessitates the latter to be more active and self-sufficient in their learning as opposed to the conventional process of instructor-led knowledge transfer (Dembo & Seli, 2004).

The demand for HEIs to focus on the provision of digital literacy skills to students is however imperative and critical for the success of students in modern society (Betts & Payne, 2016). As discussed by Bhatt (2015), apart from enriching the ability to interact with educational technology, digital literacy is essential for students to adapt

to new and emerging technologies as well as facilitate their ability to pick-up new semiotic communication languages. The enhancement of digital literacy skills within students is also critical for their holistic development, and as expressed by Jones and Hafner (2002), the affordance of digital tools facilitate not only ways of meaning, but also ways of doing, relating, thinking and being.

Various research work has been carried out on digital literacy in Turkey. In a study carried out by Karahan and Izci (1999), results were significantly in favour of men in terms of Internet applications. In their work where the participants were university students, Akdag and Karahan (2004) found similar results showing that in information literacy as it relates to digital literacy, the difference was in favour of men. The interpretation of this work suggested that female students are shy in the use of technology. Similarly, in another study carried out with the participation of prospective teachers from Turkey and Kazakhistan, again, the findings showed a difference between genders in favour of male students (Ozerbas & Kuralbayeva, 2015). On the other hand, work carried out by Ozden (2018) with the participation of Turkish computer teachers found no differences between genders. The research of Kozan and Ozek (2019) on digital literacy did not find any significant differences between genders either. There are studies showing differences in digital literacy between genders. These differences are important and should be considered with social environments and level of development. Today, in the era of technology, the development of ICTs and globalisation had a positive impact on the social and cultural equality of women and men. Hence, it may be useful to investigate the gender differences in digital literacy for the level of development.

The study addresses the following research question.

1. Does the level of digital literacy of the students show any significant difference in terms of attitude, technical, cognitive, and social-emotional sub-dimensions according to their sex and country of education?

Method

In this study, three countries were chosen for a cross-cultural study. The sample groups were chosen from university students studying engineering/technological subjects. The distinctive characteristics of these countries show some differences: while the UK is a well-developed EU member state, Malta is a less developed EU member, and finally, Turkey is a developing country and a candidate for EU membership. A summary of relevant statistics for these countries is given in Table 1 (i.e. literacy levels of different developed countries, and the differences on the use of the Internet, cited in PISA, 2015; ITU, 2016). In addition to the citations, national statistics are used for the table.

Table 1

Key Literacy Statistics of the Countries Compared (PISA 2015, ITU 2016)

	The use of the Internet (%)	PISA Mathematics mean score	PISA Reading mean score	PISA Science mean score	Literacy (%)
UK	94	492	498	509	99
Malta	60	454	467	455	92.8
Turkey	68	420	428	425	96.22

Research Design

The study was designed by relational survey model based on contrary/excessive case sampling is a kind of purposive sampling method. Contrary/excessive case sampling focuses on participants with unique or special characteristics. In this sampling method, countries with different development levels have been considered. The surveying model is a kind of approach aiming to describe a situation with its existing facts. The purpose of this model is making a description by depicting the existing state about the research topic (Buyukozturk et al., 2015). In surveying studies, no effort is done to change and influence the fact that is the subject of the study. The distribution of participants in the sample is more important than the reasons of properties and opinions (Fraenkel & Wallen, 2006). The necessary data for the relational surveying model was obtained from the individuals in the target population of the study by using measurement tools.

Research Sample

Participants were studying at the technological departments of universities in Turkey, Malta, and the UK. The study groups were selected from the Department of Computer and Teaching Technologies Education, University of Sakarya, Turkey, and Faculty of Science and Technology, Middlesex University, Malta and UK with a total number of 430 participants, giving a total of 107 female and 323 male students. The gender distribution is reflective of actual male-female ratios on the academic programmes chosen, and the students are 18-35 years old.

Table 2

Demographic Statistics of Students

		N	*%*
Gender	Female	107	24.9
	Male	323	75.1
Country	Turkey	201	46.7
	Malta	116	27.0
	United Kingdom	113	26.3

Research Instruments and Procedures

In data collection, the English and Turkish versions of the Digital Literacy Scale developed by Ng (2012) have been used. While the original English version of the scale was used in Malta and UK, the Turkish version for which validity and reliability work was carried out by Hamutoglu, Gungoren, Uyanik and Erdogan (2017) was used in Turkey. The Scale comprises of 17 items and 4 dimensions (attitude, technical, cognitive, and social-emotional). The attitude dimension of the scale comprises seven items. "I like using ICT for learning" is an example item for the attitude dimension. Within the technical dimension, there are six items, for example, "I can learn new technologies easily". The cognitive dimension included two items, and "I am familiar with issues related to web-based activities e.g. cyber safety, search issues, plagiarism" is an example. Finally, "ICT enables me to collaborate better with my peers on project work and other learning activities" is an example for the social dimension which included two items, as well. 5-point Likert scale was used ranging from Strongly Agree (5) to Strongly Disagree (1). Cronbach's Alpha calculation gave the reliability coefficient as 0.93 for the scale, and 0.88 and 0.89 and 0.7 and 0.72 and for attitude, technical, cognitive, and social-emotional dimensions for the adapted form of the scale, respectively. In addition to this, in this study, the calculated Cronbach's Alpha values were 0.91 for the scale, and 0.87 for attitude, 0.87 for technical, 0.60 for cognitive, and finally 0.62 for social-emotional dimensions. Internal consistency coefficients calculated using Cronbach's Alpha indicated acceptable to average reliability for 0.60-0.70, a good to a high degree of reliability for 0.70 and 0.90; and an excellent to a high level of reliability for values over 0.90 (George & Mallery, 2003; Ozdamar, 2002, p. 667). Furthermore, Sipahi, Yurtkoru and Cinko (2008) state that a value of Cronbach's Alpha higher than 0.70 indicates reliability for the scale; however, the authors also report that for sub-dimensions with a small number of questions, this value is 0.60 and over (p. 89). Cortina (1993) and Osburn (2000) confirm this statement that under certain

circumstances (when the number of items is small, the structure measured is one-dimensional etc.) the Cronbach's Alpha coefficient can have a lower value than normally stated. The study shows that when calculated at cognitive and social-emotional dimensions using the Cronbach's Alpha, the coefficient of internal consistency is lower compared to the values obtained for other dimensions. This can be seen in the version of the scale adapted to Turkish, too. This difference can be attributed to the smaller number of items cognitive and social dimensions have. Although lower coefficients were obtained for these dimensions, the values obtained were greater than 0.60, making these acceptable. While hard copies of the forms were presented to students in Turkey, online questionnaires are used in Malta and UK using Google Drive for data collection. These differences in collecting responses are based on the cultural differences of the participants which are identified through the experiences of the researchers involved in this work. Although in the IMD 2017 The Power of Digital Competitiveness Report the general performance of economies are measured in terms of three components; "information", "technology", and "readiness for the future", the ability of Turkish students to respond to online questionnaires is poor. Amongst these three components, the weakest side of Turkey is "information", in which Turkey sits at the 60th position in the table of countries of the world. The country's position concerning the sub-dimensions of "Information" is as follows: "skills" 49th, "teaching and learning" 63rd (the last position), and "scientific density" 48th. In terms of the technology component, Turkey occupies the 38th position. The questionnaire was given to 256 students out of 395 registered students of which 201 responded. In Malta, 116 responded out of 125, and 113 responses were received out of 160 students in the UK.

Data Analysis

The collected data were analyzed by SPSS 23 to relate cultural differences affecting digital literacy to independent parameters. In the analysis, a parametric method, Multivariate analysis of variance (MANOVA) was used to determine whether or not students' digital literacy skills varied according to gender and country of study. To do this, the data set was prepared for the analysis and extreme values were removed from the data set to meet the assumption of normality. Secondly, multicollinearity and singularity values between the dependent variables, VIF and tolerance values were controlled. Thirdly, Cook's distance and Leverage values were computed to meet the assumptions. Finally, three rows from the data set were removed. Table 3 shows the univariate normality confirmed for each dimension upon verifying hypotheses for MANOVA.

Table 3

Values for Normality Distribution in Each Dimension for each Variable

Dependent Variables			*N*	*Skewness*	*Kurtosis*
Attitude	Gender	Female	107	-.572	.085
		Male	323	-.961	2.318
	Country	Turkey	201	-.429	-.225
		Malta	116	-.209	-.794
		United Kingdom	113	-1.184	2.242
Technical	Gender	Female	107	-.096	-.491
		Male	323	-.462	-.155
	Country	Turkey	201	-.210	-.752
		Malta	116	-.334	-.053
		United Kingdom	113	-.426	-.384
Cognitive	Gender	Female	107	-.162	-.681
		Male	323	-.428	-.169
	Country	Turkey	201	-.302	-.388
		Malta	116	-.092	-.309
		United Kingdom	113	-.309	-.774
Social-emotional	Gender	Female	107	-1.251	2.093
		Male	323	-.354	-.333
	Country	Turkey	201	-.607	-.016
		Malta	116	-.280	-.285
		United Kingdom	113	-.441	-.340

Table 3 presents the normality distribution for gender and country variables under each factor by skewness and kurtosis values. Having values ranging between +2.5 and -2.5 indicates that distribution does not deviate extremely from a normal distribution (Mertler & Vannatta, 2005), and as known the values below zero show standard normal distribution. Accordingly, skewness and kurtosis coefficients for factor scores in Table 3 indicated no deviation from the normal distribution because of the variance between +2.5 and -2.5.

Other assumptions of outliers were detected via Mahalanobis Distance value considering the independent variables in the dataset ($p<0.01$) (Buyukozturk, 2005, p.99). Furthermore, multicollinearity and singularity values were seen at moderate levels (Akbulut, 2010, p.158; Buyukozturk, 2005, p.100; Field, 2005, p. 224; Pallant, 2005). Additionally, VIF values were smaller than 10 (=1.123) and tolerance values were higher than zero (=.890). Finally, Cook's distance should be smaller than 1 and Leverage values should be smaller than 0.02 to meet the assumptions. According to these results, the data met the multivariate normality assumption.

The relationship between dependent variables is the lack of multiple linear regression, and dependent variables must theoretically be related to each other (Leech, Barret & Morgan, 2005). In terms of meeting these assumptions, the high relationship (Correlation coefficients over .80 or .90) between dependent variables causes problems in MANOVA (Akbulut, 2010, p.158; Buyukozturk, 2005, p.100; Field, 2005, p. 224; Pallant, 2005). Correlation values were calculated in this study as rattitude&technical=.645; rattitude&cognitive=.575; rattitude&social-emotional=.426; rtechnical&cognitive=.650; rtechnical&social-emotioanl=.393; rcognitive&social-emotional=.363. Accordingly, it is possible to say that among dependent variables, there are no multiple linear relationships.

Another assumption, which is about the homogeneity of variance-covariance matrices in the use of MANOVA needs to be considered. To do this, the Box's M test was used, which shows the statistical significance and indicates that the assumption of homogeneity of variance-covariance matrices is provided, and the statistical insignificance of the Box's M test suggests that this assumption is violated. The number of participants is important in improving the significance of Box's M test. The significance level for this test is suggested to be taken as .025, or .01 (Mertler & Vannatta, 2010) or .001 (Pallant, 2005), and Wilks' Lambda row is interpreted. In this study, the significance level for the Box's M test was taken as .01. The findings of the study for the significance value was calculated for the dependent variable data set consisting of independent variables to show that the assumption of homogeneity of the variance-covariance matrices for the independent variables is met (gender [Box's M=4.801, p>.01] and country [Box's M=66.021, p>.01].

Results

Multivariate analysis of variance (MANOVA) was conducted to determine whether or not each factor score varied according to gender and country.

Table 4

MANOVA Results for Average Scores as of Variables

Independent Variable	*Wilks' Lambda*	*F*	*Hypothesis sd*	*Error sd*	*p*
Gender	.95	5.289	4.000	421.000	.00
Country	.91	4.963	8.000	842.000	.00

MANOVA results indicated a significant difference for each factor according to students' gender and country of students as [Wilks lambda (gender) =.95, F(4;421) =5.289 p<.05; Wilks lambda (country) =.91, F(8;842) =4.963, p<.05]. These findings suggest that scores received from the subscales changed according to the gender and country. Analysis has also covered the effect size η2 for gender and Cohen's f for country variables to show the extent of the independent variable's effect on the dependent variable. η2 is used to calculate the effect size of the difference between groups in the independent sample t-test. On the other hand, Cohen's f is a value used to calculate the effect size in variance analysis gives an estimate of the rate variance explained by the categorical variable and predicts the ratio of variance calculated by the sample. Firstly, Cohen's f formula was required to calculate η2 value as follows (1);

$$\eta^2 = Sum\ of\ Squares\ between \frac{groups}{Total} sum\ of\ squares \quad (1)$$

Finally, to calculate Cohen's *f* value, following formula needs to be used (2);

$$Cohen's\ f = \sqrt{\eta^2 / 1 - \eta^2} \quad (2)$$

The effect size for η2 is interpreted as 'small' for .01 ≤ η2 < .06, 'medium' for 0.06 ≤ η2 < .14, and 'large' for η2 ≥.14 (Cohen, 1988), and Cohen's f is interpreted as 'small' for .10, 'medium' for 0.25, and 'large' for .40 (Cohen, 1988; Kirk, 1996). Accordingly, Table 5 and Table 6 show the effect size of the results obtained from the subscales of digital literacy based on gender and country variables.

Table 5 gives mean and standard deviation values for the four factors of the scale along with factor-based one-way ANOVA results for gender.

Table 5

Mean, Standard Deviation and ANOVA Results for Gender

Dependent Variable	*Gender*	*N*	*X*	*Sum of Squares*	*F*	*Sd*	*p*	*Differences*	*η 2*
Attitude	Female	107	29.370	6.258	.377	1-428	.539		
	Male	323	29.763						
Technical	Female	107	23.261	89.051	6.481	1-428	.011*	Male>Female	0.014
	Male	323	24.747						
Cognitive	Female	107	8.344	1.149	.640	1-428	.424		
	Male	323	8.175						
Social-emotional	Female	107	7.801	3.414	1.185	1-428	.277		
	Male	323	7.510						

*<.05

As seen in Table 5, average scores for attitude, cognitive, and social dependent variables did not indicate a significant difference as of students' gender [$F_{attitude}$ (1;428)=.539, p>.05; $F_{cognitive}$ (1;428)=.424, p>.05; F_{social} (1;428)=.277, p>.05], whereas there was a significant difference among the average scores for technical dependent variable [$F_{technical}$(1;428)=.011, p<.05]. Accordingly, male students' average scores for technical sub-dimension of digital literacy were higher than that of female students, which might indicate that male students had a more tendency towards the technical dimension of digital literacy compared to female students. Besides, a review of the effect size based on Cohen's *f* value shows that gender may have a small effect on the average scores for the factor on technical dimension of digital literacy ($f_{technical}$=0.014).

Table 6 gives mean and standard deviation values for the four factors of the scale along with factor-based one-way ANOVA results for the country.

Table 6

Mean, Standard Deviation and ANOVA Results for the Country

Dependent Variable	*Country*	*N*	*X*	*Sum of Squares*	*F*	*Sd*	*p*	*Differences*	η^2	*f*
Attitude	Turkey	201	29.832	59.596	1.797	1-427	.167			
	Malta	116	30.210							
	United Kingdom	113	28.657							
Technical	Turkey	201	24.677	66.205	2.409	1-427	.091			
	Malta	116	23.944							
	United Kingdom	113	23.391							
Cognitive	Turkey	201	7.987	13.084	3.641	1-427	.027*	Malta>Turkey	0.017	0.13
	Malta	116	8.634							
	United Kingdom	113	8.158							
Social-emotional	Turkey	201	8.030	17.753	3.082	1-427	.047*	Turkey>UK	0.028	0.18
	Malta	116	7.433							
	United Kingdom	113	7.504							

*<.05

As seen in Table 6, average scores for attitude and technical dependent variables did not indicate a significant difference according to the country of students [$F_{attitude}$ (1;427)=.167, p>.05; $F_{technical}$ (1;427)=.091, p>.05], whereas there was a significant difference among the average scores for cognitive [$F_{cognitive}$(1;427)=.027, p<.05] and social-emotional dependent variables [$F_{social\text{-}emotional}$ (1;427)=.047, p<.05]. Accordingly, the male students studying in Malta had a higher average score than that of female students for cognitive subdimension, and the male students studying in Turkey had a higher average score than that of female students for social-emotional sub-dimension.

These results might indicate that students studying in Malta have a more tendency towards the cognitive dimension of digital literacy compared to students in Turkey. Moreover, considering the results that there might be a high tendency for students studying in Turkey to get high scored- in social-emotinal sub-dimension, but thiscould be different in actingwhen compared to the students in the UK. Besides, a review of the effect size showed that country may have a small effect on the average scores for the factor on cognitive ($f_{cognitive}$ =0.13), and social-emotional dimensions of digital literacy ($f_{social\text{-}emotional}$=0.18).

Discussion, Conclusion and Recommendations

This work presents a comparative study of the digital literacy levels of students studying in three different countries. The study focused on digital literacy levels in terms of attitude, technical, cognitive, and social-emotional sub-dimensions. The only difference in the findings was in the technical sub-dimension where male students scored higher. Basturk Akca and Kaya (2016) found similar results, and Antonio and Tuffley (2014a) argue that these findings are a result of women's role in society and prescriptive socio-cultural attitudes. However, it is possible to express that, this difference does not have much implication in practical life based on the calculated effect size (Cohen's *f*). Also, it was shown that when gender and country are considered together, there is no significant difference in digital literacy. The age of technology we live in has been a turning point for global gender equality. In Turkey, as well as in the rest of the world, an effort is put into engaging individuals and especially women in the use of technology in an attempt to promote equal opportunities. Turkish Statistical Institute (TUIK), the main stats organization of Turkey, reported that the use of computers by women doubled reaching 23% in 2007. This situation has seen an increase with the widening use of technology. Turkish Statistical Institute- TUIK (2019) reports support these findings, stating that in the same age groups, the use of the Internet is 81.8 per cent and 68.9 per cent for men and women, respectively.

In this respect, it is thought that the projects and studies offered to both sexes together have been effective in achieving this. The absence of significant differences in this area based on gender indicates that projects and other work promoting the skills of women have been effective (Camilleri et al., 2018; Durmuscelebi & Temircan, 2017; Intel, 2013; OECD, 2001). The findings of the study showed that all students can use a wide range of formal and informal communication technologies and software in classrooms or educational activities without any difference regardless of gender differences. These findings match the results of a similar research study stating that no significant gender difference was found in terms of self-efficacy of literacy levels (Dikmen & Tuncer, 2018). Individuals with self-efficacy are expected to give a positive opinion on digital literacy in terms of attitude and technique. On the other hand, attitude and digital literacy have generally been shown to support students' self-efficacy perceptions (Prior, Mazanov, Meacheam, Heaslip & Hanson, 2016). In a study conducted by Usluel (2006) on 1702 pre-service teachers and 289 teachers (1991 individuals in total), it was determined that there was no significant difference between the self-efficacy perceptions of the teachers and teacher candidates based on

gender differences. Based on a sample of 47, Korkut and Akkoyunlu (2008) concluded that self-efficacy perceptions of foreign language teachers did not show a significant difference according to gender either. Also, studies show that the increase in the frequency of the use of the Internet also affects information literacy (Ata, 2011). As known, the Internet is a powerful tool in the fight against gender differences in accessing and using information for education (Polat, 2012). In the globalizing world, online learning materials are now available to every individual. Especially, distance education portals and projects like Coursera help meeting experts of the world regardless of gender.

Differences between sub-dimensions were determined among countries. The findings showed that there was no difference in the attitude and technical sub-dimensions between Malta and Turkey, while a difference existed in the cognitive dimension in favour of Malta. The difference between the two countries' digital literacy can be explained by the levels of Turkey and Malta in different fields in PISA 2015. Digital literacy refers to an individual's ability to find, understand, evaluate, and use data obtained from digital platforms. PISA 2015 reports show that in Science and Mathematics that involves cognitive hard work, Turkey lags behind many other countries. Another finding is differences in social-emotional sub-dimension between Turkey and the UK, in favour of Turkey. The absence of differences in attitude and technical sub-dimensions can be explained by the fact that the students are part of the Y generation. This is because the Y generation was born into technology and were grown into social media experiences. This corresponds to a new era of globalization, where digital literacy and the use of social networks have led to the sharing of ideas and innovations in the world faster than ever (Gulbahar, Kalelioglu & Madran, 2010). The Y Generation differs from other generations in terms of interest in technology, and social, and emotional attitudes. Since they value technology and speed, they emerged as the generation most protected by their parents. However, while the Y Generation value freedom, the level of work and ambition is low. They may find it difficult to focus on anything. Research carried out in Turkey showed that the Y Generation's main use of technology is to access social media and social media is an unavoidable means of daily communication for them (Kuyucu, 2017). In this context, the cognitive differences indicate that the use of ICTs is less in Turkey compared to the other two countries. In the report, We are Social (2018), participants from all three countries believe that new technologies will bring new opportunities rather than risks. Approximately 80% of the participants were reported to have Internet access. This result in attitude and technique is thought to be caused by the fact that individuals have a positive attitude towards technology and technological tendency due to their generations. When analyzed for their cognitive dimensions, as the Human Development Index Report- UNDP, (2016) shows, Malta is the 33rd and is part of very high human development group while Turkey is the 71st and situated in the high human development category.

Statistical reports on the difference between Internet access and usage amongst women and men show that this difference is in a decline in developed countries (We Are Social, 2018). However, this is still biased towards men in developing countries.

Also, as stated by Keniston and Kumar (2003), the digital divide is not only between countries but also can be culturally present between different populations within a country. In this context, considering the access of individuals to ICT and their level of use of the Internet, cultural and gender-based digital divide (Akca, 2014; OECD, 2001), may well have affected the findings of this work in terms of digital literacy.

Students studying in the UK and Malta scored higher in cognitive dimension in terms of the use of ICT compared to students studying in Turkey. This can be explained by better infrastructure in these countries and investment in people as reflected in Human Development Reports. Especially in case of Malta, the job opportunities in software development encourage students' development of technical skills, especially in this domain. Thus, individuals who benefit more from technology, have higher literacy rates, and perhaps have better access to technology in terms of income. Opportunities encourage them to better use these technologies in education and self-development which benefits them further. It is obvious that even if you have a technological tool, those who cannot use it consciously and who do not have the knowledge and skills for this usage will be at risk. Also, the effects of the differences in the PISA 2015 reports, which include results in science, mathematics and reading area of 15-year-old students, are also thought to have an impact on the cognitive dimension of digital literacy. This is because of the positive effect of digital literacy on education (Mohammadyari & Singh, 2015; Tang & Chaw, 2016).

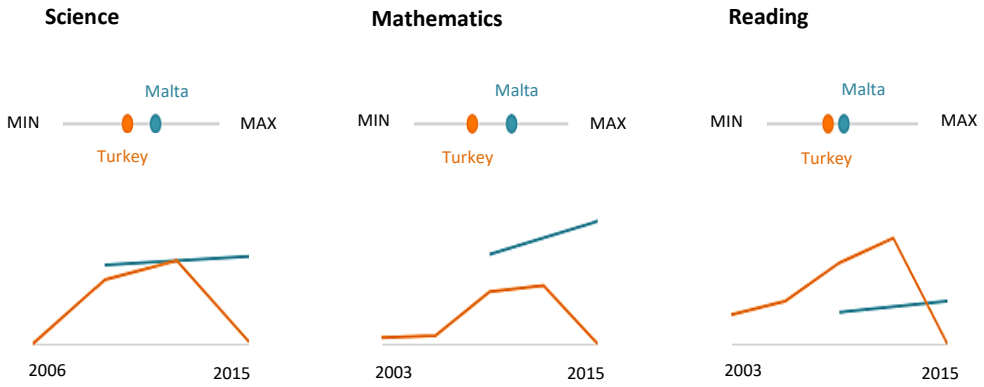

Figure 1. *Comparison of Turkey and Malta in PISA 2015 Reports*

Being a former British colony, Malta is known to have been influenced by many aspects of British culture and social life. Secondary and higher educations are no exception in this sense. For example, in Malta, undergraduate education and master's degree last three years and one year respectively, just like UK higher education. Similarly, yearly Human Development Reports based on means of income, education, health, and safety opportunities of the individuals show both countries in the same section; Most Advance Human Development, where the UK is the 16th and Malta is the 33rd in the most recent report. All these explain the absence of any differences in digital literacy between the two countries.

Considering the items of social-emotional dimension, a difference was detected between Turkey and the UK in favour of Turkey. In information and communication technology skills, cybersecurity, plagiarism, and research concepts (*as stated in the instrument*), students studying in Turkey obtained higher scores. Similarly, studies in the new media literacy covers topics such as cyberbullying, hate speech, digital observation, online security, freedom of expression (Bulus, 2017, p. 33). These topics relate to the social-emotional dimension as shown in digital literacy instrument used in this study. Since digital literacy focuses on the sociological, political, cultural, economical, and behavioural aspects of digital technologies, the difference is thought to arise from the structural differences between countries (Fransman, 2005; Green & Beavis, 2012; Kellner, 2004).

The results of the study show the importance of the informatics course that has lately been questioned. It is also argued that informatics courses enable students to become active participants in the digital world, preparing them for future jobs as digitally literate (developing and presenting their own ideas through the use of information and communication technologies) individuals (Barut & Kuzu, 2017). Furthermore, the importance of these courses in raising the digital literacy levels of teachers, prospective teachers, and students, implementation of teacher training programs and enabling teachers to lead their students in technology is stated (Ustundag, Gunes & Bahcivan, 2017). In this context, Computer Education and Instructional Technology (CEIT) departments providing ICT courses have higher responsibilities. The cognitive comparison of digital literacy between Turkey and the two other countries studied in this work showed that Turkey lags behind the two. This shows the need for CEIT departments and the essence of increasing ICT courses at different educational levels. Research carried out on digital literacy examined the relationship between the levels of digital literacy to use social networks in terms of different variables and found that students studying in the CEIT departments scored higher than the students in other departments (Hamutoglu, Gungoren, Uyanik & Erdogan, 2018). This finding is promising in the sense that the competence in digital literacy gained in the CEIT departments can be achieved by students of other departments through interaction between CEIT and demonstrates the importance of CEIT departments for education faculties. Students will be able to increase their awareness and skills in digital literacy by interacting with their colleagues who are competent in this. This interaction can be achieved during students' social and academic time-sharing activities.

Finally, various research showed that in the context of digital literacy, the use of computers, the skills in the use of computers, and the grasp of the fundamental concepts of computing shows differences based on gender. These differences may have an impact on student-tutor, and student-student interactions as well as learning processes. Hence, teachers using computer-assisted learning should pay attention to these differences (Ertl & Helling, 2011).

Future studies can focus on assessing the effects of experimental activities on digital literacy. Besides, teaming up individuals from various departments with those

more skilled in computer and instructional technologies to work collaboratively can be facilitated to increase individuals' digital literacy skills.

Limitations and Recommendations

This work is restricted by the dependent and independent variables it considers, sampling methodology, and sampling size. While the dependent variables are attitude, technic, cognitive and social-emotional sub-dimensions of digital literacy, gender and country formed the independent variables as accepted in the relevant literature. Future work may consider digital literacy with total points for different variables. Furthermore, different sampling methods can be used to identify cultural situations. Finally, future work may focus on interviews with participants based on qualitative research provided that time and distance limitations are resolved. It is expected that the findings of such interviews would support current findings.

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Dijital Okuryazarlık Üzerine Karşılaştırmalı Kültürlerarası Bir Çalışma*

Atıf:

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Özet

Problem Durumu: Günümüzde bireyler artık dijital vatandaşlık kimlikleri ile dünyaya gelmektedirler. Gelişen teknoloji özellikle de İnternet'in gelişimi bu noktada dijital vatandaşlık kavramını kaçınılmaz kılmaktadır. Dijital vatandaşlığın, en önemli öğelerinden biri ise dijital okuryazarlık kavramıdır. Dijital okuryazarlık "genellikle çeşitli dijital teknoloji ortamlarından bilgi edinme, anlama, değerlendirme ve kullanma kabiliyeti" olarak tanımlanmaktadır. Dijital okuryazar birey, farklı teknolojileri doğru kullanmak, doğru bilgiye ulaşmak, üretmek ve paylaşımda bulunabilmek ve eğitim süreçlerinde teknolojiyi kullanabilme becerilerine sahip olan kişi olarak tanımlanmaktadır. Bilgi ve iletişim teknolojisi araçları ile İnternet'i kullanan bireylerin iyi birer dijital okuryazar olabilmesi için ülkeler bazı politikalar geliştirmektedir. Çünkü ülkeler, günümüzde bilgi ve iletişim teknolojisi araçlarının kullanımının toplumsal, ekonomik ve kültürel yapıya olumlu ve olumsuz etkilerini bilmektedir. Dijital okuryazarlık kavramı söz konusu olduğunda cinsiyet faktörünü

göz önüne almak ve dijital okuryazarlıktaki farklılıkları kültürel farklılıklar açısından değerlendirmek önemlidir. Bu, farklı ülkelerde dijital okuryazarlığın geliştirilmesine yönelik önerilere yol açabilir.

Bu çalışmada teknoloji alanında öğrenim görmekte olan öğrenciler ile kültürlerarası bir çalışma gerçekleştirmek için üç ülke seçilmiştir. Bu ülkeler birbirinden gelişmişlik anlamında farklılık göstermektedir ki ayırt edici özellikleri; birincisinin Birleşik Krallık iyi gelişmiş bir AB üyesi; ikincisi ise Malta olup İngiltere'ye göre daha az gelişmiş bir AB üyesi ve üçüncüsü ise Türkiye olup gelişmekte olan ve AB üyeliğine aday bir ülke olmasıdır.

Araştırmanın Amacı: Bu çalışma, farklı üç ülkede öğrenim görmekte olan üniversite öğrencilerinin okur-yazarlık düzeylerini tutum, teknik, bilişsel ve sosyal-duygusal alt boyutları açısından karşılaştırmalı olarak incelemeyi amaçlamaktadır. Bu amaç doğrultusunda aşağıdakileri sorulara yanıt aramaktadır:

1. Öğrencilerin dijital okuryazarlık düzeyleri, cinsiyetlerine ve eğitim gördükleri ülkelere göre tutum, teknik, bilişsel ve sosyal-duygusal alt boyutları açısından anlamlı bir farklılık göstermekte midir?

Araştırmanın Yöntemi: Bu çalışma tarama modellerinden ilişkisel tarama modeli ile amaçlı örnekleme yöntemlerinden aykırı durum örneklemesine uygun olarak tasarlanmış olup; mevcut durumu tanımlamayı amaçlayan bir tür yaklaşımdır. Bu yaklaşımın amacı, mevcut durumu araştırma konusu hakkında tasvir ederek bir açıklama yapmaktır (Büyüköztürk vd., 2015). Anket çalışmalarında, çalışmanın konusu olan gerçeği değiştirmek ve etkilemek için çaba gösterilmemektedir. İlişkisel tarama modeli için gerekli veriler, ölçüm araçları kullanılarak araştırmanın hedef popülasyonundaki bireylerden elde edilmiştir. Çalışma grubunu, Türkiye, Malta ve İngiltere'de teknoloji ile ilgili bölümlerde öğrenim gören 430 üniversite öğrencisi oluşturmaktadır. Nicel araştırma yöntemlerinden tarama yöntemi ile desenlenen çalışmada veri toplama araçları olarak (Ng, 2012) tarafından geliştirilen dijital okuryazarlık ölçeğinin İngilizce ve Türkçe sürümü kullanılmıştır. Geliştirilen ve uyarlanan ölçek 4 boyuttan oluşmakta olup toplam 17 madde içermektedir. Dijital okuryazarlık ölçeği tutum, teknik, bilişsel ve sosyal-duygusal alt boyutlarından oluşmaktadır. 5'li Likert tipinde olan ölçek, Kesinlikle Katılıyorum (5) ile Kesinlikle Katılmıyorum (1) arasında kategorilendirilmiştir. Türkçe'ye uyarlanan ölçeğin Cronbach Alpha ile hesaplanan, iç tutarlık katsayısı tüm ölçek için 0.93 iken; tutum, teknik, bilişsel ve sosyal boyutları için sırasıyla 0.88, 0.89, 0.7 ve 0.72'dir. Elde edilen veriler SPSS 23 programı ile analiz edilmiş olup; dijital okuryazarlığı etkileyen kültürel farklılıklar bağımsız parametrelerle ilişkilendirilerek analilz gerçekleştirilmiştir. Yapılan analizde, öğrencilerin dijital okuryazarlığa ilişkin durumlarının cinsiyete ve ülkeye göre değişip değişmediğini belirlemek için çok değişkenli varyans analizi (MANOVA) kullanılmıştır.

Araştırmanın Bulguları: Elde edilen bulgular teknik alt boyutunun cinsiyet açısından anlamlı bir farklılık oluşturduğunu ve erkeklerin kadınlara göre daha yüksek puana sahip olduğunu göstermektedir. Ayrıca elde edilen sonuçlar ülkeler açısından bilişsel ve sosyal-duygusal alt boyutu açısından da anlamlı farklılık göstermektedir. Buna

göre, Türkiye'de öğrenim görmekte olan katılımcılar bilişsel alt boyutunda Malta'da öğrenim görmekte olan katılımcılardan daha az; sosyal-duygusal alt boyutunda ise İngiltere'de öğrenim görmekte olan katılımcılardan daha yüksek puana sahiptir. Son olarak, çalışmada cinsiyet ve ülke değişkenlerinin birlikte dijital okuryazarlık alt boyutları üzerinde anlamlı bir etkiye sahip olmadığı da bulunmuştur.

Araştırmanın Sonuçları ve Öneriler: Elde edilen bulgular, sadece teknik alt boyutunda cinsiyet açısından bir farklılık olduğunu ve bu alandaki farklılık erkeklerin kadınlara göre daha yüksek olduğunu göstermektedir. Ancak, bu farkın pratik anlamda pek bir etkisinin olmadığı görülmektedir. Bununla birlikte çalışma sonuçları, cinsiyet değişkeninin ülke değişkeni ile birlikte değerlendirilmesi durumunda dijital okuryazarlık açısından anlamlı bir fark olmadığını göstermektedir. Buna göre, içinde yaşadığımız teknoloji çağının küresel cinsiyet eşitliği için bir dönüm noktası olduğu söylenebilir. Tüm dünyada olduğu gibi Türkiye'de de bireylerin ve özellikle de kadınların teknolojiyi kullanma konusunda eşit fırsatlar oluşturmaya teşvik edilmesi için çaba gösterilmektedir.

Elde edilen sonuçlar ülkeler arasında alt boyutlar açısından farklılıklar olduğunu; Malta ile Türkiye arasındaki tutum ve teknik alt boyutları arasında bir fark olmadığını, bilişsel boyutta ise Malta lehine bir fark olduğunu, Türkiye ile İngiltere arasında ise sosyal-duygusal alt boyutta Türkiye lehine farklılıklar olduğunu göstermektedir. Tutum ve teknik alt boyutlarındaki bulgular öğrencilerin Y kuşağının bir parçası olmasıyla açıklanabilir. Bu, Y kuşağının teknolojinin içine doğmuş olmasından kaynaklanmaktadır.

Elde edilen bulgular İngiltere ve Malta'da okuyan öğrencilerin, Türkiye'de okuyan öğrencilere kıyasla bilişsel boyutta BİT kullanımı bakımından daha yüksek puana sahip olduğunu göstermektedir. Bu sonuç, mevcut ülkelerin (İngiltere ve Malta) teknolojik anlamda gelişmiş bir alt yapıya sahip olmaları ile İnsani Gelişme Endeksi Raporlarına yansıdığı gibi insanlara yapılan yatırım ile açıklanabilir. Özellikle Malta'nın, yazılım geliştirmede öğrencilere tanıdığı iş fırsatları düşünüldüğünde; öğrencilerin bu alanda özellikle de bilişsel ve teknik beceriler açısından kendilerini geliştirmelerine destek olduğu söylenebilir. Dolayısıyla, teknolojiden daha fazla yararlanan bireyler ile teknolojiyi öğretim müfredatlarına entegre etmiş ülkelerin, okuryazarlık oranlarının daha yüksek olduğu söylenebilir.

Dijital okuryazarlığın sosyal-duygusal alt boyutu dikkate alındığında, Türkiye ile İngiltere arasında Türkiye lehine anlamlı bir fark olduğu görülmektedir. Bu boyutta bilgi ve iletişim teknolojisi becerileri, siber güvenlik, intihal ve araştırma konuları yer almaktadır. Buna göre elde edilen bulguların Türkiye'de öğrenim görmekte olan öğrenciler açısından farklılık arz etmesinin; ülkeler arasındaki yapısal farklılıklardan kaynaklı olduğunu düşündürmektedir.

Çalışmanın sonuçları, son zamanlarda sorgulanan bilişim derslerinin önemini göstermekte olup; bilişim derslerinin öğrencilerin dijital dünyada aktif birer katılımcı olmalarını sağlayarak, onları dijital okuryazar bir birey (Barut ve Kuzu, 2017) olarak geleceğe hazırlamada katkı sağladığı alanyazında tartışılmaktadır. Hamutoğlu ve diğerleri (2018), öğrencilerin dijital okuryazarlık düzeyleri ile sosyal ağları kullanma

amaçları arasındaki ilişkiyi farklı değişkenler açısından incelemiş ve Bilgisayar ve Öğretim Teknolojileri Eğitimi (BOTE) bölümünde okuyan öğrencilerin diğer bölümlerdeki öğrencilerden daha yüksek puan aldığını tespit etmiştir. Bu bulgu, BOTE bölümlerinde kazanılan dijital okuryazarlık konusundaki yeterliliğin, BOTE bölümleri ile diğer öğretmenlik programlarında öğrenim görmekte olan öğrenciler arasındaki etkileşimi arttıracağı düşüncesi ile BOTE bölümlerinin eğitim fakülteleri için önemini göstermesi açısından umut vericidir. Öğrenciler bu alanda yetkin meslektaşları ile etkileşime girerek dijital okuryazarlık konusundaki farkındalıklarını ve becerilerini artırabileceklerdir. Bu etkileşim, öğrencilerin sosyal ve akademik zaman paylaşımı aktiviteleri sırasında da gerçekleştirilebilir.

Anahtar Sözcükler: Karşılaştırma, gelişmiş ve gelişmekte olan ülkeler, dijital okuryazarlık, cinsiyet, bilgi ve iletişim teknolojileri (BIT).

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Conceptual Understanding Levels of Students with Different Cognitive Styles: An Evaluation in Terms of Different Measurement Techniques*

Sema AYDIN CERAN[1], Salih ATES[2]

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ABSTRACT

Purpose: This study aimed to determine the conceptual understanding (The Unit of Force) levels of seventh-grade students with different cognitive styles with different measurement techniques and to observe how the conceptual understanding levels measured by different measurement techniques are affected by their cognitive styles.

Research Method: The sample of the study, which wasa causal-comparative study, consisted of 80 seventh-grade students in a public school in Ankara. To determine the field-dependent/field--independent cognitive style differences of the students, the Group Embedded Figures Test was used. To determine students' conceptual understanding levels two different measurement techniques were used together. The first of these was the Life Based Concept Test. The test consisted of multiple-choice questions using real-life contexts that the student was familiar with in everyday life. Force Concept Map was anothermeasurement technique used to determine students' conceptual understanding. The data obtained were analyzed with MANOVA, one-way ANOVA and t-tests.

Findings: The findings of this research show that there was a significant difference concerning conceptual understanding levels measured by Life Based Concept Test and Force Concept Map in favor of students with field-independent cognitive style. The results obtained in this context revealed that the conceptual understanding levels measured by different measurement techniques in the unit of force differ according to cognitive styles of the students.

Implications for Research and Practice: This study points out that cognitive style differences are an effective factor in student success. This difference in student achievement shows that measurement techniques may lead to a disadvantage/advantage for the student. Therefore, it is recommended to review the studies in which the conceptual understanding is measured by uniform tests in the literature. In addition, researchers are recommended to use multiple measurement techniques that consider students' individual differences to obtain more valid results.

[1] Selcuk University, TURKEY, e-mail: sema.aydin.ceran@gmail.com, ORCID: https://0000-0001-6847-2766
[2] Gazi University, TURKEY, e-mail: sates0@yahoo.com, ORCID: https://0000-0003-0425-0982

Introduction

In the article "Why everyone needs to understand science" Jonathon Garlick (2014), one of the authors of the World Economic Forum [WEF], expressed the importance of understanding science concepts as:

> Science is not important only to scientists or those who profess an interest in it. Whether you find fascinating every new discovery reported or you stopped taking science in school as soon as you could, a base level understanding is crucial for modern citizens to ground their engagement in the national conversation about science-related issues (p.2).

Today, the skills expected from an individual learning science concepts have changed. Understanding science concepts requires the ability to be aware of daily life questions and to find solutions to these problems as a global citizen(WEF, 2020). Considering the connection between science and daily life, the dimensions of teaching science at the conceptual level and evaluation of the conceptual knowledge learned are important in terms of the individual understanding the life and producing solutions from the science perspective. Based on this point, we can say that the evaluation of an in-depth conceptual understanding is one of the basic dynamics of science education.

Conceptual Understanding and Importance

Sinan (2007) defined conceptual understanding as in-depth learning in which relationships and similarities between concepts can be clearly demonstrated, these concepts can be transferred to new environments when necessary and can be used to solve problems encountered in daily life. Concerning providing in-depth learning, the structuring aspects of the science curriculum and the classes which constitute the core of teaching are frequently encountered in the literature. Also, when it comes to conceptual understanding, three elements that draw attention in the literature are; teaching science concepts, misconception and concept evaluation (Amir a& Tamir, 1994; Black & William, 1998; Driver, 1983; Gobert & Clement, 1999; Kavanagh &Sneider, 2007; Tregaust & Duit, 2008; Yagbasan & Gulcicek, 2003; Yin, Tomita & Shavelson, 2013). Scott, Asoko& Leach (2007) formulated conceptual understanding as "concepts are basic units of knowledge and that conceptual understanding results when concepts are accumulated, gradually refined, and combined to form ever richer cognitive structures". From this point of view, we can express that developing a conceptual understanding is a process and, in this process, an in-depth understanding is realized by structuring the concepts. Konicek-Moranand Keeley (2015) stated that concepts are the building blocks of ideas and definitions. And they emphasized that when students have an understanding of a concept, they can (a) think with it, (b) use it in areas other than that in which they learned it, (c) state it in their own words, (d) find a metaphor or an analogy for it, or (e) build a mental or physical model of it. In other words, the students have made the concept their own. In short, if the student can internalize and reflect the concepts, we can say that he/she developed a conceptual understanding. Based on these expressions, developing a solid conceptual understanding in science education is one of the basic dynamics in terms of

transforming science knowledge of students into skills in every field of life. Therefore, developing and monitoring conceptual understanding in the science curricula of nations has an important place.

Measuring Conceptual Understanding

The development of a full conceptual understanding occurs over time and through repeated contact with concepts (Wild, Hilson & Hobson, 2013). In this process, one of the basic dynamics in the development and monitoring of conceptual understanding is the evaluation of conceptual understanding. In this process, one of the complementary dynamics in the development and monitoring of conceptual understanding is evaluation activities developed in accordance with teaching methods (Black & William, 1998; Tokiz, 2013; Yin, Tomita & Shavelson, 2013). When the literature is examined, it is seen that different measurement techniques are used to determine students' conceptual understanding levels. When these studies are examined, it is noteworthy that two-or three-tier conceptual understanding tests (Artun & Costu, 2013; Cetinkaya & Tas, 2016; Haslam & Treagust 1987; Ozbayrak & Kartal, 2012; Sinan, 2007; Putranta & Supahar, 2019; Sen, Yilmaz & Geban, 2018) and multiple-choice concept tests in which the misconceptions in the options take place as a distractor (Ates&Polat, 2005; Kayacan & Selvi, 2017; Park & Liu, 2016) are frequently used. Aykutlu and Sen (2012) identified misconceptions about electrical current among high school students using concept mapping and analogy in addition to gradual tests. In his study, Kalman (2011) used the reflective writing technique through scientific texts related to physics to enable students to learn concepts in textbooks and to determine their level of conceptual understanding. Yorek (2007) determined the conceptual understanding levels of students through their drawings about biology, Unit of Cell. Although current practice in science education encourages the use of multiple means to assess student learning outcomes, the multiple-choice question still plays the primary role in the evaluation of scientific learning among students (Chang, Kuang Yeh&Barufaldi, 2010). In fact, referring to both teaching and evaluation of concepts, Roth (1990) stated that meaningful conceptual understanding in science goes far beyond knowing facts and labels, and rather, conceptual knowledge becomes meaningful only when it can be used to explain or explore new situations. Based on this point, in this research, a concept test based on real-life contexts and concept map were used to determine conceptual understanding. In the Programme for International Student Assessment [PISA] study, which Organization for Economic Co-Operation and Development [OECD] conducts every three years and determines the level of students' science literacy in one dimension, it is seen that a life-based measurement understanding is dominant in science questions. Questions based on real-life contexts can be defined as questions that enable students to link what they learn in class with real life, to organize data, to establish relationships, to do classification activities, to be concrete, personalized, and to require more reading-thinking skills, and to put the student through certain thinking processes (Bellocchi, King & Ritchie, 2011; Lubben, Campbell & Dlamini, 1996; Taasoobshirazi & Carr, 2008; Tekbiyik & Akdeniz, 2008). Benckert and Pettersson (2005) stated that classical science questions idealize science (in a way that is not related to real-life) and therefore,

students and teachers cannot link real life through these questions. In light of all this, this research, a concept test consisting of questions dealing with daily life contexts were used to determine the level of understanding of Force concepts of 7th-grade students. And, in the options of the test, misconceptions commonly seen in the literature were used as a distractor.

In this research, another measurement tool used in determining the level of understanding of students about force concepts is the concept map. Thus, it was aimed to draw attention to the drawbacks of measuring conceptual understanding with uniform measurement tools. Novak and Gowin (1984) put forward the idea that "Concept Maps" can be used to make concrete relations between concepts in line with the basic principles of Ausubel regarding meaningful learning, and they emphasized that this schematic tool is important in organizing information, developing high-level thinking skills, and eliminating misconceptions. Concept maps are an easy way to monitor and evaluate the quality of thinking and learning (Cañas, Novak & González, 2006). Researchers, however, pointed out that concept maps are a metacognitive tool and emphasized that concept mapping improves higher-order thinking skills and can, therefore, be used as a powerful assessment tool (Cañas, Novak & González, 2006; Novak, 1990; Novak & Cañas, 2006). In addition, research has shown that when concept map is used as a measurement and evaluation approach, it is effective in revealing students' conceptual knowledge structures according to multiple-choice or standard tests (Hartmeyer, Stevensen & Bentsen, 2018; Markham, Mintzes & Jones, 1994; Ruiz-Primo & Shavelson, 1996; Taber, 2002). Within the scope of this research, the concept map was used as a measurement and evaluation tool to determine students' conceptual understanding in terms of establishing relationships between concepts and explaining these relations.

When the relevant literature is analyzed, the studies in which the concept maps are handled together with questions based on real-life contexts are limited in evaluating the conceptual understanding about the Unit of Force. Besides, one of the most common misconceptions in students in science classes is the Force. When the science curriculum (Ministry of National Education [MoNE], 2017) is examined, the student encounters many of the scientific concepts in the Force Unit for the first time at the 7th grade. These science concepts form the basis of the secondary physics course. Therefore, misconceptions about these scientific concepts are important. If there is a misconception, it should be determined and prevented so that the student does not affect the success of science in the future. Indeed, Gunstone and Watts (1985) argue that changing students' pre-thoughts about mechanics is more difficult than changing their thoughts about other fields of science. This is the main reason for choosing the subject of Force in the research.

In this study, this factor is one of the main objectives in measuring students' conceptual understanding in the subject of the force with different measurement techniques. Another reason for the use of different measurement techniques is the individual differences that students have. In education, gender, physical characteristics, socio-cultural-economic-demographic characteristics of the student,

etc. can be mentioned about many different individual characteristics that should be taken into account. Cognitive styles are just one of these individual differences.

Cognitive Styles as an Individual Difference

It is undoubtedly significant to construct teaching methods and environments and to use measurement and assessment approaches appropriate to this structure in learning science at the conceptual level. However, one of the main elements here is the characteristics of the student's individual differences. According to Tokiz (2013), it is a difficult and complex process to understand how students construct knowledge and learn concepts in their minds and therefore, it is recommended to use different measurement methods with their own advantages and disadvantages. Thus, in this research, one of the reasons for the use of different measurement techniques is the individual differences that students have.

From this point of view, in this study, cognitive style differences, which are the interests of many researchers in the field of science and examined their interactions with different variables in the literature (Bahar, 2003; Bassey, Umoren & Udida, 2007; Horzum & Alper, 2006; Karacam & Ates, 2010; Kang & Woo, 1995; Ogunyemi, 1973; Ozarslan &Bilgin, 2016; Sari, Altiparmak & Ates, 2013; Scott & Sigel, 1965), are handled. Tinajero and Paramo (1998) emphasized that the earliest research into cognitive styles was carried out by members of the "New Look" movement, a group of psychologists who were concerned that traditional models of perception placed insufficient emphasis on the individual. The concept of cognitive style was introduced for the first time in a study conducted by Allport (1937) with the expression "the name given to the individual in general and as usual to solve problems, think, perceive and remember (p.21)". Sternberg (1997) defined cognition as being aware of and understanding something. The concepts which Sternberg expressed as recognition and understanding are pointed out to a process of mental processing. Sternberg and Grigorenko (1997) emphasized that cognitive styles represent a bridge between cognition and personality, two different areas of psychological research. In addition, studies (Messick, 1982; Witkin, 1977) that point to the difference between cognitive styles and mental (intellectual) abilities in the field, argue that mental abilities are specific to content or area such as verbal or numerical, while cognitive styles intersect with both talent and personality areas. We can say that cognitive styles reflect the organization of knowledge and experience, not mental ability. Knappenberger (1998) stated that Cognitive style has a broad influence on many aspects of personality and behavior, including perception, memory, problem-solving, interest, and even social behaviors and self-concept. Sternberg and Grigorenko (1997) emphasized that the interest in cognitive styles goes back to Jung's research in 1923, who proposed the theory of psychological types still used in the evaluation of styles through the Myers Briggs Type Inventory; however, modern research on the subject began with Witkin's work. Witkin et al. (1971) conducted a series of standardized psychological test development studies, which they called the Group Embedded Figures Test, to classify and define cognitive styles.

Witkin and Goodenough (1981) considered individuals in two ways considering cognitive styles the field-dependent and field-independent. This polar structure, also known as a psychological differentiation, expresses the extent to which a person's perceptual field is dependent on the perceptual field independent of the organization (Sternberg & Grigorenko 1997). It is revised as the individual's recognition of a pattern is strongly dominated by the total organization of the perceptual domain. On the contrary, in the field-independent cognitive style, the individual is more likely to see parts of the field separately from the organized field (Witkin, Oltman, Raskin & Karp, 1971, p.4). According to Jonassen and Grabowski (1993), field-independent students are concept-oriented, analyze concepts and think analytically. Field-dependent students are real-oriented, influenced by the format and shape structure, and think globally. Cognitive styles develop slowly and experientially and cannot be easily changed through special training (Messick, 1982, quoted from Kagan). It is important to reflect the cognitive styles that are emphasized to be a characteristic feature of the education process (Messick, 1982; Sternberg & Grigorenko, 1997). According to Messick (1982), education should be concerned not only with the acquisition of knowledge but also with the way the student thinks and accordingly should use multiple thinking methods for educational outcomes. Depending on the proximity to the extremes of the dimension Tinajero, Lemos, Araújo, Ferrace and Páramo (2012) draw attention that individuals show diverse ways of information processing, which seem to modulate their academic achievement. These differences in the cognitive structure of individuals appear to be a factor affecting academic achievement and different measurement techniques can provide students with advantages or disadvantages compared to cognitive style differences (Ates & Karacam, 2005; Ates & Cataloglu, 2007). Karacam and Ates (2010) determined the level of conceptual knowledge of the students on physics with different measurement techniques (open-ended and multiple-choice questions) and found that the students with field-independent cognitive style were more successful than the students with field-dependent cognitive style. However, in the context of open-ended questions, they stated that there was no significant difference between the achievements of field-independent and field-dependent students. When the literature is examined, it is noted that students with field-independent cognitive style are more successful in conceptual understanding and achievement tests measured by multiple-choice questions (Celik, 2010; Karacam & Ates, 2010; Onyekuru, 2015; Sari, Altiparmak & Ates, 2013).

In this research, two different types of measurement tools were used to determine students' conceptual understanding levels about the Unit of Force. With the Life Based Concept Test, it is aimed to examine the level of students' ability to transfer the concepts they have learned in daily life contexts to other contexts and concepts. The concept map was used to explore the meanings that students have loaded on concepts, and to understand how they establish relationships between concepts of different importance (Kaya, 2003) and between concepts and examples. Thus, it was aimed to draw attention to the need to eliminate the drawbacks in measuring conceptual understanding by uniform tests. In addition, it is tried to observe what kind of results different measurement techniques produce about the conceptual understanding of

students with field-dependent and field independent cognitive styles. This aspect of the research is thought to contribute to the literature.

In the light of all the above, the aim of this research is to determine the conceptual understanding level of seventh-grade students with different cognitive styles by different measurement tools and interpret them according to field-dependent/field-independent cognitive style features.

Method

Research Design

This study was designed as a causal-comparative study. Causal-Comparative Method included the comparison of samples which differ in critical variables but were comparable (Balci, 1995, p.264). Cohen, Manion and Morrison (1994) stated that in the causal comparison studies, there are at least two groups affected differently from the same situation, or two groups effected and unaffected from the assumed condition. To sum up, to investigate the possible causes and effects of the present situation, these groups were examined concerning some variables. In this study, field-dependent and field-independent cognitive styles of the students were determined and the effects of these variables on the mean scores obtained from different measurement techniques used to determine conceptual understanding was examined. However, causal comparison studies should not be confused with empirical research trying to establish a cause-effect relationship. In the case of causal comparison research, the situation investigated, unlike the experimental researches arises independently from the manipulation of the researcher. The researcher explains the possible causes of this situation and it tries to identify the effectors (Cohen, Manion & Morrison, 1994).

Sample

In this research, the 7th-grade students in the school, where the first author was the teacher, were included in the study group with the convenience sampling method. This sampling method is to select the sample from easily accessible and applicable units due to the limitations in terms of time, money and workforce (Buyukozturk, 2012). The reason for working with seventh-grade students was that, according to the science curriculum, students encountered many scientific concepts related to force for the first time at this grade level. In this context, 80 seventh-grade students from four different classes in a public school in Ankara consisted of the sample of this study.

Data Collection Tools

Within the scope of this research, three different data collection tools were used. Because this study aimed to make a comparison according to the cognitive style differences of the students, the cognitive styles of the students were determined and used Group Embedded Figure Test firstly. However, implementation of Life-Based Concept Test and Force Concept Maps was carried out after the teaching of the force unit.

Group Embedded Figures Test. To determine the cognitive styles of the students, The Group Embedded Figures Test, a standard test developed by Oltman, Raskin and Witkin (1971) were conducted, was used in this study. This test is still popular today and is preferred by researchers to examine differences from cognitive styles (Karacam & Ates, 2010; Mefoh, Nwoke, Chukwuorji & Chijioke, 2017; Saracho, 1997; Ozarslan & Bilgin, 2016). The content of the test, which was developed to investigate cognitive styles of students' field dependence/field independence, includes 25 questions which require participants to identify simple geometric shapes from complex geometric shapes over a period of time. The test consisted of three parts. In the first part, seven questions were easy and students were expected to practice. The duration of the first part was two minutes. In the second and third parts, there were nine questions with increasing difficulty. For these two parts, students were given five-minute periods. Students' cognitive tendencies were determined according to their answers to 18 questions in the last two sections. The questions in the first part were not included in the scoring because the students were intended to practice. The score can be graded between 0-18 and the students who were of the most correct in determining the simple shape within the complex shape were classified as field-independent and the students with the least correct are classified as field-dependent. In this study, the method formulated by Alamolhodaei (1996) was used to classify the cognitive styles of the students. Alamolhodaei (1996) has developed this method using the components of the methods used by researchers, such as Scardamalia (1977), Case (1974) and Case and Gobersen (1974). Nicolaou and Xistouri (2011) stated that "In order to avoid the different criteria found in the literature for discriminating between field-dependent and field-independent participants, the Alamolhodaei's study uses a statistical technique for the discrimination"(p.5). And so, this method is often preferred because it produces more valid and reliable results in cognitive style researches (Aydin, 2015; Cataloglu & Ates, 2014; Mousavi, Radmehr & Alamolhodaei, 2012). In this method, the students who find more correct shapes than the number obtained as a result of adding one-quarter of the standard deviation of the scores obtained, are classified as field-dependent, and the students who find less correct shape than the number obtained by subtracting one-quarter of the standard deviation from the average are classified as field-dependent. However, the students whose correct shape numbers are found between these two numbers are classified as students with field-intermediate cognitive style. The descriptive statistic of student's scores obtained from the Group Embedded Figures Test determined by the method of Alamolhodaei is presented in the Findings section.

Witkin and colleagues (1971) showed the age-related developmental curve of the Group Embedded Figure Test empirically. According to their study, they found that the independent agility of children between the ages of 8-15 increased, this trend remained stable until the age of 24, and as the age increased, there was a more field-dependent curve in adults. The results of Witkin and colleagues' research show that the test can be applied in a wide range of age groups. Thompson, Pitts and Gipe (1983) conducted research on the applicability of the Group Embedded Figure Test in the fourth, fifth and sixth grades. The results showed that the test was applicable in these age groups. Indeed, there are many studies in the literature where the test is applied

to children between the ages of 9-15 (Alptekin & Atakan, 1990; Chalip, 1979; Chuang, 1999; Jantan, 2014; Roberge & Flexer, 1983; Sharma, 2018).

Life-Based Concept Test. The Life-Based Concept Test using real-life contexts was developed by the researchers of this study to determine the students' level of understanding of the concepts of Force. During the development process of the test, firstly literature review was performed and the table of the specification was created to ensure the scope validity of the test. The test was chosen from the literature (Sahin &Cepni, 2011) and was composed of questions prepared by the researchers. The test includes at least two questions for each outcome in the 7th Class Force Unit in the National Science Curriculum. In addition, the misconceptions found in the literature about Force and frequently encountered misconceptions have been used as a distractor in the options in the items of this test. In this context, it is aimed that the test can be used to determine the conceptual understanding levels of students' who have different cognitive style, to transfer the contexts used in the course to other contexts (contexts used in the test) and to reveal misconceptions.

Life Based Concept Test Validity, Reliability and Item Analysis. To ensure the validity of the test, the test was examined by 1 (one) science education field expert and 2 (two) science teachers in terms of the suitability of the questions to the outcomes and the level of 7th-grade students, and a pilot test with 17 questions was created in line with the feedback. The pilot test was applied to 290 students at the 8th-grade level who learned the "Force" unit at the previous grade level. During the pilot implementation, the issues that the students could not understand were noted and the questions were revised in the context of these notes in the formation of the final test. Cronbach Alpha reliability coefficient, which is the internal consistency coefficient of the data obtained from the pilot implementation of the test, was calculated as 0.71. The difficulty indices of the questions in the test and the discrimination indices calculated by taking the lower and upper groups of 27% were analyzed. When the item analyzes of the test were examined, two items with a discrimination index below 0.29 (Tekin, 2012) were excluded from the test. It was observed that the items with item discrimination indices below 0.29 and removed from the test were also very easy (0.60 to 1.00) or very difficult (0.00 to 0.40) items. Descriptive statistics of the Life Based Concept Test, which was revised after the items removed from the test, are presented in Table 1.

Table 1

Descriptive Statistics of the Concept Test-Revised after the Subtracted Items

Number of Students	290
Number of Items	15
Mean	6.71
Standard Deviation	2,12
Minimum Score	2
Maximum Score	13
Skewness	0.128
Kurtosis	- 0.981
Average Item Difficulty	0.57
Average Item Discrimination	0.43

The lowest score of the Life Based Concept Test is 2, and the highest is 13. The mean of the total scores was 6.71 and the standard deviation was 2.12. The skewness coefficient was 0.128 and the kurtosis coefficient was -0.981. Since the central tendency measures are close to each other and the skewness coefficient is within the range of ± 1.00, it was seen that the scores did not deviate excessively from the normal distribution, and the test scores were considered to be a normal distribution. The Cronbach Alpha reliability coefficient of the Concept Test, which was rearranged with the items excluded from the test (two items), was 0.77. In addition, it can be said that in the writing of the test items, the items removed from the test do not decrease the scope validity of the test since at least two items were prepared for each acquisition. The Life Based Concept test developed in this framework is a valid and reliable test.

Force Concept Map. In this research, the concept mapping technique was used in conjunction with the Life-Based Concept Test to evaluate the level of conceptual understanding, as it is thought to better reflect the difference between students' knowledge structures (Ruiz-Primo, Schultz & Shavelson, 2001). In the research, the method of creating a concept map from scratch was preferred. This method is a method with a low level of orientation, one of the methods of creating a concept map of Ruiz-Primo (2004). The reason for this was that the basic concepts in Force were many in number and the method was considered to be more suitable for the 7th-grade student level. Thus, students were given concepts related to the subject and asked to draw a concept map using these concepts. In addition, network type pattern was preferred from concept map patterns. Network type pattern was preferred because (1) it contains more than one level (2) reflecting complex interactions at different conceptual levels and thus high integrity (3) adding one or more concepts does not require changing the map much because there are different ways (4) It is possible to reorganize when it is necessary to reflect a wider worldview or to add a missing link (Unlu, Ingec&Tasar, 2006 quoted from Kinchin, Hay and Adams). According to the protocol proposed by Ruiz-Primo, Schultz and Shavelson (1997a), the students were given 2 hours of training about Concept Maps during the preparation and application of network concept maps preferred as a measurement technique within the scope of this research. A sample concept map about the Cell was drawn and feedback was given. In this research, the Force Criterion Concept Map developed by Aydin Ceran (2018) was used. In determining the concepts of force, four field experts (one science education field expert, two science teacher and one physics teacher) were asked to choose basic concepts from different sources. A concept pool was created from these concepts and 12 concepts (Mass, Weight, Force, Newton, Dynamometer, Pressure, Solid Pressure, Surface Area, Liquid Pressure, Gas Pressure, Mass Gravity Force, Gravitational Force) with the highest frequency were selected (Aydin Ceran, 2018). Students were given only 12 concepts and asked to create a concept map with these concepts. The Criterion-Map Relational Scoring Method (McClure, Sonak & Suen, 1999) was used to evaluate concept maps drawn by students. This scoring method was preferred in many studies where concept maps were used as a measurement tool (Ingec, 2009; Lee, Jang & Kang, 2015; Rye & Rubba, 2002; Yin, Vanides, Ruiz-Primo, Ayala& Shavelson, 2005). The highest 66 points can be obtained according to the concept map. The students were given 25 minutes to create a concept map.

Reliability and Validity of Concept Maps. McClure et al. (1999) state that there are three sources of error that may affect reliability when concept maps are used as a measurement tool. These; Students' experiences in creating concept maps are different, the subject area information differences between the evaluators and the differences between the ratings of the evaluators. Within the scope of the research, in order to minimize these three sources of error, a 2-hour lesson was given to students about concept maps and a sample concept map was drawn. Thus, the stages that the students had difficulties were observed and efforts were made to eliminate them. The concept maps of the Force drawn by the students were evaluated by the one expert in science education and one science teacher. In order to ensure reliability, which can be expressed as the consistency of the scores obtained from the concept map, the inter-rater consistency is generally considered (Ruiz-Primo &Shavelson, 1996; Ruiz-Primo et al., 1997b). In order to provide rater reliability in the evaluation of force concept maps, student scores were scored by two raters according to the relational scoring protocol and the scoring reliability was tested. Independent groups t-test was performed for the significance of the difference between the points assigned by the raters in the evaluation of the Force Concept Maps. The findings are presented in Table 2.

Table 2

Force Concept Map Inter-rater t-Test Results

	N	$\bar{X}$	*S*	*t*	*sd*	*P*
Rater 1	71	22.24	2.79	.351	140	.854
Rater 2	71	21.92	2.84			

According to Table 2, there is no significant difference between the scores assigned by both raters [t140 = 0.453, p<0.05]. In addition, the Correlation Coefficients among the Scores Assigned by the Rats were also examined and found to be 0.988.

In ensuring the validity of the force concept map, content validity, criterion validity and structure validity were taken into consideration. In the concept maps, Ruiz-Primo and Shavelson (1996) state that the scope validity can be ensured by the conformity of the concepts to be used in creating the map and the concepts covering the whole structure of the subject. In this regard, to ensure concept-subject integrity, the validity-tested concept map and force concepts (12) were used (Aydin Ceran, 2018). For criterion validity in concept maps, the correlation of concept map scores and scores obtained from another measurement tool whose validity and reliability have been proven should be examined (Ruiz-Primo & Shavelson, 1996; Ruiz-Primo et al., 1997b). In the literature, it is possible to come across many studies that determine the criterion validity of concept maps according to the correlation with standard tests (Conradty & Bogner, 2012; Liu and Hinchey, 1996; Novak, Gowin & Johansen, 1983; Rye & Rubba, 2002; Unlu, Ingec& Tasar, 2006). In this study, Pearson Correlation Coefficients between total scores obtained from concept maps and Life Based Concept Test scores were examined and found to be 0.89.

Data Analysis

The data obtained from the data collection tools were analyzed by One Way MANOVA, one- way ANOVA and t-test method, and analyzes were presented in the Findings section.

Results

Findings from the Group Embedded Figure Test

The descriptive statistic of student's scores obtained from the Group Embedded Figures Test determined by the method of Alamolhodaei (1996) is presented in Table 3.

Table 3

Mean and Standard Deviation of Data Obtained from the Group Embedded Figures Test

number of students	*maximum score*	*minimum score*	*M*	*SD*
80	18	1	7.83	4.53

According to Table 3, the number of correct answers based on determining the cognitive styles of the students is determined as - the correct answer between 0-6 is field-dependent, 7-8 correct answers are field- intermediate, 9-18 correct answers are field independent. In this context, the findings of the students classified according to their cognitive styles were given in Table 4.

Table 4

Number of Students by Cognitive Styles

number of students	*field-dependent*	*field-independent*	*Field-intermediate*
80	34	37	9

In the scope of this study, as several researchers used before, in the context of making a comparison between field-dependent and field-independent cognitive style students, field- intermediate cognitive style students were not included in the analysis (Alamolhodaei, 1996; Ates & Cataloglu, 2007). Thus, the result of the analysis, research was carried out with 71 students (34 field-dependent and 37 field-independent).

Findings Regarding the Assumptions of the MANOVA

To test the significant difference between Life Based Concept Test and Force Concept Map scores, according to field-dependent and field-independent cognitive style, was analyzed by one-way MANOVA. Before starting the analysis, the assumptions of the One-Way MANOVA analysis were tested for one independent (cognitive style) and two dependent variables. Box's M test was conducted to examine the distribution of covariance matrices. The test results showed that MANOVA analysis could be performed and variance-covariance matrices of dependent variables were evenly distributed (Box's M = 3,400, $p > .05$). Thus, the assumption of equal distribution of covariance matrices, one of the basic assumptions of multiple variance

analysis, was met. The Levene's test results for the homogeneity of variances are presented in Table 5.

Table 5

Levene's Test Results for Homogeneity of Variances

Dependent Variable	*sd1/sd2*	*F*	*P*
Life Based Concept Test	1/69	,701	,408
Force Concept Map	1/69	,360	,557

When the values in the table are analyzed, it is seen that Levene F test values related to the assumption of whether the variances are equal for each dependent variable are greater than the limit value of 0.05. This value shows that there is no significant difference between the groups in the distribution of the error variances of the dependent variables and the variances are homogeneous.

Findings Related Conceptual Understanding Level of Students with Field-dependent and Field-Independent Cognitive Styles

The results obtained from the one-way MANOVA analysis of the scores obtained from Life Based Concept Test and Force Concept Map of the students with field-dependent and field-independent cognitive styles are given in Table 6.

Table 6

MANOVA Results of Life Based Concept Test and Force Concept Map Scores according to Cognitive Styles

Effect	*Wilks' λ*	*F*	*Hypothesis sd*	*Error sd*	*Sig.*
Cognitive Style	0.700	7.910	2	68	0.001

MANOVA results revealed that students with field-dependent and field-independent cognitive style showed a significant difference in terms of conceptual understanding scores measured by different tests [Wilks Lambda (λ) = 0.701, F (2, 68) = 7.910, p <.05]. This finding showed that the scores obtained from the linear component consisting of the Life Based Concept Test and Force Concept Map scores differed depending on the cognitive style differences.

The results of one-way analysis of variance on Life Based Concept Test and Force Concept Map scores according to cognitive styles are presented in Table 7.

Table 7

Life Based Concept Test and Force Concept Map Scores of Students with Different Cognitive Styles One Way Analysis of Variance Results

Test	*Cognitive Styles*	*N*	*M*	*SD*	*Sd*	*F*	*p*
Life-Based Concept Test	Field-dependent	34	5.58	1.71	1-69	2017	0.000
	Field İndependent	37	10.10	2.22			
Force Concept Map	Field-dependent	34	21.64	8.69	1-69	31.29	0.000
	Field İndependent	37	39.13	9.11			

In Table 7, one-way analysis of variance results, which are realized as per having the field-dependent and field-independent cognitive styles on Life Based Concept Test and Force Concept Map scores are given. When these values are considered, it was observed that the mean scores of the students who had the field-independent cognitive style from both test types were significantly higher than the mean scores of the students with field-dependent cognitive style the scores in terms of Life Based Concept Test [$F (1, 69) = 20.17$, $p<.05$] and Force Concept Map mean scores [$F (1, 69) = 31.29$, $p<.05$].

Discussion, Conclusion and Recommendations

The findings obtained from this study showed that students with field-independent cognitive style were significantly more successful than the students with field-dependent cognitive style statistically in terms of scores obtained from both Life Based Concept Test and Force Concept Map. When the findings of the related literature are examined, it is seen that the students with field-independent cognitive style in science have a higher level of achievement in terms of conceptual understanding and achievement than the field-dependent students (Al-Naeme, 1991; Altiparmak, 2009; Ates & Cataloglu, 2007; Ates & Karacam, 2005; Cataloglu & Ates, 2013; Crow & Piper,1983;Celik, 2010; Ozarslan & Bilgin, 2016; Prayekti, 2015; Stamovlasis, Tsitsipis & Papageorgiou, 2009; Ziane, 1996).

In the scope of this research, The Life Based Concept Test is in a multiple-choice format. It has been demonstrated by various studies that the test structure is a factor affecting students' achievement due to individual differences (Celik, 2010; Karacam & Ates, 2010; Sari, Altiparmak & Ates, 2013). With this dimension, the results of this research coincide with the findings of the relevant literature. Witkin et al. (1977) attributed the success of the field-independent students to be more in multiple-choice tests that students of this cognitive style were able to recognize unstructured problems, incorrect structures in activities, and unclear clues to problems. On the other hand, Ozarslan and Bilgin (2016) stated that some of the techniques to be used in the measurement and evaluation process, where student achievement is determined, may offer students an equal chance and help eliminate the advantages which may arise from cognitive differences. The items in the Life Based Concept Test used in the research were developed based on real-life contexts. Thus, it is aimed to determine the

conceptual understanding levels of students based on establishing a concept-context relationship by placing science concepts into familiar daily life contexts. It is stated by various researchers that life-based questions are quite effective compared to classical science questions in terms of attracting students' interest, concretizing science concepts, transferring the context learned in different contexts and observing to what extent the student can use the concepts in daily life (Ahmed & Pollitt, 2007; Heller & Hollabaugh, 1992; Cepni, 2016; Park & Lee, 2004; Tekbiyik & Akdeniz, 2010). Today, it is obvious that the science questions should be designed in a structure that measures higher-level thinking skills, shows what the student knows and can do and is related to daily life (OECD, 2019). However, this study shows that even if the questions are created with real-life contexts, multiple-choice questions provide students with the independent cognitive style taking advantage of the test structure.

In addition, the structure of the questions included in The Life-Based Concept Test may also have caused this finding. If we evaluate this finding within the scope of the skills that Life-Based Concept Test aims to measure, we can say that; students who have field-independent cognitive styles are more successful than field-dependent students in using the concepts of force in their daily life problems or real-life contexts. Tinajero and Paramo (1998) evaluated research in the field dealing with the relationship between cognitive styles and science achievement and stated that the difference between the science achievements of students in field-dependent/field-independent cognitive style may be due to the type of content to which it refers. Today, however, it can be said that current studies that reveal the relationship between new generation science questions (such as PISA science questions) and cognitive styles are needed.

Another measurement tool used in determining the conceptual understanding of the research is the Force Concept Map. Results in terms of scores obtained from Concept Map; field-independent students have higher scores than field-dependent students. When the relevant literature in the field of science education was examined, no research investigating the relationship between concept maps as a measurement tool and cognitive styles was found. However, there are studies examining this relationship in different disciplines (Graff, 2005; Jablokowet al, 2015). In addition, in his study, Abayomi (1989) used concept maps as a learning method for eighth-grade students in science class. When the concept map is used as a learning method, it has reached the end that there is no significant difference between field-dependent and field-independent. Karacam (2005) in the research that students measure their understanding of Force and Motion concepts with different test formats; It was found that Structured Grid Technique, which aims to exhibit the conceptual structure (Bahar, 2001) does not make a significant difference between field-dependent and field-independent students. Hay and Kinchin (2006) emphasized that the most important feature of concept maps is "reveal the structure, organization, and elaboration of understanding". They also point to the need to increase the studies for the integration of cognitive styles, which is a psychometric feature with concept mapping methods. The findings of this study showed that students with a field-independent cognitive style were more successful in concept mapping. This may be due to cognitive style

features or may be due to the content and concept mapping method. The scarcity of studies combining concept maps and cognitive differences in the field of science education and especially in primary school limits the interpretation of the findings obtained from this research. Therefore, the features of cognitive styles were focused on discussing the findings obtained from the research.

When the concept map is used as a measurement tool, this research showed that field-independent students were more successful in establishing the relationships between concepts in the field of Force, defining these relationships and revealing the conceptual structure related to the subject. In this research, only the concepts list about force were given in order that the students should create a concept map concerning the subject and were expected to form the relationships between the concepts and propositions. Thompson (1988) stated that field-independent students could select information from unstructured knowledge areas, from hypotheses to concepts and understandings they carry; they are more advantageous in concept learning in which relevant and irrelevant features are compared and they are more successful in perceiving and synthesizing parts of the whole. And also, Wang and Jonassen (1993) stated that field-independent learners generally prefer to impose their own structure on information rather than accommodate the structure that is implicit in the materials. In the Handbook of Individual Differences, Jonassen and Grabowski (1993) stated that individuals with field-independent cognitive style are more successful in creating a new structure and analyzing the concepts, and also claim that these individuals are less affected by the format and shape structure, they are concept-oriented and analytical. These characteristics may be a reason for independent students to be more successful than field-dependent students in establishing new conceptual structures in concept mapping. Therefore, when it comes to conceptual understanding measurement, it can be thought that concept maps contain findings parallel to multiple-choice test results.

Brooks and Brooks (1999) state that while we have considerable control over what we teach as teachers, we have much less control over what students learn and the reason for this is that each student builds his or her own meaning through their own cognitive processes. Teaching methods, assessment and evaluation approaches, in-class and out-of-class environmental factors confront us as the main factors that affect student achievement in shaping teachers' effective teaching process. However, the results of this research reveal that individual differences the students have are another important factor affecting student achievement.

Recommendations

Findings obtained from the Life Based Concept Test of this study showed that students with field-independent cognitive style are more successful than the field-dependent in the questions prepared using real-life contexts. Even if the questions are based on real-life contexts, multiple-choice test structure provides an advantage to field independent students. This may also be related to the contextual structure of the life-based concept test. However, in the literature, the lack of life-based questions and research on the interaction of individual differences limits the interpretation of this

finding. Thus, researchers may be advised to carry out research that deals with new generation science questions and different cognitive style features.

It was observed that students with field-independent cognitive style were more successful in establishing relationships between science concepts and establishing correct propositions. Concept maps are frequently used in science education as both a learning and measurement tool. Based on this study, it is possible to say that the cognitive style features affect concept mapping. Thus, it is thought that it is necessary to review the studies measuring conceptual success with concept maps. Based on this, researchers are recommended to conduct research examining the causes of cognitive style interactions with the use of concept maps as a measurement tool in science education.

In summary, the test formats used to determine the level of conceptual understanding affect students' conceptual understanding of force depending on their individual differences. Considering that this difference decreases in open-ended or performance-based measurements, this result indicates the necessity of using different measurement and evaluation techniques at an equal distance for all cognitive style students. In this respect, it is suggested that the findings of this study should be considered in the interpretation of the findings of studies aimed at determining conceptual understanding. Each student's having different psychological, social and physical development characteristics requires individualization of instruction (Ari and Bayram, 2011). The individualization of instruction reveals the necessity to diversity and individualize the assessment and evaluation approaches used both in classrooms and national examinations.

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Farklı Bilişsel Stillere Sahip Öğrencilerin Kavramsal Anlama Düzeyleri: Farklı Ölçme Teknikleri Açısından Bir Değerlendirme

Atıf:

Aydin Ceran, S., & Ates, S. (2020). Conceptual understanding levels of students with different cognitive styles: An evaluation in terms of different measurement techniques. *Eurasian Journal of Educational Research 88,* 149-178. DOI: 10.14689/ejer.2020.88.7

Özet

Problem Durumu: Fen Bilimleri ve günlük yaşam arasındaki organik bağ göz önüne alındığında, fen derslerinin kavramsal düzeyde öğrenilmesini sağlamak ve kavramsal bilginin değerlendirilmesi, bireyin derste öğrendiği bilgiyi gerçek yaşamında beceriye dönüştürmesi, bu yol ile hayatı anlaması ve bilim perspektifinde çözüm üretmesi açısından önemlidir. Derinlemesine bir öğrenme olarak tanımlanan kavramsal anlamayı (Sinan, 2007) sağlayacak bir öğretim süreci şekillendirmenin tamamlayıcı bir unsuru ise öğretim yöntemleriyle uygun değerlendirme faaliyetlerinin

tasarlanmasıdır (Black ve William, 1998; Yin, Tomita ve Shavelson, 2013; Tokiz, 2013). Alanyazın incelendiğinde öğrencilerin kavramsal anlama düzeylerini belirlemeye yönelik farklı ölçme tekniklerinin kullanıldığı görülmektedir. Bu araştırmalar incelendiğinde iki veya üç aşamalı kavramsal anlama testleri (Artun ve Coştu, 2013; Çetinkaya ve Taş, 2016; Haslam ve Treagust 1987; Özbayrak ve Kartal, 2012; Sinan, 2007; Şen, Yılmaz ve Geban, 2018) ve seçeneklerinde genellikle kavram yanılgılarının çeldirici olarak kullanıldığı çoktan seçmeli kavram testleri (Ateş ve Polat, 2005; Kayacan ve Selvi, 2017), aşamalı testler ile birlikte kavram haritası ve analoji (Aykutlu ve Şen, 2012), yansıtıcı yazma (Kalman, 2011) ve öğrenci çizimleri (Yörek, 2007) gibi tekniklerinde kullanıldığı görülmektedir. Fen bilimlerinin kavramlar düzeyinde öğrenilmesinde öğretim yöntemlerinin ve ortamlarının yapılandırılması ve bu yapıya uygun ölçme değerlendirme yaklaşımlarının kullanılması önemlidir. Ancak burada önem taşıyan bir diğer ana unsur ise öğretimin merkezindeki öğrencinin bireysel farklılıklarından kaynaklanan özellikleridir. Bu noktadan hareketle bu araştırmada fen bilimleri alanında pek çok araştırmada incelenen öğrenci başarısını en fazla etkileyen ve araştırmalarda farklı değişkenler ile etkileşimi bakımından ele alınan öğrencilerin alan bağımsız/alan bağımlı bilişsel stil (Witkin ve Goodenough, 1981) farklılıkları dikkate alınmıştır (Horzum ve Alper, 2006; Karaçam ve Ateş, 2010; Özarslan ve Bilgin, 2016; Sarı, Altıparmak ve Ateş, 2013). Psikolojik bir farklılaşma olarak ta bilinen bu polar yapı bir kişinin çevredeki algısal alanın organizasyondan bağımsız olarak ne ölçüde bu algısal alana bağımlı olduğunu ifade eder (Sternberg ve Grigorenko 1997). Bireylerin sahip oldukları bu bilişsel yapı farklılıkları ise akademik başarıya etki eden bir faktör olarak karşımıza çıkmakta ve farklı ölçme teknikleri öğrencilere bilişsel stil farklılıklarına göre avantaj ya da dezavantaj sağlayabilmektedir (Ateş ve Karaçam, 2005; Ateş ve Cataloğlu, 2007). Bu araştırmada öğrencilerin kavramsal anlama düzeylerini belirlemede iki farklı türde ölçme aracı kullanılmıştır. Yaşam Temelli Kavram Testi ile öğrencilerin günlük yaşam bağlamlarını ve bu bağlamlar içinde öğrendikleri kavramları diğer bağlamlara ve kavramlara transfer edebilme düzeylerinin incelenmesi amaçlanmıştır. Kavram haritası ise öğrencilerinin kavramlara yükledikleri anlamları keşfetmek, farklı öneme sahip kavramlar arası ve kavramlar ile kavram örnekleri arasındaki ilişkileri nasıl kurduklarını anlamak (Kaya, 2003) amacıyla kullanılmıştır. Literatürde sıklıkla karşımıza çıkan ve kavramsal anlamayı değerlendirmede kullanılan bu ölçme tekniklerinin alan bağımlı ve alandan bağımsız bilişsel stile sahip öğrencilerin kuvvet konusundaki kavramsal anlama düzeylerini belirlemede ne gibi farklılıklar içerdiği ve ne tür sonuçlar ürettiği gözlemlenmeye çalışılmıştır. Araştırmanın bu yönüyle alana katkı sağlayacağı düşünülmektedir.

Araştırmanın Amacı: Bu araştırma ile farklı bilişsel stillere sahip yedinci sınıf öğrencilerinin Fen Bilimleri Dersi "kuvvet" konusundaki kavramsal anlama düzeylerinin farklı ölçme teknikleri ile belirlenmesi ve bu perspektifte öğrencilerin farklı ölçme teknikleri ile ölçülen kavramsal anlama düzeylerinin sahip oldukları bilişsel stillerden nasıl etkilendiğinin gözlemlenmesi amaçlanmıştır.

Araştırmanın Yöntemi: Bu çalışma bir nedensel karşılaştırma araştırması olarak tasarlanmıştır. Nedensel Karşılaştırma Yöntemi, kritik değişkenlerde farklılık gösteren

ancak karşılaştırılabilir olan örneklemlerin karşılaştırılmasını içerir (Balcı,1995, s.264). Bu çalışmada da öğrencilerin alan bağımlı ve alan bağımsız bilişsel stilleri belirlenmiş, bu değişkenlerin kavramsal anlamayı belirlemede kullanılan farklı ölçme tekniklerinden elde edilen puan ortalamaları üzerindeki etkisine bakılmıştır. Çalışmanın örneklemini Ankara'da bir devlet okulunda yedinci sınıf düzeyinde öğrenim gören 80 öğrenci oluşturmaktadır. Öğrencilerin bilişsel stillerini belirlemek amacıyla Oltman, Raskin ve Witkin (1971) tarafından geliştirilen ve geçerlik ve güvenirlik çalışması yapılmış standart bir test olan Grup Saklı Figürler Testi kullanılmıştır. Öğrencilerin günlük yaşam bağlamlarını ve bu bağlamlar içinde öğrendikleri kavramları diğer bağlamlara ve kavramlara transfer edebilme düzeyleri ekseninde "Kuvvet" konusundaki temel kavramları anlama düzeylerini belirlemek amacıyla günlük yaşam içerisinden seçilen gerçek yaşam bağlamlarının kullanıldığı çoktan seçmeli formatta bir kavram testi geliştirilmiştir. Öğrencilerin "Kuvvet" konusuna ilişkin kavramsal anlama düzeylerini ortaya çıkarmak ve bilgi yapıları arasındaki farklılığı daha iyi belirleyebilmek amacıyla (Ruiz-Primo, Schultz ve Shavelson, 2001) kavram haritası diğer bir ölçme aracı olarak kullanılmıştır. Kuvvet konusunun öğretimi tamamlandıktan sonra öğrencilere konu ile ilgili 12 kavram verilmiş ve bu kavramları kullanarak bir kavram haritası çizmeleri istenmiştir. Kavram haritası ile değerlendirme yapılmadan önce öğrencilere Ruiz-Primo, Schultz ve Shavelson (1997a) önerdiği protokol referans alınarak 2 saatlik bir kavram haritası çizme öğretimi yapılmıştır. Öğrencilerin çizdikleri kavram haritaları Aydın Ceran (2018) tarafından geliştirilen ve güvenirlik ve geçerlik çalışmaları yapılan kriter kavram haritasına göre değerlendirilmiştir. Elde edilen kavram haritalarını puanlandırmak için ise kriter haritalı ilişkisel puanlama yöntemi kullanılmıştır (McClure, Sonak ve Suen, 1999). Yaşam Temelli Kavram Testi ve Kuvvet Kavram Haritası, birinci yazar tarafından kuvvet ünitesinin öğretimi yapıldıktan sonra uygulanmıştır. Araştırmada veri toplama araçlarında elde edilen veriler Tek Yönlü MANOVA, ANOVA ve t-testi yöntemiyle analiz edilmiş ve analizler Bulgular bölümünde sunulmuştur.

Araştırmanın Bulguları: Öğrencilerin Grup Saklı Figürler Testinden aldıkları puanların betimsel istatistiklerine göre yapılan değerlendirme sonucunda 34'ünün alan bağımlı, 37'sinin alan bağımsız ve 9'unun ise alan orta bilişsel stilde olduğu belirlenmiştir. Bu çalışma kapsamında ise alan bağımlı ve alan bağımsız bilişsel stile sahip öğrenciler arasında bir karşılaştırma yapmak amaçlanığından alan orta bilişsel stildeki öğrenciler analize dahil edilmemiştir. Yaşam Temelli Kavram Testi puan ortalamaları ve Kuvvet Kavram Haritası puan ortalamaları bakımından alan bağımsız bilişsel stile sahip öğrencilerin her iki test türünden aldıkları puanların ortalamalarının alan bağımlı bilişsel stile sahip öğrencilerin puan ortalamalarından istatistiksel olarak anlamlı bir şekilde daha yüksek olduğu gözlenmiştir.

Araştırmanın Sonuçları ve Öneriler: Araştırmada kullanılan Yaşam Temelli Kavram Testindeki maddeler gerçek yaşam bağlamlarına dayalı olarak geliştirilmiştir. Öyleki öğrenciye tanıdık gelen günlük yaşam bağlamları içine fen kavramları yerleştirilerek kavram-bağlam ilişkisi kurma temelinde öğrencilerin kavramsal anlama düzeylerinin belirlenmesi amaçlanmıştır. Yaşam temelli soruların öğrencinin ilgisini çekmede, fen

kavramlarını somutlaştırmada, derste öğrenilen bağlamı farklı bağlamlara transfer etmede ve öğrencinin kavramları günlük yaşamda ne ölçüde kullanabildiğinin gözlemlenebilmesi çerçevesinde klasik fen sorularına kıyasla oldukça etkili olduğu çeşitli araştırmacılar tarafından belirtilmiştir (Ahmed ve Pollitt, 2007; Heller ve Hollabaugh, 1992; Çepni, 2016; Park ve Lee, 2004; Tekbıyık ve Akdeniz, 2010). Bu araştırma kapsamında alan bağımsız bilişsel stildeki öğrencilerin yaşam temelli sorularda daha başarılı olmaları geleneksel anlayış dışındaki kavramsal bilgi içeren fen sorularında da çoktan seçmeli test yapısının alan bağımsız bilişsel stile sahip öğrencilere avantaj sağladığı şeklinde yorumlanabilir. Araştırmada kavramsal anlamanın belirlenmesinde kullanılan bir diğer ölçme aracı ise Kuvvet Kavram haritalarıdır. Sonuçlar alan bağımsız öğrencilerin Kavram Haritalarından elde edilen puanlar bakımından alan bağımlılara göre istatistiksel olarak daha yüksek puana ulaştıklarını göstermektedir. Alan yazın incelendiğinde farklı bilişsel stile sahip öğrencilerin kavram haritalarında göstermiş oldukları performansı değerlendiren bir çalışmaya rastlanmamıştır. Fen eğitiminde kavram haritalarının bir değerlendirme aracı olarak sıklıkla kullanıldığı düşünüldüğünde, kavram haritalarının farklı bilişsel stillere ne ölçüde hitap ettiğine yönelik çalışmaların yapılmasına ihtiyaç olduğu açıktır. Genel bir değerlendirme ile kavramsal anlama ölçümü söz konusu olduğunda kavram haritalarının çoktan seçmeli test sonuçlarına paralel bulgular içerdiği düşünülebilir. Öğretmenlerin etkili bir öğretim süreci şekillendirmesinde öğretim yöntemleri, ölçme ve değerlendirme yaklaşımları, sınıf içi ve dışı çevresel faktörler öğrenci başarısını etkileyen temel faktörler olarak karşımıza çıkmaktadır. Ancak araştırma sonuçları öğrencinin sahip olduğu bireysel farklılıkların öğrenci başarısına etki eden bir başka önemli faktör olduğunu ortaya koymaktadır.

Anahtar Sözcükler: Alan bağımlı/alan bağımsız bilişsel stiller, kavram haritası, yaşam temelli kavram testi, bilişsel farklılıklar.

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Latent Class Approach to Detect Differential Item Functioning: PISA 2015 Science Sample*

Seyma UYAR[1]

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ABSTRACT

Purpose: This study aimed to compare the performance of latent class differential item functioning (DIF) approach and IRT based DIF methods using manifest grouping. With this study, it was thought to draw attention to carry out latent class DIF studies in Turkey. The purpose of this study was to examine DIF in PISA 2015 science data set. **Research Methods:** Only dichotomous items were considered in this study. Turkey and Singapore samples were used to examine DIF. There were 6115 students in Singapore data set and 5895 students in Turkey sample. To detect DIF among countries based on manifest grouping, Item Response Theory Likelihood Ratio (IRT-LR) and Lord's Chi-Square techniques were used. Besides, with Mixture Item Response Theory latent classes were defined and DIF items were detected with Mantel Haenszel method (MH) among latent classes. Number of DIF items were detected according to latent classes and the two countries were compared.
Findings: There were 8 items including DIF among latent classes. With Lord's Chi square method, four items were detected to include DIF at medium and high level among Turkey and Singapore. And IRT-LR method revealed that only two items included DIF among countries.
Implications for Research and Practice: According to the results, it was recommended to use latent class approach in the investigation of DIF items in cross-country studies.

* This study was presented as an oral presentation in 3rd International Congress on Education Sciences and Learning Technology in Atina on 15-19 November 2017.

[1] Mehmet Akif Ersoy University, TURKEY, e-mail: syuksel@mehmetakif.edu.tr,
ORCID: https://0000-0002-8315-2637

Introduction

A test item should be able to measure ability without involving characteristics of examinees that are in different subgroups. This is because examinees with equal abilities should have the same probability to answer an item correctly, even though they are in different subgroups. When an item has more advantages for one subgroup, then this item is considered biased (Camili & Shepard, 1994; Mellor, 1995; Zumbo, 1999). Biased items cause a systematic error, so they can affect the validity of scores. In addition, biased items prevent the comparability of scores across groups.

International large scale assessments such as Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) are assessments that are applied for different groups varying in culture, country, linguistic, socioeconomic status, school and gender. These demographic factors are irrelevant with test construct and not related to the characteristic measured by the test. But these factors may affect examinees' performance in different subgroups (Oliveri, Ercihan & Zumbo, 2013). PISA and TIMSS are applications, which have multiple language versions. Different language forms of a test may cause to occur biased items in tests, because bias can arise due to test administration, response procedures, or inappropriate translations (Asil & Gelbal, 2012; Hambleton, Merenda & Spielberger, 2007; Van de Vijyer & Tanzen, 2004; Wu & Ercikan, 2006). Results from international assesments may be helpful to policymakers to get educational decisions according to examinees' achievement, but before applications, test developers should examine the items in terms of bias to make the scores comparable across groups.

Item bias determination processes are carried out in two stages. The first stage is a statistical process called differential item functioning (DIF). In this process, item response distributions are examined in reference groups and focal groups, established by considering observed variables (gender, country etc.) under equal ability levels (Cohen & Bolt, 2005; Steinberg & Thissen, 2006). DIF, in the simplest sense, refers to the change of the statistical properties of an item between subgroups when the abilities of these groups are equivalent. (Angoff, 1993; Clauser & Mazor, 1998; Holland & Wainer, 1993). But the presence of DIF in an item is not enough to claim that this item is biased. In the second stage, these items should be examined qualitatively. The DIF items are examined by experts, whether they provide advantages to certain groups (Camilli & Shepard, 1994). DIF can occur in uniform and non-uniform forms (Mellenberg, 1982). In uniform DIF, item discrimination parameters do not vary across groups, but item difficulties vary across the reference and focal groups. An item favors only one group along the ability scale. If non-uniform DIF appeared, it means that this item varies in terms of item difficulties and item discrimination parameters across the reference and focal groups. And this item favours in an ability range one group and in another ability range it favours the other group (De Ayala et al., 2002; Zumbo, 1999).

It can be said that there are many methods to determine DIF items (Camilli & Shepard, 1994; Holland & Wainer, 1993; Millsap & Everson, 1993). To classify these methods, one approach seperates them based on the Classical Test Theory (CTT), such as Mantel Haenszel (Mantel & Haenszel, 1959) and Logistic Regression (Zumbo, 1999),

or methods based on the Item Response Theory (IRT) such as Lord's Chi square, Raju's Area or Item Response Theory Likelihood. However, each method may have disadvantages over the other. Test length, number of DIF items, DIF magnitude, or sample size can affect the performance of DIF methods (Clauser, Mazor & Hambleton, 1993; Gierl, Gotzmann & Boughton, 2004; Kabasakal, Gök, Kelecioglu & Arsan, 2012; Sunbul & Sunbul, 2016). But it is a common view that IRT methods are more effective than CTT based methods, for IRT based methods can estimate ability independently from items (Narayanan & Swaminathan, 1996). Methods based on item response theory (IRT) to detect DIF deal with the differences in the probability to answer the item correctly for two manifest groups. For this reason, IRT methods focus on comparing item characteristic curves (ICCs) (Raju, 1988) or item parameters of the groups (Lord, 1980; Thissen, Steinberg & Wainer, 1993). DIF studies, when used in the manifest grouping, assume that the groups, for example, males and females or ethnic groups, represent homogenous subgroups. Homogeneity means that the items function the same way for these subgroups, which means items do not include DIF within the subgroups (De Ayala, Kim, Stapleton & Dayton, 2002). In addition, these manifest variables are thought to be the source of the DIF. In reality, these manifest groups can be easily identified, but they often do not represent homogeneous populations in terms of the feature that is measured (Samuelsen, 2005). Therefore, it is a fact that an item may contain DIF within the same group. The individuals in a manifest group (e.g. all girls) can be divided into latent classes if all examinees (e.g. all girls) do not have homogeneous response patterns (De Ayala et al.,2002; Ercikan et al. 2013; Samuelsen, 2005). Samuelsen (2005) argued that it is considered a 100% overlap between latent class and manifest group if examinees of a manifest group are also clustered within a single latent class. However, the probability of overlapping manifest group and latent class is poor in real studies. In these cases, it is argued that DIF results obtained from manifest groups may be biased when the ratio of overlap is less than 70%. In this context, it is proposed that DIF studies should be examined among unknown groups/ latent classes (Bilir, 2009; Choi et al., 2015; Cho, 2007; Cohen & Bolt, 2005; De Ayala et al., 2002; De Mars & Lau, 2011; Finch & French, 2013; Karadavut, 2017; Maij-de Meij et al., 2010; Oliveri, Ercikan, & Zumbo, 2013; Samuelsen, 2005, Uyar, Kelecioglu & Dogan, 2017; Yalcin, 2018). Kelderman and McReady (1990) agree with the idea that a latent class approach to detect DIF can be productive. They argue that using latent classes allows DIF to be evaluated independently of any variable or set of variables. These efforts can be helpful for researchers to provide a more precise explanation of the presence or cause of DIF.

A Mixture Item Response Model (MixIRT) can be used to identify the unobservable groups that have similar response patterns and cluster these heterogeneous groups with the help of their response behaviours (Cho & Lee, 2016). MixIRT approach was proposed by Rost (1990) and Mislevy and Verhelst (1990) to have homogeneous subgroups from the tested data. MixIRT is a model that combines the Rasch model and latent class analysis, which allows to estimate item parameters differentially for each latent class. With this separation, examinee's responses in one latent class can be homogeneous, but it is heterogeneous between latent classes. MixIRT models can be

adopted to Rasch models, 2-PL, and 3-PL models (Bolt & Cohen, 2005; Finch & Finch, 2013).

In Mixture Rasch models, the probability of an item to answer it correctly is as follows (Cho, 2007):

$$\left(y_{ijg} = 1 \mid g, \theta_{jg}\right) = \frac{1}{1 + \exp[-(\theta_{jg} - \beta_{ig})]}$$

In this formula $g = 1, \ldots, G$ refers to index with latent class membership; j= $1, \ldots, J$ is responders; θ_{jg}: is examinee's latent ability in latent class g; β is the difficulty parameter of item i in class g. Ability has normal distribution with μ and σ parameters, where these parameters have class-specific features.

MixIRT models are important and valuable. They can establish hypotheses about individual characteristics, which are related with DIF (Sawatzky, Ratner, Kopec & Zumbo, 2012). This is because mixture modeling focuses on maximizing differences among latent classes. This procedure results in an existing large number of DIF items and high DIF effect sizes among latent classes (Samuelsen, 2005). Studies in this field revealed there was a weak correlation between gender and latent classes. This means that DIF analysis conducted with gender groups may produce misleading results (Cohen & Bolt, 2005; Yalcin, 2018). Some members in one group can have the advantage to respond to an item correctly, but other members in this group can be disadvantaged (Cohen & Bolt, 2005; De ayala et all, 2002). Therefore, according to previous studies, it can be said that the performance of manifest DIF analysis may be lower than latent DIF analysis. Studies, related to MixIRT DIF were carried with simulated and real data (Cohen & Bolt, 2005; Maij-de Meij, 2010), with simulated data (Bilir, 2009; Samuelsen, 2005, Uyar et al., 2017; Yuksel, 2012) or only with real data (Finch & Finch, 2013; Karadavut, 2017; Van Nijlen & Janssen, 2008; Yalcin, 2018). According to Cho & Lee (2016), it is required to examine the performance of manifest DIF detection methods for studying latent DIF approach in future studies. Thus, in this study it was aimed to compare the performance of latent class DIF approach and IRT based DIF methods using manifest grouping. With this study, it was thought to draw attention to carry out latent class DIF studies in Turkey. In this context, the following research questions were asked:

1. To which model does the data fit, consisting of Turkey and Singapore samples? And how is the distribution of members from different countries in latent classes?
2. How is the distribution of estimated item difficulties for latent classes?
3. How many items are detected, including DIF according to latent class approach?
4. How many items are detected including DIF among countries with Lord's Chi-square and Item Response Theory Likelihood procedures?

Method

Research Design

In this study, the number of DIF items in PISA science application was investigated with latent class and manifest group approaches. This study is a descriptive study for it tries to reveal the current situation (Büyüköztürk, 2019).

Research Sample

The countries, Turkey and Singapore, were chosen for this study. The countries were selected for some reason. First, this study focused on the countries which are different in terms of their culture and language. According to previous studies, greater DIF items were investigated across different language groups (Ercikan, Oliveri & Zumbo, 2013). On the other hand, Turkey and Singapore have different methods in terms of instruction, curriculum and education policies (Levent & Yazici,2014). These factors may affect the examinees' performance and response styles. Secondly, we focused on the achievement rank of countries. Singapore reached the first rank in science, reading and mathematics literacy, where Turkey's achievement was below the OECD means. To focus on potential DIF sources, it was thought that a comparison of these countries in terms of item response behaviours can provide an opportunity for DIF investigation.

There were 6115 examinees in the Singapore data set and 5895 examinees in the Turkey sample. But once the missing data were removed, and examinees who responded to the common items were selected, 614 examinees in Singapore and 498 examinees in Turkey sample were excluded from the study.

Research Instruments and Procedures

In PISA 2015 application, science was the major domain. For this study, dichotomous items from PISA 2015 science test were used. There were 17 dichotomous items common in Turkey and Singapore samples to test science literacy.

PISA 2015 Science Literacy: PISA is an ongoing program that can help policymakers to take decisions about education. Besides, with PISA applications, it is easy to follow examinees' knowledge and skills across countries although these examinees may be included in other subgroups in each country. PISA is implemented every 3 years. In each cycle, one domain is tested in detail (covering almost half of the test time). In 2006 and 2015 the major domain was science, in 2000 and 2009 reading was the major domain, and in 2003 and 2012 mathematics was the major domain. Since 2012, in each cycle an innovative domain has been tested together with the major domain. In the PISA 2015 assessment, science was the major domain, where collaborative problem solving and financial literacy were innovative domains. (OECD, 2018-PISA 2015 results in focus). Literacy is defined as examinees' adequacy to use their knowledge and skills, logical inferences, and effective communication in terms of interpreting and solving a problem they encountered. According to this, the 'science literacy' terminology expects the student to be a reflective citizen when dealing with science-related issues and ideas. This student can evaluate and design scientific

research, can interpret the data, can give reasoned answers about science and technology problems (OECD, 2016).

In PISA 2015 scientific literacy assessment contexts were health and disease, natural resources, environmental quality, hazards and frontiers of science, and technology. In addition, the questions were associated with personal, local/national, and global problems (OECD, 2018).

Data Analysis

First, data were checked for IRT assumptions. To analyze the dimensionality of the science items, confirmatory factor analysis (CFA) approach was applied in the Mplus 7 software (Muthén & Muthén, 2012). Despite the factor that indicated items were categorical, a robust weighted least square estimation method was preferred (Brown, 2006). To examine the model fit, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) were investigated. In the literature, it is a common opinion that RMSEA should be smaller than 0.08 and CFI and TLI should be greater than .90 for an acceptable fit (Browne & Cudeck, 1993; Hu & Bentler, 1995; Jöreskog & Sörbom, 1993). In this study, it was seen that the model fit to the data, because the fit indices were between the acceptable value ranges. Therefore, it was decided that the unidimensionality of the data was provided (RMSEA =. 02, CFI = 0.97, TLI = 0.97).

DIF detection:

By manifest DIF detection, items that function differently among Turkey and Singapore group members were examined. A Likelihood Ratio Test for DIF (IRT-LR) was used to detect DIF. This analysis was conducted using the computer program IRT-LR DIF (Thissen, 2001). The other procedure for manifest DIF detection in this study was Lord's Chi-square (χ^2) method from the IRT models. IRT-LR and Lord's χ^2 analysis was conducted with 2PL model, but only uniform DIF was reported in this study.

IRT-LR: This procedure is closely related to the IRT model and includes hypothesis testing of item response theory parameters, which are slope, guessing or difficulty parameters (Thissen, 2001). IRT-LR compares the results of the compact and augmented model. A compact model assumes that item parameters are equal for focal and reference groups. It means that items do not include DIF across groups (Thissen, 2001). On the other hand, the augmented model assumes that the parameters of item *i.* can differ for focal and reference groups, but other items supposed to be equal in terms of parameters across these groups (Cohen, Kim & Wollcak, 1996). IRT-LR is the difference between likelihood ratios, calculated from the compact model and augmented model. Distribution of IRT-LR is as a chi-square with the difference in the degree of freedom between the compact and the augmented models. This procedure is appropriate to polytomous and dichotomous data. Besides, with this procedure, it is possible to detect uniform and non-uniform DIF. According to Greer (2004), items will detect DIF with IRT-LR method, when G^2 values are between the following intervals (Greer, 2004):

3.84<G^2<9.4 negligible dif (A level)

9.4≤G^2< 41.9 middle level dif (B level)

G^2≥ 41.9 high level dif (C level)

Lord's Chi-Square (χ^2): Lord's χ^2 test is related to the differences in the variance-covariance matrix of difficulty and discrimination parameters. This method is based on the differences in the item parameters obtained for the reference and focal groups (Hambleton & Swaminathan, 1985). Lord's chi-square test is explained in Equation 1 (Kim, 2010):

$$\chi_i^2 = (a_{diff} b_{diff} c_{diff})' \Sigma^{-1} (a_{diff} b_{diff} c_{diff})$$

In this formula Σ^{-1} refers to the inverse variance-covariance matrix for differences in item parameter estimates; a_{diff}; refers to the difference of parameters obtained for reference and focal group; b_{diff}, is the difference between difficulty parameters obtained estimated for reference and focal group, and c_{diff} is the difference between pseudo guessing parameters among groups.

The obtained χ^2 statistic is distributed as chi-square at the degree of freedom "1' for 1PL model, with two degrees of freedom for 2PL model and with three degrees of freedom for 3PL model (Lord, 1980). When the χ^2 statistical value exceeds the critical value, the item is thought to contain DIF based on the relevant level of significance. Analyses related to this method were carried out in "difR" library in R 3.1.2 software. It is determined that an item contains DIF, when it is found to be significant at a 0.5 level. For DIF, item effect size was calculated, where the difference between item difficulties among reference and focal groups was -2.35 times. This effect size is similar to Mantel Haenszel's Δ_{MH}. To classify the effect sizes, ETS delta scale was used (Holland & Thayer, 1988; Magis, 2018; Penfield, 2007). Based on the size of this value, assessed items showed DIF at the A, B, or C level.

To detect DIF among latent classes, MRM was conducted in WINMIRA (von Davier, 2001) program. After deciding on the number of latent classes, DIF items were detected using the Mantel Haenszel method. ΔMH Coefficient suggested by Roussus, Scnipke and Pashley (1999) was;

$$\Delta MH = -2.35 \ln(\alpha) = -2.35 \ln\left[e^{-1.7a(b_R - b_F)}\right] = 4\alpha((b_R - b_F)$$

b_R is the item difficulty for focal group and b_F is the item difficulty for reference group. Based on ΔMH value intervals it is decided if an item contains DIF. The intervals are listed below:

If |ΔMH | < 1 DIF is negligible (A level)

1 ≤ |ΔMH | <1.5 middle level DIF (B level)

If |ΔMH | ≥1.5 high level DIF (C level)

Results

The examinees' responses were investigated with MixIRT. The fit of one class model was compared with the fit of two and three class models by comparing their Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Consistent Akaike Information Criterion (CAIC) statistics. Table 1 shows the information criteria for latent class models.

Table 1

Information Criteria for Latent Class Models

Number of Class	AIC	BIC	CAIC
1	22611.39	22701.64	22719.64
2	22409.28	**22594.79**	**22631.79**
3	22357.81	22638.59	22694.59

According to Table 1, the two-class model had the smallest BIC and CAIC values. For this reason, the model with two latent classes with sizes .56 and .44 was selected. Based on this model, we can interpret that the manifest group and latent class overlapping was poor. The distribution of examinees in latent classes according to the two latent class models by country is given in Table 2.

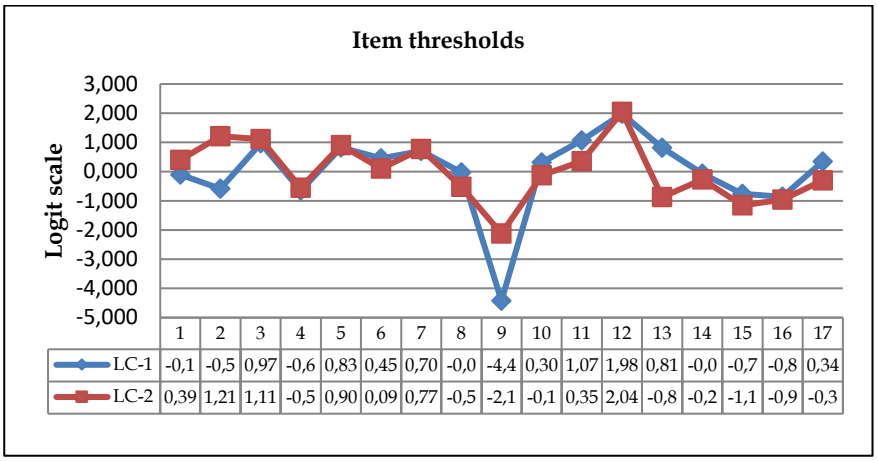
Table 2

Cross-tabulations of Country and Class Membership

Country		LC-1	LC-2	Total
Singapore	n	470	144	614
	%	76,55	23,45	100
Turkey	n	146	352	498
	%	29,32	70,68	100
Total	n	616	496	1112
	%	55,40	44,60	100

LC: Latent class

According to Table 2, there were 616 examinees in LC-1. In this class, 470 participants (76.55%) were from Singapore and 146 (29.32%) were from Turkey. In the second class, there were 496 examinees in total. Besides, 144 (23.45%) of examinees were from Singapore, and 352 (70.68%) were from the Turkey sample in the second class. Figure 1 displays the thresholds (difficulty) parameters for two classes.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
LC-1	-0,1	-0,5	0,97	-0,6	0,83	0,45	0,70	-0,0	-4,4	0,30	1,07	1,98	0,81	-0,0	-0,7	-0,8	0,34
LC-2	0,39	1,21	1,11	-0,5	0,90	0,09	0,77	-0,5	-2,1	-0,1	0,35	2,04	-0,8	-0,2	-1,1	-0,9	-0,3

Figure 1. *Item difficulty parameters obtained for each latent class*

According to Figure 1, every class had similar item difficulties except for items 1, 2, 9 11 and 13. In general, LC-1 found items easier than LC-2 in the first part of the test. But it is interesting that in the second part of the test, LC-2 found the test easier than LC-1.

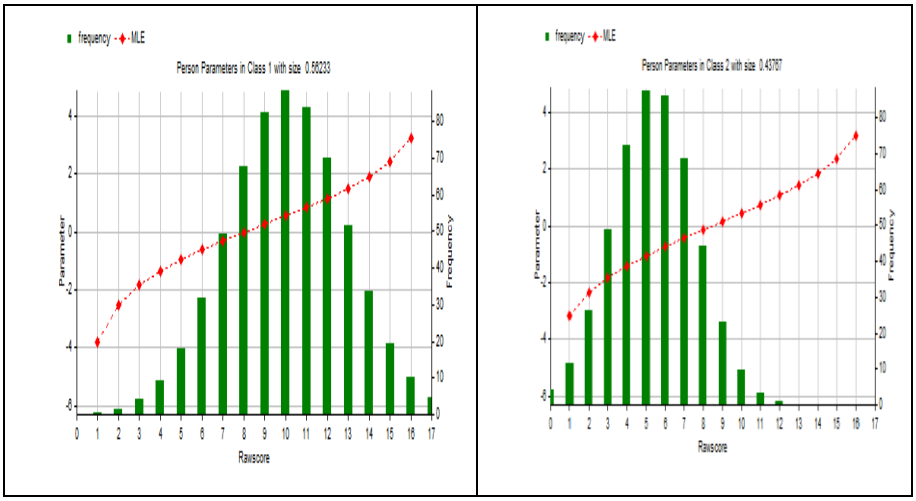


Figure 2. *Ability parameters obtained for each latent class*

As can be seen in Figure 2, ability parameters were higher in LC-1 than LC-2. In this context, it can be interpreted that the examinees in LC-1 achieved higher success than in LC-2. Membership in LC-1 included more examinees from Singapore (high-performing), and fewer from Turkey (low-performing). In addition, there were more examinees in LC-2 from Turkey and fewer from Singapore. According to these results,

it can be interpreted that the items were medium level for examinees in LC-1 and were at a difficult level for the examinees in LC-2.

Table 3

Mixture Rasch Difficulty Estimates for 2-Class Solution

	LC-1	LC-2			
Item	Est.	Est.	Diff.	-2.35*Diff.	DIF Level
1	-0.106	0.395	-0.501	1.177	**B**
2	-0.583	1.213	-1.796	4.221	**C**
3	0.974	1.110	-0.136	0.320	A
4	-0.654	-0.553	-0.01	0.237	A
5	0.831	0.906	-0.075	0.176	A
6	0.459	0.099	0.360	-0.847	A
7	0.705	0.773	-0.068	0.160	A
8	-0.027	-0.525	0.498	-1.170	**B**
9	-4.420	-2.119	-2.301	5,407	**C**
10	0.309	-0.125	0.434	-1.020	**B**
11	1.071	0.351	0.72	-1,691	**C**
12	1.980	2.043	-0.063	0,148	A
13	0.816	-0,.873	1.68	-3.969	**C**
14	-0.067	-0.267	0.200	-0.470	A
15	-0.76	-1.161	0.396	-0.942	A
16	-0.865	-0.963	0.098	-0.230	A
17	0.342	-0.303	0.646	-1.516	**C**

Est: Estimation, Diff: Difference

According to Table 3 it can be said that 8 of 17 items displayed DIF among latent classes. Items 1, 8 and 10 had DIF at B level. The items 2, 9, 11, 13 and 17 showed C level DIF.

Table 4

Lord's Chi Square DIF Solutions Among Turkey and Singapore

Item	Statistic	p-value	Δ_{χ^2}	DIF Level
1	0.27	0.60	-0.32	A
2	122.96	0.00***	4.19	**C**
3	3.22	0.07	0.55	A
4	2.49	0.11	0.41	A
5	0.92	0.33	-0.49	A
6	6.83	0.00***	0.78	A
7	6.16	0.01**	0.78	A
8	0.01	0.91	-0.18	A
9	0.45	0.50	-0.48	A
10	5.77	0.02*	0.69	A
11	19.90	0.00***	-1.74	**C**
12	6.85	0.00***	1.24	**B**
13	72.92	0.00***	-3.04	**C**
14	4.47	0.03*	-0.86	A
15	0.79	0.37	-0.46	A
16	0.00	0.94	-0.17	A
17	4.79	0.03*	-0.89	A

*Sig. codes: '***' 0.001 '**' 0.01 '*' 0.05*

Table 4 shows the χ^2 statistics, p significance and Δ_{χ^2} values obtained by Lord's χ^2 methods. The results indicated that items 6, 7, 10 and 14 were identified as DIF items at A level. These items can be considered, including DIF at negligible effect size. Only item 12 had B level DIF. The items 2, 11 and 13 were detected as DIF items at C level between Turkey and Singapore.

Table 5

The IRT-LR Solutions between Turkey and Singapore

Item	G^2	df	DIF Level
1	0,5	1	-
2	6,5	1	A
3	0,2	2	-
4	7,4	1	A
5	12,6	1	**B**
6	0,8	1	-
7	2,4	2	-
8	2,1	2	-
9	1,2	1	-
10	9,6	1	**B**
11	7	1	A
12	2,9	2	-
13	1,9	1	-
14	0,1	1	-
15	1,1	2	-
16	3	2	-
17	3,5	2	-

df: Degrees of Freedom

According to Table 5, it was determined using the IRT-LR technique that item 5 and item 10 included DIF. These items showed B level DIF between Turkey and Singapore samples. For items 5 and 10, G^2 test of the hypothesis that b parameters were equal for the reference and focal groups did not exceed 3.84 (the a = 0.05 critical value of the χ^2 distribution for one degree of freedom). To compare DIF detection methods, a summary of information was given in Table 6.

Table 6

Comparing Results of Latent Class and Manifest Groups Approaching

Method	Items with DIF (B and C Level)
MRM	1,2,8,9,10,11,13 and 17
Lord's χ^2	2,11,12 and 13
IRT-LR	5 and 10 (2,4,11)

According to Table 6, items 2,10,11 and 13 were determined including DIF on two different techniques results and DIF level of these items were not negligible. On the other hand, items 2 and 11 could be detected as DIF items with all techniques, where IRT-LR detected these items at a negligible level. Finally, it can be said that MRM could detect more items than manifest group methods. When we analyzed these items from PISA booklet, it was seen that item 2 is related to Earth's temperature, items 10 and 11 were related to Airbags, and item 13 and 12 were related to the subject extinction of the dinosaurs.

Discussion, Conclusion and Recommendations

A test item should be able to measure ability without involving characteristics of examinees who are indifferent subgroups. This is because examinees with equal abilities should have the same probability to answer an item correctly, even though they are in different subgroups. When this condition is not provided, this item is considered as a biased item. To investigate bias, one way is to examine this item in terms of differential item functioning (DIF). With DIF analysis, we can see whether an item differs in functioning among the reference and focal groups. When an item functions differentially, then we can infer with qualitative studies whether this item is biased.

This study aimed to examine DIF in PISA cognitive science items between Turkey and Singapore samples and among latent classes that emerged from these countries. In this study, it was seen that data were fit to two latent class models. This suggests a secondary nuisance dimension that is not measured by the item (Choi et al., 2015). The distribution of emerging latent classes showed that there were many members from Singapore in first class, where the second class consisted mostly of members from Turkey sample. It is a common idea that country can represent the class membership best to define reference and focal groups. However, this approach is not very accurate. For instance, approximately 23% of the examinees in the Singapore sample belonged to LC-2 at the same time. According to this, item-based interpretation for each latent class may give more insight into what constitutes the characteristics of each latent class (Nijlen & Janssen, 2008). Looking at item difficulties, items were at medium level for the members in first latent class, but they were difficult for members in the second class. This finding is consistent with the results of Yalcin (2018). So, we can say that conducting reference and focal groups in terms of the country may not be sufficient to represent equal ability level groups.

When DIF was investigated with MH among these classes, it was seen that three items showed B level and five items showed C level DIF among latent classes. According to manifest DIF results with Lord's χ^2 DIF method, it was observed that one item included B level DIF and three items showed C level DIF between Turkey and Singapore samples. According to another result of this study with the IRT-LR method, two items showed B level DIF between countries. Considering the results of the research, it is possible to state that the latent class approach can detect most DIF items than manifest group methods. Maij-de Meij et al. (2010) examined DIF among latent classes with Lord's χ^2 method. They found that DIF studies conducted with

latent classes were more effective than manifest group methods. In addition, if the correlation between the manifest group and latent class decreases, the effectiveness of the manifest group method decreases. Cohen and Bolt (2005) pointed out that ethnical features were related with latent classes. In addition, Asil (2012) specified that DIF in PISA items generally arises from translation and adaptation applications. Choi et al. (2015) applied 3PL MixIRT to TIMSS 2007 data among seven countries. They found that data fit to the two-class model, where the first latent class consisted of high achievement countries and the second class consisted of low achievement countries. Karadavut (2017) revealed that there appeared only one latent class in the PISA Turkey sample when groups were considered in terms of gender. According to Cohen and Bolt (2005) and Yalcin (2018), the gender variable is weakly correlated with latent class membership. According to the obtained results and literature, especially in cultural comparisons, more items can be detected, including DIF with a latent class approach. . It is also stated that at least two latent classes appeared in DIF studies based on culture. In this study, the appearance of two latent classes pointed the DIF in the items. So, latent class approach can be more effective to give ideas about the source of DIF if we examine the properties of latent classes.

According to the other finding of this study, Lord's χ^2 produced similar results with MRM method in 3 items and IRT-LR methods produced similar results with MRM only in 2 items. However, DIF magnitude obtained from these methods was different. This may occur due to the difference of DIF level intervals belonging to classifications (Arikan Akin, 2015). When three methods were compared, IRT-LR showed lower performance to detect DIF items. Gao (2019) compared Logistic Regression (lR), IRT-LR and Multiple Indicator and Multiple Causes (MIMIC) models performance in terms of detecting DIF with a simulation study and pointed that the LR and IRT-LR procedures were powerful to detect non-uniform DIF. On the other hand, the MIMIC model method was better than the IRT-LR under most conditions to identify DIF items. In the current study, it was aimed to detect uniform DIF, but not nonuniform DIF. This may explain why the IRT-LR procedure showed lower performance than the other methods in this study.

In summary, it can be concluded that DIF determination based on latent classes is a good alternative when compared with manifest DIF detection methods. On the other hand, to detect uniform DIF, it can be suggested using Lord's χ^2 method instead of IRT-LR. Items, which were detected to show DIF should be examined in terms of item bias. In the future, qualitative studies can be conducted to investigate items in terms of bias among Turkey and Singapore. These DIF items were related to subjects such as airbags, earth temperature, and extinction of dinosaurs. It may be appropriate to provide training in these areas in schools. This study had some limitations. First, it examined only uniform DIF. Therefore, future studies can focus on nonuniform DIF among latent classes. What is more, future studies might compare DIF results across many countries. Simulation studies may be effective to compare latent class and manifest group approaches based on IRT.

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Değişen Madde Fonksiyonunun Belirlenmesine Örtük Sınıf Yaklaşımı: PISA 2015 Fen Örneklemi

Atıf:

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Özet

Problem Durumu: Aynı yetenek düzeyinde farklı gruplarda yer alan bireylerin bir test maddesini doğru yanıtlama olasılıkları eşit olmalıdır. Eğer madde, gruplardan birine daha fazla avantaj sağlıyorsa maddenin yanlı olduğu düşünülür. Yanlı maddeler sistematik hata içerir, bu nedenle puanların geçerliğini düşürür. Aynı zamanda puanların gruplar arasında doğru bir şekilde karşılaştırılmasına tehdit oluşturur. PISA ve TIMSS gibi uluslararası sınavlar kültür, dil, sosyoekonomik düzey ya da cinsiyet gibi farklı gruplarda yer alabilen bireylere uygulanmaktadır. Bu demografik özellikler her ne kadar testle ölçülmek istenmese de bireyin performansına etki edebilir. Bu nedenle testler uygulanmadan önce madde yanlılığı açısından incelenmelidir. Yanlılığın ilk işareti maddenin aynı yetenek düzeyindeki iki grupta farklı fonksiyonlaşmasıdır. Değişen madde fonksiyonu (DMF), yanlı olabilecek maddelerin belirlenmesinde istatistiksel bir tekniktir. Bu yöntem cinsiyet ya da ülke gibi gözlenen gruplardan birini referans diğerini odak grup olarak belirlendikten sonra gruplar arasında madde parametrelerinin karşılaştırılmasına dayanır. Ancak gözlenen gruba dayalı yöntemlerde bazı sınırlılıklar bulunmaktadır. Bir gözlenen grubun (örneğin kızlar) içerisinde yer alan tüm bireyler aynı madde bakımından avantajlı ya da

dezavantajlı sayılmaktadır. Oysa madde aynı grup içerisinde yer alan farklı bireyler için avantajlı ya da dezavantajlı olabilir. Bu varsayımın sebebi gözlenen grupların homojen grup olma düşüncesinde yatmaktadır. Aynı zamanda bu gözlenen grup DMF'nin kaynağı olarak yansıtılır. Varsayımın sağlanmasının düşük olmasına yönelik eleştiriler örtük sınıflara göre DMF belirlemenin, DMF kaynağını bulmada daha etkili olduğunu belirtmişlerdir. Yapılan çalışmalar DMF incelemede örtük sınıf yaklaşımının avantaj sunabileceğini, DMF kaynağını herhangi bir değişken setinden bağımsız olarak incelemeye fırsat vereceğini belirtmektedir.

Araştırmanın Amacı: Bu çalışmanın amacı örtük sınıfa ve madde tepki kuramı çerçevesinde yöntemlerden gözlenen grup yaklaşımıyla belirlenen DMF sonuçlarının karşılaştırmaktır.

Araştırmanın Yöntemi: Araştırmada farklı kültürden biraraya gelen bireylerin örtük sınıfları yansıtma oranının yüksek olması nedeniyle PISA 2015 uygulamasına katılan Singapur ve Türkiye örneklemleri kullanılmıştır. Bu çalışmada PISA bilişsel fen maddelerinden yalnızca ikili (1-0) şeklinde puanlananlar dikkate alınmıştır. Çalışmaya maddeleri ortak olarak işaretleyen Türkiye örnekleminden 498, Singapur'dan 614 öğrenci dahil edilmiştir. Örtük sınıfların belirlenmesinde Karma Madde Tepki Kuramı (KTMK) modelinden yararlanılmıştır. Bu analiz Winmira (2001) programında yapılmıştır. Örtük sınıflar arasında DMF karşılaştırmak üzere Mantel-Haenszel tekniği kullanılmıştır. Gözlenen gruplara Dayalı DMF'yi belirlemek üzere Lord'un ki-kare (χ^2) yöntemi ve Madde Tepki Kuramı Olabilirlik Oranı (MTK-OO) yönteminden yararlanılmıştır. Bu analizler ise R programında 'difR' kütüphanesinde gerçekleştirilmiştir.

Araştırmanın Bulguları: KMTK modeline göre elde edilen bilgi kriterleri (AIC, BIC ve CAIC) bir sınıflı, iki ve üç sınıflı modellerde karşılaştırılmıştır. BIC ve CAIC istatistikleri indeksleri iki sınıflı modelde en küçük değeri aldığından iki sınıflı model kabul edilmiştir. Örtük sınıflarda ülkelerin dağılımı incelendiğinde birinci örtük sınıfta Singapur'dan daha çok öğrencinin, ikinci örtük sınıfta ise Türkiye'den daha çok öğrencinin olduğu görülmüşür. Madde güçlükleri incelendiğinde birinci örtük sınıfta yer alan öğrenciler için maddelerin orta güçlükte olduğu, ikinci örtük sınıfta yer alan bireyler için daha zor olduğu görülmüştür. Maddeler örtük sınıflar arasında DMF bakımından karşılaştırıldığında 3 maddenin B düzeyinde, 5 maddenin ise C seviyesinde DMF içerdiği görülmüştür. DMF analizi Türkiye ve Singapur ülkeleri arasında Lord'un χ^2 yöntemiyle yapıldığında 12. maddenin B düzeyinde, 2, 11 ve 13. maddeler olmak üzere üç maddenin C düzeyinde DMF gösterdiği görülmüştür. MTK-OO yöntemi ile yapılan DMF analizi sonucunda 5. ve 10. maddeler B düzeyinde DMF göstermiştir. Gözlenen gruba ve örtük sınıfa dayalı DMF yaklaşımları karşılaştırıldığında 2, 10, 11 ve 13. maddelerinin en az iki yöntemde DMF gösterdiği, DMF madde sayısının örtük sınıf yaklaşımıyla daha fazla olduğu görülmüştür.

Araştırmanın Sonuçları ve Öneriler: Bu araştırmada örtük sınıf ve gözlenen gruba dayalı DMF yaklaşımları DMF'li bulunan madde sayıları bakımından PISA 2015 fen testi üzerinde karşılaştırılmıştır. DMF'li bulunan madde sayısı örtük sınıf yaklaşımında daha fazladır. Maij-de Meij ve diğerleri (2010) Lord'un χ^2 yöntemiyle örtük sınıflar

arasında DMF karşılaştırdıklarında örtük sınıfa göre daha fazla DMF'li madde bulduklarını belirtmişlerdir. Ayrıca, gözlenen grup ve örtük sınıf arasındaki korelasyon düştükçe gözlenen grup yönteminin etkililiğinin azaldığını belirtmişlerdir. Cohen & Bolt (2005) kültürel özelliklerin örtük sınıflarla ilişkili olduğunu belirtmiştir. Asil (2012) ise PISA maddelerinin çeviri ve uyarlama uygulamalarında DMF içereceğini vurgulamıştır. Choi ve diğerleri (2015) maddelerin 7 ülke arasında DMF bakımından karşılaştırdıkları çalışmalarında iki örtük sınıfın ortaya çıktığını, birinci örtük sınıfın yüksek başarı gösteren ülkeler, ikinci örtük sınıfın başarısı düşük ülkelerden oluştuğunu ifade etmişlerdir. Karadavut (2017), Yalcin (2018) ve Cohen & Bolt (2005) cinsiyet değişkeni dikkate alınarak örtük sınıf oluşturduklarında tek bir sınıfın ortaya çıktığını be nedenle cinsiyetin örtük sınıfla düşük düzeyde ilişki gösterdiğini belirtmişledir. Elde edilen sonuçlar ve alanyazın birlikte değerlendirildiğinde özellikle kültürler arası karşılaştırmalarda örtük sınıf yaklaşımına göre DMF'li bulunan madde sayısı daha fazla olabilmektedir. Ayrıca kültüre göre DMF çalışmalarında en az iki örtük sınıfın ortaya çıktığı da belirtilmektedir. Bu çalışmada da iki örtük sınıfın ortaya çıkması maddelerde DMF'ye işaret etmekte ve örtük sınıfların özellikleri ayrıca incelenirse DMF'ye neden olan kaynağın bulunması konusunda da fikir verme bakımından daha etkili olabileceğini göstermektedir. Araştırmada ulaşılan bir diğer sonuç Lord'un χ^2 yönteminin KMTK ile 3 maddede, MTK-OO yönteminin 2 maddede benzer sonuçlar verdiğini göstermiştir. Ancak, DMF etki büyüklüğü farklıdır. Bunun nedeni ise DMF aralıklarını sınıflama yöntemlerinden kaynaklanabilir (Arikan Akin, 2015). MTK-OO yöntemi ise bu çalışmada en az sayıda DMF bulan yöntem olmuştur. Gao (2019)'a göre MTK-OO yöntemi tek biçimli olmayan DMF'yi bulmada etkilidir. Bu çalışmada yalnızca tek biçimli DMF incelendiğinden sonuç bu şekilde çıkmış olabilir. Sonuç olarak örtük sınıf yaklaşımının DMF bulmada alternatif bir yaklaşım olarak ele alınması, DMF kaynağını yalnızca bir alt gruba dayalı olarak değil örtük sınıf içerisinde oluşan alt grupları inceleyerek bulabilmeye olanak sunması bakımından kullanılması önerilmektedir. Gözlenen gruba dayalı yöntemlerden Lord'un χ^2 yöntemi tek biçimli DMF'yi inceleyen çalışmalarda kullanılabilir. DMF gösteren maddeler, madde yanlılığı açısından nitel araştırmalarla incelenebilir. Ülkeler arasında DMF gösteren maddelerin hava yastığı, küresel ısınma ve dinosorların neslinin tükenmesi ile ilgili olduğu görülmüştür. Bu nedenle okullarda benzer konularda eğitim ile destek verilmesi önerilebilir. İleriki araştırmalarda tek biçimli olmayan DMF bakımından örtük sınıf yaklaşımı incelenebilir. Farklı ülkelerde çalışmalar tekrar edilebilir.

Anahtar Sözcükler: Örtük sınıf, karma madde tepki kuramı, değişen madde fonksiyonu, madde yanlılığı.

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The Effect of Critical Reading Skills on the Evaluation Skills of the Creative Reading Process

Yasemin BAKI[1]

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ABSTRACT

Purpose: To raise authentically creative individuals, it is compulsory to employ contemporary reading methods. Although critical reading, which is the main medium for accessing the right knowledge, is defined as a sub-category for creative reading in which high cognitive processes are involved, the connection between these has not been clearly put forward. This study aimed at examining the effect of critical reading skills of 5th grade learners on their evaluation skills of creative reading process, and the role of gender in this effect through structural equation modelling.

Research Methods: The study was supported by relational screening model. The study group was formed by simple random sampling and composed of 265 5th grade learners. The data were collected through the Scale for the Evaluation of Creative Reading Process and the Critical Reading Scale. SPSS 23, AMOS 22.0, and structural equation modeling were utilized for data analysis. Maximum Likelihood method was selected in the estimation of parameters related to models which were formed for examining the effect of critical reading skills on the evaluation of creative reading process and the role of gender. To this end, fit indices (χ^2/df, CFI, GFI, TLI, NFI, IFI, RMSEA, and SRMR) were used.

Findings: The study demonstrated that all hypotheses models were valid; critical reading skills explained the evaluation skills of creative reading process by 57%, and that they had a direct and strong impact on the evaluation skills of the critical reading process. In the female-learner model, critical reading skills affected the evaluation skills by 43%, whereas the male-learner model explained this effect by 67%. In addition, both models bear a direct and strong impact.

Implications for Research and Practice: The results of the study reveal that critical reading skill is a significant predictor for the evaluation of the creative reading process. It can be stated that the evaluation skills of the creative reading process may improve in conjunction with the development of critical reading skills.

[1] Recep Tayyip Erdogan University, TURKEY, e-mail: ysmnbaki@gmail.com, ORCID: 0000 0003 4064 3724

Introduction

In contemporary society, the medium of reading has changed from written and published form to a digital dimension. Moreover, this concept has been replaced by the concept of literacy. The individual, with an infinite number of opportunities of access to knowledge in this century, has also changed his/her perception of reading. This change has transcended the reality perceived through five senses and made it a prerequisite to raise individuals who can read everything as a book. In contemporary societies, the main aim is to raise individuals that can think critically and creatively, invent and discover, have a vision and pioneer for change (Balta & Demirel, 2012). This line of thought can be gained through knowledge, and reading constitutes one of the tools for obtaining knowledge. A creative and basic language skill, reading per se is also a creative process. (Dunn, 1979; Turkel & Unlucomert, 2013).

Reading, which is a life-long skill (Wang, 2006), is actualized through five steps: obtaining knowledge, comprehension, continuity, critical and creative reading (Uzun, 2009). This is also reflected in the evolution of the education system. Whereas the behavioral approach aims at developing open reading skills, the cognitive approach focuses on developing critical reading skills. On the other hand, the constructivist approach addresses interaction with the knowledge and creating new knowledge, and therefore is concentrated on the creative reading process (Yurdakal & Susar Kirmizi, 2017).

Creative reading is a high-level reading skill and the re-construction of a text through interpreting it based on individual experiences and imagination (Sever, 2010). Referred to as weaving of a text or enclosing it with imagination, the re-construction of a text (Yavuz, 2010) goes beyond memorization (Ipsiroglu, 2000) and aims at mobilizing learner creativity by building connections with the text (Catuksoken, 2007). In another parlance, the important thing in this type of reading is to notice the invisible in the text, which awaits to be reshaped (Moorman & Ram, 1994; Padgett, 1997). Therefore, the text is reconstructed in mind through imagination and individuals go beyond the content of the text (Torrance, 1970). Thereafter, comprehension, understanding, questioning and familiarization with content and creativity skills are activated (Kasap & Susar Kirmizi, 2017; Nardelli, 2013). It aims at high-level thinking and comprehension skills (Hizir, 2014).

Creative reading is composed of divergent and convergent reading. Convergent creative reading is concentrated on meeting the individual's and writer's thoughts on common ground. On the other hand, divergent reading, which is the main aim of creative reading, is aimed at producing extraordinary, unique and creative ideas by using the writer's ideas (Smith, 1965). Asking quite surprising and unexpected questions is the most important assistant to this process (Yurdakal, 2018). Divergent questions help the individual think flexibly with a broader perspective without focusing on one truth only (Hizir, 2018) because contemporary information societies pay importance to interact with the text through metacognitive skills and reconstructing the text rather than learning or memorizing content (Yurdakal & Susar Kirmizi, 2017).

It is important to create a comfortable learning-teaching environment in order to keep curiosity alive at all times (Anselmo, 1984; Small & Arnone, 2011). Text selection and reading it aloud constitute some of the important points of this process. The teacher should read the selected literary text as a film artist. In this way, the learners are enabled to benefit from the musicality of the text and enjoy the content (Yurdakal & Susar Kirmizi, 2017 as cited in Mearns, 1958). Besides the joy of listening, the learners should be drawn closer to the text by means of intermittent divergent questions (Aytan, 2016). The teacher should assume the role of an usher in this process by directing questions that enable imagination and extraordinary thoughts during creative reading (Smith, 1974).

Creative reading enables individuals to understand the subject matter and words correctly, comprehend literary meanings, integrate past experiences with ideas, discover covert meanings and connections through symbols, develop new ideas and apply these to new fields (Hizir, 2014 as cited in Witty, 1974). In this context, creative reading acts as an effective method that improves learners' attitudes towards reading (Yurdakal, 2018), decreases reading anxieties, improves comprehension during the reading process, teaches multidimensional thinking, develops imagination, and creates a culture of reading (Yilmaz, 2009).

Focusing on creativity which is a mysterious and an extremely individual phenomenon (John, 2004), creative reading attempts to understand the concepts beyond the content and comprehend the unseen connections between them through imagination reveal the secret and covert beauties of life as a self-creation process, and reach the best (Ramsey, 1930). In this way, the individual is enabled to renew and develop by adapting to the continuous changes in life.

Critical Reading

Referred to as reading through thinking, critical reading (Gelen, 2003) is reconsidering a text with an impartial perspective and instinct (Devine, 1986), questioning, analyzing, evaluating and interpreting a text in depth and detail (Sahin, 2011; Ozdemir, 2007). While questioning the text with an impartial perspective, the individual is enabled to find his/her own truths among the available correct information (Wheeler, 2007; Yildiz, 2008). Foremost, the texts have to be examined and clarified and assessed by analyzing the written symbols and deep meanings in the text without reference to its content (Criscuolo, 1975). In other words, critical reading aims at discovering and evaluating what is beyond the text by means of objective and in-depth thinking (Unal, 2006) in order to find not only the embedded meanings but also meanings hidden in between the lines (Cervetti, Pardeles & Damico, 2001; Maker & Lenier, 1996). In critical reading, readers are expected to study the sources, identify author's purpose, evaluate these, distinguish the truths, and form their own judgments (Adali, 2010; Unalan, 2006).

Critical reading, which is the discovery of information and thoughts in a text, is an active and participatory process (Kurland, 2000). This process focuses on high-level comprehension of the text through the individual's interpretation and evaluation skills and drawing logical conclusions by approaching the truths as much as possible

(Comber & Nixon, 2011; Pirozzi, 2003). Because a text is not only a construct composed of sentences but also a metalinguistic association, the individual decides to evaluate the content of texts at his/her own free will by using this process (Unal, 2006).

Since the author may have flaws in his knowledge and the same individuals may have different perspectives on the same subject, this line of thinking aims at evaluating the various dimensions in that field (Rautman, 2014). Thanks to the perspective gained through critical reading, the individual does not make absolute judgments and realizes that the truth is multidimensional, that it is a situation- and place-dependent, and that there might be alternative explanations in every phenomenon and situation. In another parlance, after going beyond the symbolic dimension of reading, s/he is mentally liberated from the control of the text and the writer and travels into meaning (Asilioglu, 2008). Therefore, it is necessary to actively use high-level mind activities in the comprehension, evaluation and interpretation processes of reading (Criscuolo, 1975). In addition, the real message of a literary text is indirectly provided with the reader (Adali, 2010) as one of the main qualities of this text is polysemy. Besides the overt meaning of a text, there is also a deep semantic structure constructed through metalinguistic co-occurrences. This structure is comprised of layers in itself. For this reason, literary texts can be re-interpreted and draw on new meanings on different levels (Aktas, 2009). What is expected of the reader is to understand and discover the unsaid based on what is said in the text (Yurtseven Uze, 2010).

It is an indispensable prerequisite to acquire critical reading skills to access accurate information and use this effectively in the right place in this era of limitless information flow (Cheu-jey, 2016; Kuta, 2008) because it is necessary to have not only good reading but also critical reading skills in order to perceive the changes brought by life and adapt to them (McDonalds & Trautman, 2006). Furthermore, critical reading skills- through the broad lens it provides-function as spectacles that can enable equal participation in life despite the economic, social and cultural diversity (Comber, Nixon, Ashmore, Loo & Cook, 2006). Therefore, critical reading skills assume significant functions in today's education system. Within this vein, studies confirm that activities based on critical reading skills provide better success rates in reading comprehension, reading attitude, and the development of critical thinking skills when compared to other in-class activities (Bayraktar, 2012; Isik, 2010; Karabay, 2012; Ozensoy, 2011; Unal, 2006).

Conceptual Relation Between Variables

In the literature on reading, reading is classified into three categories, such as creative, open, and critical reading (Edwin, 1965; Morris, 1972). According to Smith (1965), reading is divided into three categories, which are receptive, critical and creative reading. It is essential to reveal the position and views in the text, whereas critical reading requires a critical analysis of these views and thoughts. Having passed these two levels successfully, the learner arrives at the creative reading level (Yurdakal, 2018). This structure demonstrates that critical reading is the dimension prior to creative reading. However, some researchers categorize creative reading within critical and receptive reading (Adams, 1968; Gainsburg 1961). It is a reading

type which is generally combined with critical reading (Edwin, 1965) but encapsulates skills higher than critical reading (Adams, 1968; Walter, 1974). In other words, critical reading is one of the steps of creative reading and the techniques used in critical reading are compatible with each other (Yurdakal, 2018). Reading comprehension, critical analysis of text content and affective commitment components demonstrate the perspective of critical reading (Morris, 1972; Nardelli & Nardelli, 1955). Moreover, the fundamental concepts of this reading type- respect, empathy, authenticity and divergent thinking- are reflections of the authenticity of critical thinking. Nevertheless, critical thinking is imbued with reasoning, whereas imagination and free association are in the forefront in creative reading. Namely, creative reading uncovers not only the ideas in the text but also the readers' ideas through the inclusion of imagination in the process (Yurdakal, 2018).

Based on the definitions and classifications in the literature, it can be stated that critical thinking is a reading type that constitutes an important step of creative reading and is itself nested in creative reading. In the creative reading process, text and life are combined. In addition, there is also a complex interaction in which original thinking ways and cognitive processes are also combined. The different techniques used in this process attract learners' attention, increase their curiosity and enable learners to use their imagination more. Besides activating imagination, creative thinking skills also contribute to the development of creative thinking skills. This skill is one of the basic skills to be included in the Turkish Language Teaching Syllabus (2017), along with 21st-century skills (Yurdakal, 2018). There is a positive two-way relation between reading and creativity. Individuals with high creativity skills are more successful in the reading process, and individuals with developed reading skills are more creative (Harris & Sipay, 1990; Ritche et al., 2013). The reading material is shaped and interpreted through the creative imagination in creative reading (Ramsey, 1930). In this way, imagination is activated and learners develop their creativity and imagination through techniques that can take them beyond the text (Wang, 2006). Using their imagination and generating extraordinary ideas increase learner motivation and improve learner attitudes towards reading lessons (Morris, 1972). Freedom and extraordinariness constitute some of the basic features of creative reading which contribute to learning enjoyably, developing learners' comprehension and learning skills since reading is actualized in a flexible environment (Wang, 2006).

Despite the positive sides of creative reading, there is a limited number of studies focusing on creative reading in Turkey. The existing studies examine the effects of creative reading activities on developing creative reading skills (Aytan, 2014a; Turkel & Unlucomert, 2013; Uzun, Bozkurt & Erdogan, 2011; Yurdakal, 2018), reading comprehension (Kasap, 2019) and creative writing skills (Kasap, 2019; Susar Kirmizi & Kasap, 2017), creativity (Hizir, 2014), attitudes towards reading (Yilmaz, 2009). Furthermore, there also exist various studies on the measuring tools (Kasap & Susar Kirmizi, 2017; Yurdakal & Susar Kirmizi, 2017) for creative reading and the theoretical dimension of creative reading (Aytan, 2014b; Aytan, 2014a; Catuksoken, 2007; Ipsiroglu, 2000; Uzun, 2009). Foreign researchers conducted various theoretical studies on the effectiveness of creative reading activities (Andresen & Pawlak, 1976; Barrett,

2001; Dollins, 2016; Dunn, 1979; El-Hayek, 2016; Ericsson, 2013; Moorman & Ram, 1994; Moorman & Ram, 1996; Nardelli & Nardelli, 1955; Ritchie et al., 2013; Tuzlukova, Eltayeb & Gilhooly, 2013; Wang, 2006).

In textbooks, creative reading is not allocated sufficient space and theoretically handled (Edwin, 1965). Therefore, learners do not engage in creative reading activities sufficiently (Martin & Cramond, 1983). However, it is necessary to include creative reading in school syllabi to develop learners' reading skills more effectively (Adams, 1968). Creative reading- a method that can be applied to any age group (Moorman & Ram, 1994)- should be allocated necessary space in textbooks (Dawson, 2005) and included in teaching programs and syllabi (Adams, 1968; Martin & Cramond, 1983; Wang, 2006). It can be stated that creative reading as a concept is allocated space within themes and topic examples as of 2017. Within this scope, it can be stated that studies to be conducted on creative reading may make positive contributions to the existing literature. In addition, there exists no study examining the relationship between critical and creative reading, which are two of the stages of creative reading. All the same, creative reading is one of the most neglected reading styles in which high cognitive processes are activated (Dunn, 1979; Gainsburg 1961; Smith, 1974). It is considered that studying the relationship between creative and critical reading can make positive contributions to the existing literature in order to enable more effective use of this reading style. Due to a limited number of evaluation tools for creative reading (Kasap & Susar Kirmizi, 2017; Yurdakal & Susar Kirmizi, 2017) this study was conducted solely on 5th graders. It is thought that this study will have positive contributions to the development of basic, critical and creative reading skills. Based on the literature review, a model was created to examine the effect of critical reading skills on the evaluation of creative reading process. Figure 1 shows the abovementioned model.

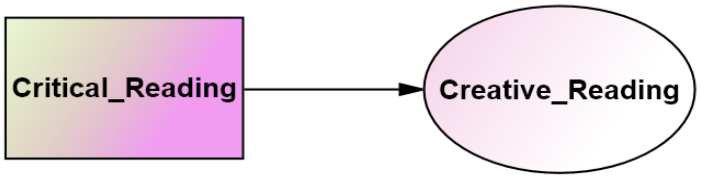

Figure 1. *Research Model*

Within the frame of the abovementioned research model, this study aims at identifying the effect of 5th graders' critical reading skills on the evaluation of creative reading process, and the role of gender on this. The following are the hypotheses to be tested.

H_1: 5th graders' critical reading skills predict their evaluation skills of the creative reading process significantly.

H_2: Critical reading skills of male learners predict their evaluation skills of the creative reading process significantly.

H_3: Critical reading skills of female learners predict their evaluation skills of the creative reading process significantly.

Method

Research Design

This study aimed at identifying the effect of 5th graders' critical reading skills on the evaluation of creative reading process, and the role of gender in this. It utilized relational screening model. In this model, the aim is to identify the relations between two or more variables as well as the existence and/or degree of change (Karasar, 2011).

Study Group

The study group was formed by means of a simple random sampling method. The participants were comprised of 265 learners who were enrolled as 5th graders in three different primary schools in the province of Rize. 127 (47,9%) of participants were male, whereas 138 (52,1%) were female.

Data collection

After the required permissions were taken for data collection, the study was conducted with 5th-grade learners in three different primary schools. In order not to have any problems, the learners were provided with the necessary information before the study, and it took 45 minutes to apply the scales in each and every class.

Data Collection Tools

The data was collected by means of the Critical Reading Scale and Evaluation of the Creative Reading Process. The results regarding the validity and reliability of these scales are as follows:

Critical Reading Scale

The Critical Reading Scale, which was developed by Unal (2006), is used for identifying levels of critical reading skills. This measurement tool was prepared in 5-point Likert style as ''always (5)'', ''generally (4)'', ''sometimes (3)'', ''rarely (2)'' and ''never (1)''. An exploratory factor analysis was conducted in relation to the scale. The scale is comprised of one dimension and 22 items, and the Cronbach Alpha reliability coefficient was estimated at .88 for the whole scale. The reliability and validity analysis of the Critical Reading Scale can be found below.

Reliability Analysis

In order to determine the reliability of the Critical Reading Scale, the Cronbach Alpha internal consistency coefficient was estimated. As a result of this analysis, the internal reliability coefficient for the abovementioned scale was estimated at .81

Confirmatory Factor Analysis: The confirmatory factor analysis was conducted to identify whether the factor structures in the original Critical Reading Scale were confirmed or not. Figure 2 (Path Diagram) shows the results of confirmatory factor analysis (CFA).

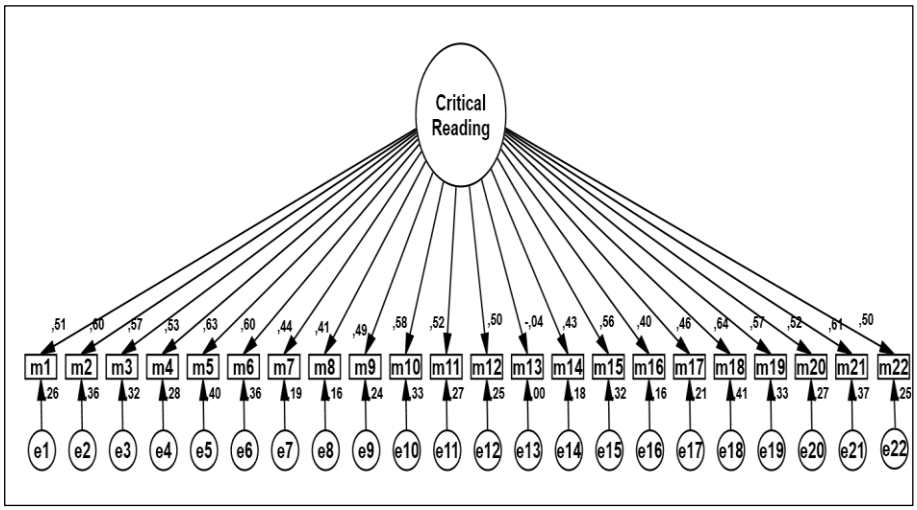

Figure 2. *Path Diagram on Critical Reading Scale*

The confirmatory factor analysis conducted on the Critical Reading Scale showed that the scale is made up of a four-factor structure, which was also confirmed for this study, and the goodness of fit was estimated at χ^2/sd=1.57 (p<.01), *GFI*=.90, *CFI*=.91, *IFI*=.91, *TLI*=.90; *RMSEA*=.04, *SRMR*=.05.

According to the results of the confirmatory factor analysis (CFA) of scale validity, it can be stated that goodness of fit indices are on an acceptable level for the model which was created with the four-factor structure of the scale (Hu & Bentler, 1999; Joreskog & Sorbom, 1993; Kline, 2011; Sumer, 2000). These analyses demonstrated that the factor structures in the original form of the scale were also confirmed for this study and the scale had a sufficient level of validity.

Scale for the Evaluation of Creative Reading Process

The Scale for Evaluation of the Creative Reading Process was prepared for participants' self-evaluation in the creative reading process. The scale was prepared in 5-point Likert style as ''always (5)'', ''generally (4)'', ''sometimes (3)'', ''rarely (2)'' and ''never (1)''. The confirmatory factor analysis (CFA) of the scale shows that it is comprised of three dimensions and 28 items. The first dimension of the scale is '' divergent thinking'' whilst ''communication with the author and characters'' constitute the second dimension. The third dimension, on the other hand, is named ''reconstruction of the text''. Factor load values of the items in the first dimension varied between .95 and .53; the factor load values of the second dimension was .89 and .70; factor load values of the third dimension varied between .76 and .43. Cronbach Alpha reliability coefficient was estimated at .86.

The scale for the Evaluation of Creative Reading Process was assessed in terms of validity and reliability, and the relevant analyses can be found below.

Reliability Analysis

Cronbach Alpha coefficient for internal consistency was estimated to identify the reliability of the Scale for Evaluation of the Creative Reading Process. As a result of this analysis, Cronbach Alpha coefficient for internal consistency was estimated at .81 for ''divergent thinking'' dimension; .86 for ''communication with the author and characters'', .81 ''reconstruction of the text'', and .88 for the whole scale.

Confirmatory Factor Analysis

Figure 2 shows the path diagram which demonstrates the results of CFA conducted in order to identify whether the original factor structures were confirmed within the frame of the study or not.

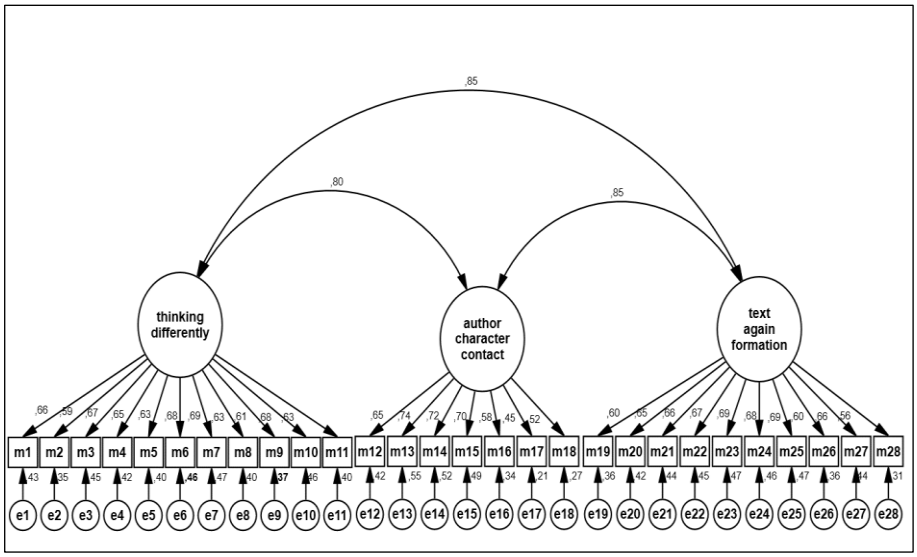

Figure 3. *Path Diagram-The Scale for Evaluation of Creative Reading Process*

The results of confirmatory Factor Analysis (CFA) demonstrated that the abovementioned scale is comprised of a four-factor structure and that it was also confirmed for this study. The goodness of fit indices were estimated at χ^2/sd=1.85 (p<.01), *GFI*=.85, *CFI*=.90, *IFI*=.90, *TLI*=.90; *RMSEA*=.05, *SRMR*=.05. According to the results of the confirmatory factor analysis (CFA) of scale validity, it can be stated that goodness of fit indices are on an acceptable level for the model which was created with the four-factor structure of the scale (Hu &Bentler, 1999; Joreskog & Sorbom, 1993; Kline, 2011; Sumer, 2000). These analyses demonstrated that the factor structures in the original form of the scale were also confirmed for this study and the scale had a sufficient level of validity.

Data Analysis

For data analysis, SPSS 23 and AMOS 22.0 were utilized. Frequency, percentage, mean values, kurtosis and skewness values were estimated for descriptive statistics

and demographic variables. A Structural equation modeling (SEM), an increasingly significant model in social sciences, was used for the estimation of descriptive statistics regarding the variables and assessment of the links between variables. Prior to SEM analysis, a two-stage method was utilized for determining whether the data support the model (Joreskog & Sorbom, 1993; Meydan & Sesen, 2011). Primarily, the scales were pre-examined, and inadequate and unreliably completed scales were identified. Thereafter, the scales were numerically classified. To determine the validity and the reliability, scale-DFAs were applied to the factor structures of scales in the first stage. DFA results of each scale were provided in the sections in which scale-related information is given. It was also put forward that the scales conformed to the resulting data and that the original factor structures were also confirmed for this study.

In the second stage, significant relations between the model structures were assessed. Prior to the start of the SEM analysis, hypotheses regarding the analysis were controlled. The sample size required for this analysis, multivariate normality and multi-colinearity hypotheses were tested. It is sufficient to have 100-150 sample size recommended for the SEM (Kline, 2011).

Skewness and kurtosis values for each variable were estimated for univariate normality, which is a prerequisite to meet the hypothesis of multivariate normality (Kline, 2011). The coefficient of Mardia's normalized multivariate kurtosis was estimated for the examination of the multivariate normality hypothesis (Raykov & Marcoulides, 2008). The complete conformity of the model to the dataset was examined subsequent to the confirmation of the hypotheses about the dataset. Maximum Likelihood was selected for the analysis of parameter estimation in SEM. *χ^2/df, CFI, GFI, TLI, NFI, IFI, RMSEA* and *SRMR* fit indexes were used for assessing the conformity of the model following the analyses. Figure 1 shows the interpretation and conformity of fit indexes to the model (Hu & Bentler, 1999; Klem, 2000; Kline, 2011).

Table 1

Fit Indices of Structural Equation Models

Fit Indices	*Perfect fit*	*Acceptable Fit*
χ^2/sd	$0 \leq \chi^2/sd0 \leq 2$	$2<\chi^2/sd \leq 5$
RMSEA	0 ≤ RMSEA ≤ .05	.05 < RMSEA ≤ .08
SRMR	0 ≤ SRMR≤ .05	.05 ≤ SRMR≤.10
IFI	0.95 ≤ IFI< 1.00	0.90≤ <IFI<0.95
TLI	0.95≤ TLI< 1.00	0.90 ≤ TLI<0.95
CFI	0.95≤CFI<1.00	0.90≤CFI<0.95
GFI	0.95≤ GFI< 1.00	0.90 ≤ GFI<0.95
NFI	0.95≤ NFI< 1.00	0.90≤NFI<0.95

Results

The findings of the study were presented in two sections. The first section laid out descriptive statistics, whereas the second section dealt with variables included in the structural equation modeling and estimations regarding the relations between these variables, exploratory rates and model compliance of the variables.

Descriptive Statistics Related to Model Variables

Table 2 shows the descriptive statistics related to the variables (DT, CW, RT, SCR) in the research model.

Table 2

Descriptive Statistics Related to Measurement Items

		DT	*CW*	*RT*	*SCR*
All group	M	42.56	25.08	38.16	80.65
	SS	8.99	6.62	8.58	14.96
	SK	-.57	-.45	-.58	-.71
	K	-.20	-.42	-.12	.54
Male	M	41.24	24.34	36.92	77.97
	SS	9.43	7.24	8.99	16.68
	SK	-.63	-.46	-.62	-.51
	K	.01	-.55	.13	.20
Female	M	43.78	25.76	39.90	83.11
	SS	8.41	5.94	8.05	12.74
	SK	-.41	-.28	-.46	-.73
	K	-.88	-.67	-.78	.45

Scale for the Evaluation of Creative Reading Process (DT: Divergent Thinking, CW: Communication with Writer and Characters, RT: Reconstruction of Text, SCR: Scale for Critical Reading

According to Table 2, the arithmetic means of all variables in the research model (DT, CW, RT, SCR) were between 25.76 and 83.11 which are above the median level of relevant score interval. This demonstrated that participant averages of measured qualities was positive. The standard deviation values demonstrated that they were close to average numbers. For the hypothesis of univariate normality of data, it is required that the skewness and kurtosis values of the variables should not be greater than |3.0| and |10.0|, respectively (Kline, 2011). In the light of this information, it was observed that the skewness values of these variables changed between -.28 and -.71 whereas the kurtosis values showed a change between -.01 and .88. These findings showed that univariate normality of the data was proven. To determine whether the hypothesis of multivariate normality is proven, coefficient of Mardia's normalized multivariate kurtosis was estimated and this value was estimated at 4.31, 5.13, 2.82 respectively for all groups (the whole sample, male, female). To prove the hypothesis related to this distribution, the critical value for multivariate normality was estimated to be 15 according to the equation ($p(p+2)$ (p: *number of observed variables*) proposed by Raykov and Marcoulides (2008). According to Raykov and Marcoulides (2008), it is necessary that the value obtained from the equation for the multivariate normality

should be greater than the coefficient of kurtosis. It was seen that the hypothesis of multivariate normality was proven as the value obtained from the equation (15) was greater than the coefficients of kurtosis (4.31, 5.13, 2.82).

Findings Related to Measurement Model

Figure 2 shows the results (a, b, c) of the test on the models (whole-sample, male, female) related to the impact of 5th-grade learners' critical reading skills on their attitude towards the evaluation of the creative reading process.

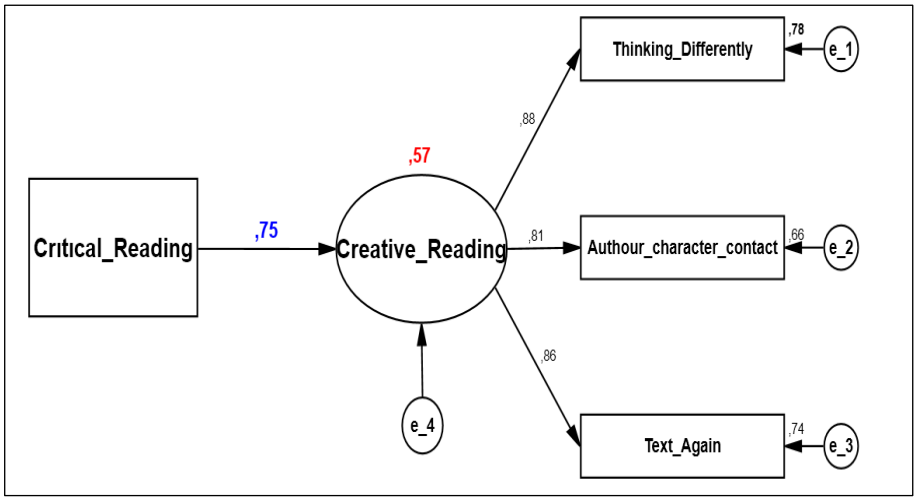

Figure 4a. *Whole Sample*

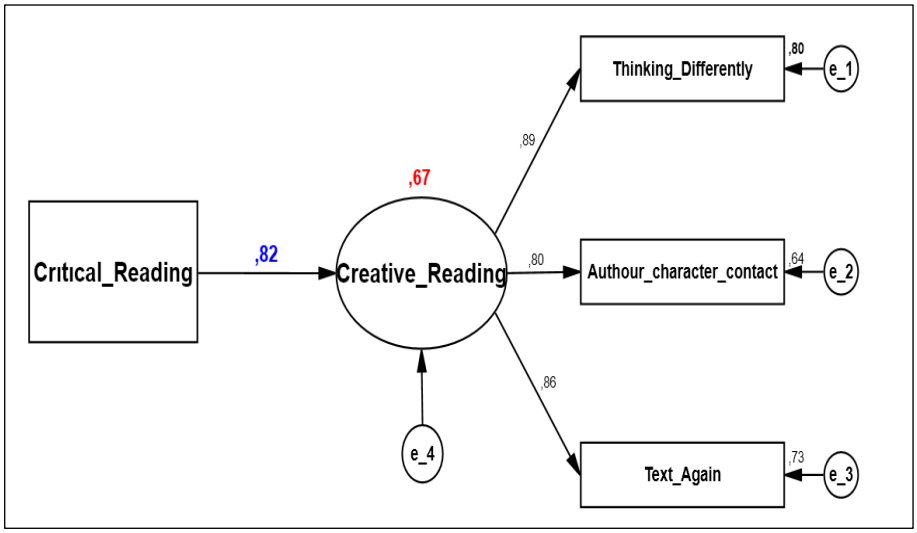

Figure 4b. *Male Students*

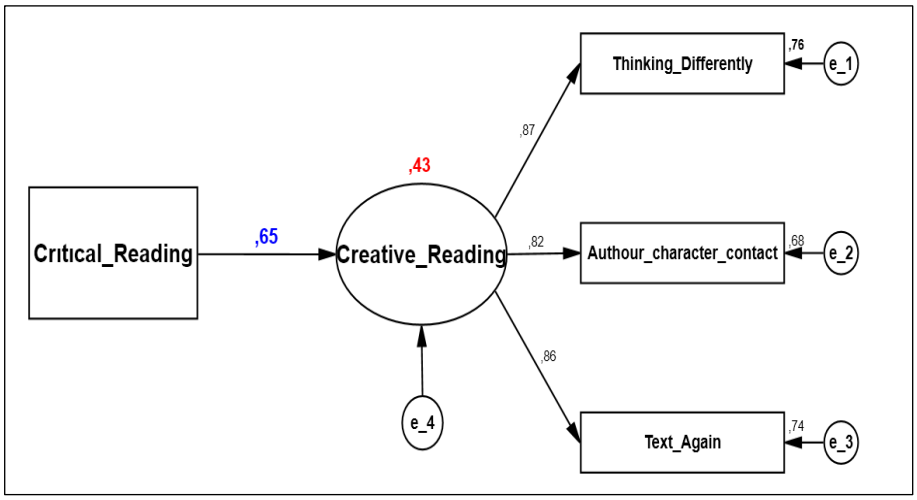

Figure 4c. *Female Student*

According to the results of the whole- sample model (χ^2/df=5.07; *GFI*=.98; *CFI*=.99; *AGFI*=90; *IFI*=99, *RMSEA*=.12; *SRMR*=.02), male-learner model (χ^2/df=3.17; *GFI*=.97; *CFI*=.99; *AGFI*=87; *IFI*=99, *RMSEA*=.13; *SRMR*=.02) and female learner model (χ^2/df=2.07; *GFI*=.98; *CFI*=.99; *AGFI*= 92; *IFI*= 99; *RMSEA*=.40; *SRMR*=.02) it can be said that the goodness of fit indexes were on an acceptable levels in the all-sample variable model. As a result of the structural model test, it was observed that the factor loads related to the latent variable of creative reading varied between .81 and .88 in the all-sample model, .80 and .89 in male-learner model, and .82 and .87 in female-learner model. Table 3 shows the results from the structural equation models.

Table 3

Standardized Regression Weight Results of the Effect of Creative Reading Skills on the Evaluation of Creative Reading Process

		Path			Road Coefficient (β)	Standardize Forecast (Estimate)	Standard Error (S.E)	Critical Ratio (C.R)	Significance Value (p)
All Group		Critical Reading	→	Evaluating Creative Reading	.75	.40	.02	14.96	.000***
Gender	Male	Critical Reading	→	Evaluating Creative Reading	.82	.41	.03	12.20	.000***
	Female	Critical Reading	→	Evaluating Creative Reading	.65	.37	.04	8.52	.000***

According to Table 3, three hypotheses tested in the frame of the models were all statistically supported by the data and all hypotheses were supported. In the whole-sample model, it was observed that critical reading skills positively and significantly predicted the skills for evaluating creative reading (β=.75, p<.01) and hypothesis H_1 was supported. In the male-learner model, it was seen that critical reading skills positively and significantly predicted the skills for evaluating creative reading (β=.82, p<.01) and hypothesis H_2 was supported. In the female-learner model, critical reading skills positively and significantly predicted the skills for evaluating creative reading (β=.65, p<.01) and hypothesis H_3 was supported.

Table 4

Standardized Direct, Indirect, and Total Impact Sizes

		Estimated	R^2	*Estimator*	*Standardized Estimates*		
					Direct	Indirect	Total
All group		Evaluating Creative Reading	.57	Critical Reading	.75	…	.75
Gender	Male	Evaluating Creative Reading	.67	Critical Reading	.81	…	.81
	Female	Evaluating Creative Reading	.43	Critical Reading	.65	…	.65

In Table 4, it was seen that critical reading skills had a direct and total high-level impact (.75) on the skills for evaluation of creative reading in the whole-sample model, and explained 57% of the variance of the evaluation of the creative reading process. It was seen in the male-learner model that critical reading skills had a direct and high-level total impact (.81) on the evaluation of the creative reading process, and that it explained 67% of the variance of the evaluation of the creative reading process. It was observed in the female-learner model that critical reading bear a direct and high-level total impact (.65) on the evaluation of the creative reading process and that it explained 43% of the variance of evaluation of the creative reading process.

Discussion, Conclusion and Recommendations

The hypotheses in this study were analyzed through structural equation modeling. Model hypotheses were generated based on the relevant literature and tested. It has been concluded that all models are valid. All three hypotheses were supported. In the whole-sample model, creative reading skills explained 57% of the variance of the evaluation of the creative reading process; 43% of the same variance in the female-learner model, whereas it explained 67% of the abovementioned variance in the male-learner model. According to these findings, critical reading skills is a significant predictor for the evaluation skills of the creative reading process, and there is a strong and positive correlation between critical reading skills and evaluation skills of the creative reading process. Upon examining the exploratory rates related to the models, the highest exploratory rate is observed in the male-learner model. Whole sample and female-learner models follow this model, respectively. Departing from these findings,

it can be said creative and critical reading are correlated. This overlaps with the results of myriad studies that point out that there is a correlation between critical and creative reading (Adams, 1968; Edwin, 1965; Morris, 1972; Smith, 1965). Moreover, research demonstrates that critical and creative reading are intertwined concepts, and it can be stated that critical and creative reading activities should be implemented in conjunction with each other in order to develop reading skills.

Considering the impact level of the results, critical reading skills have a positive and high impact on the evaluation of the creative reading process in the whole sample model. In gender-based models, these skills have a positive and high impact in both models. However, in the male-learner model, this impact is higher compared to the female-learner model. Based on these findings, it is observed that an improvement in 5th grade-learners' critical reading skills enhances the evaluation skills of the creative reading process. Moreover, this impact creates a higher-level interaction in male learners. In the literature, there are no studies on the effect of critical reading on creative reading skills and the role of gender in this effect. In addition, there exist some studies which are more theoretical and investigate the relations between other variables (Aytan, 2014a; Barrett, 2001; Catuksoken, 2007; Dollins, 2016; Hizir, 2014; Kasap, 2019; Ritchie et al., 2013; Small & Arnone, 2011; Tuzlukova, Eltayeb & Gilhooly, 2013; Turkel & Unlucomert, 2013; Uzun, Bozkurt & Erdogan, 2011; Yurdakal, 2018). Nevertheless, no studies on the role of gender were encountered. In a study by Sadioglu and Bilgin (2008) on 5th-grade learners, levels of critical reading in female learners demonstrate significant differences compared to male learners' critical reading skills. In terms of critical reading and affective variables related to critical reading, there exist various studies which find significant differences in support of female learners (Akyol, 2011; Guven & Cam Aktas, 2013; Ozmutlu, Gurler, Kaymak & Demir, 2014; Sadioglu & Bilgin, 2008; Yalınkilic & Celik, 2011). Nonetheless, a study by Ozdemir (2017) concludes that there are no significant differences in self-evaluation of critical reading based on gender, and some other studies also support this result (Altunsoz, 2016; Emiroglu, 2014; Gunduz, 2015; Yayli & Ulper, 2011). Reading more is regarded as one of the important factors which may explain better critical reading skills in female learners (Sadioglu & Bilgin, 2008). Critical reading takes place if an individual has sufficient vocabulary to comprehend a text and intellectual competence to evaluate the text (Guleryuz, 2004). This is also supported by studies that suggest that comprehension skills in female learners are more developed than in male learners (Orhan, 2007). However, this study does not overlap with various studies in the literature considering the fact that critical reading skills in male learners have a higher exploratory rate and impact on the evaluation skills of the creative reading process. In this case, the effect of critical reading skills on creative reading can be investigated in various studies. In this way, these gender-based differences can be minimized and these skills can be employed most competently.

Another finding is that critical reading skills have a direct positive impact on the creative reading process in all models. It can be stated that improved critical reading skills may enhance the evaluation skills of the critical reading process in both the whole sample and gender-based models.

It can be asserted that these two reading styles (Yurdakal, 2018) are parallel to each other in terms of the techniques used in research, and that creative reading includes higher-level skills than critical reading (Walter, 1974). Within this context, it can be predicted that improved critical reading skills will enhance both creative reading (a high-level reading type) and basic reading skills. Research shows that improved critical reading skills contribute to the development of reading comprehension and attitude (Karabay, 2012; Unal, 2006) as well as critical reading skills (Isik, 2010; Ozensoy, 2011; Senturk, 2009), and that lessons become more functional with critical reading activities (Bayraktar, 2012; Karabay, 2012; Ozensoy, 2011). Furthermore, there is a positive correlation between critical reading skills and academic success in Turkish classes (Cam, 2006). In a similar vein, the development of creative reading skills bears an impact on reading skills. In their study on primary school learners, Martin and Cramond (1983) assert that creative reading practices make positive contributions to student likes for reading. Creative reading activities (Uzun, Bozkurt & Erdogan, 2011; Witty, 1974 cited in Hizir, 2014; Yurdakal, 2018) develop learning and comprehension skills (Wang, 2006), and function as an effective method for creating a reading culture and attitude as well as developing creative thinking skills (Ramsey, 1930; Wang, 2006). Learners with developed reading skills broaden their horizons (Harris & Sipay, 1990; Ritche et al., 2013), contribute to their learning through fun (Wang, 2006) and therefore have enhanced attitudes and motivation for lessons (Morris, 1972). Based on these conclusions, it can be asserted that critical and creative reading makes important contributions to the development of reading skills. Although there are references to the concept of creative reading in the Turkish Teaching Program (2018), the concept of critical reading is not included in the same program. Assorted studies assert that it is important to include critical reading in the syllabus (Wolf, King & Huck, 1968; Rogers et al., 1985). Therefore, creative and critical reading should be handled as a separate subject in Turkish lessons, and samples for both reading types should be included in the coursebooks, and the level should be progressively adjusted according to class level. In this way, competence (Turkish Teaching Program 2018) in creative and linguistic interaction in the mother tongue will be improved.

Considering the findings of the study as a whole, it can be asserted that critical reading and evaluation skills of creative reading are interrelated variables and that the development of critical reading skills is required for the development of creative reading skills. For this reason, an increase in the number of critical reading activities included in the syllabus and Turkish lessons may contribute to the development of creative reading skills. Based on the exploratory rates of 57% in the whole model, 43% in the female-learner model, and 67% in the male-learner model, it may also be stated that critical reading still needs explanation in some aspects in all models. This limitation may be overcome through the inclusion of other variables in the existing models and the unexplained parts can be investigated. In addition, due to the limitations in measurement tools, the validity of the model applied to 5th-grade learners can also be tested with broader studies, which include secondary school level as well as studies on different sample levels. Besides experimental studies on variables that affect creative and critical reading skills, qualitative studies, which increase the effectiveness of practices and analyze the faulting aspects of the process, may also be

administered. As a result, it is considered that the use of critical and creative reading activities in lessons may contribute to better success rates. In this way, the upcoming generations will become more successful by means of better critical and creative reading skills as well as higher-level linguistic development.

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Eleştirel Okuma Becerilerinin Yaratıcı Okuma Sürecini Değerlendirme Becerileri Üzerindeki Etkisi

Atıf:

Baki, Y. (2020). The effect of critical reading skills on the evaluation skills of the creative reading process. *Eurasian Journal of Educational Research 88,* 199-224. DOI: 10.14689/ejer.2020.88.9

Özet

Problem Durumu: Günümüz teknolojilerinin sunduğu sınırsız bilgi akışının yaşandığı çağımızda doğru bilgiye erişmek ve bunu etkin şekilde kullanabilmek için eleştirel okuma becerilerinin kazanılması vazgeçilmez bir zorunluluktur (Cheu-jey, 2016; Kuta, 2008). Alan yazındaki tanımlardan ve sınıflamalardan hareketle eleştirel okumanın, yaratıcı okumanın önemli bir basamağı olup yaratıcı okumayla iç içe olan bir okuma türü olduğu söylenebilir. Yaratıcı okuma sürecinde metinle yaşamın birleştirilmesinin yanı sıra orijinal düşünüş şekillerinin zihinsel düşünme süreçleriyle birleştirildiği karmaşık bir etkileşim söz konusudur. Bu süreçte kullanılan farklı teknikler öğrencilerin ilgilerini çekmekte, meraklarını arttırmakta ve hayal güçlerini daha çok kullanmalarına olanak tanımaktadır. Hayal gücünün aktive edilmesini sağlayan yaratıcı okuma süreci, yaratıcı düşünme becerisinin gelişimine de katkı sağlamaktadır. Bu beceri Türkçe Öğretimi Programı'nda öğrencilere kazandırılması amaçlanan temel

becerilerden biri olmasının yanı sıra 21. yüzyıl yeterlilikleri içerisinde de en görkemli yerlerden birine sahiptir (Yurdakal, 2018).

Yaratıcılığın bütün ihtişamıyla sergilendiği bu yüzyılda oldukça ön plana çıkmasının yanı sıra yaratıcılık ve okuma arasında pozitif ve çift yönlü bir ilişki de mevcuttur. Yaratıcılığı yüksek bireyler okuma sürecinde de daha başarılı olmakla birlikte okuma becerisi gelişmiş bireyler de daha yaratıcıdır (Harris & Sipay, 1990; Ritche vd., 2013). Yaratıcı okuma sürecinde okuma materyaline yaratıcı hayal gücü aracılığıyla şekil verilmekte ve anlamlandırılmaktadır (Ramsey, 1930). Böylelikle düş gücü harekete geçirilerek öğrencilerin metnin ötesine geçmesini sağlanmakta ayrıca bu tekniklerle yaratıcılıkları ve hayal güçleri de gelişmektedir (Wang, 2006). Öğrencilerin yaratıcı okuma sürecinde hayal güçlerini kullanmaları, sıra dışı fikirler üretmeleri derse yönelik tutum ve motivasyonlarını da arttırmaktadır (Morris, 1972). Yaratıcı okumanın temel özelliklerinden olan özgürlük ve sıra dışılıkla okuma eylemi, esnek bir süreçte gerçekleştirildiği için öğrencilerin eğlenerek öğrenmelerine katkı sağlamakta böylelikle öğrenme ve anlama becerileri de gelişmektedir (Wang, 2006).

Yaratıcı okumanın sahip olduğu bu üstünlüklere rağmen Türkiye'de yaratıcı okumayla ilgili çalışma sayısı oldukça sınırlıdır. Bu araştırmalarda yaratıcı okuma uygulamalarının, yaratıcı okuma becerilerini (Aytan, 2014a; Turkel & Ünlücömert, 2013; Uzun, Bozkurt & Erdoğan, 2011; Yurdakal, 2018), okuduğunu anlamayı (Kasap, 2019) ve yaratıcı yazma becerilerini (Kasap, 2019; Susar Kırmızı & Kasap, 2017), yaratıcılığı (Hızır, 2014), okumaya yönelik tutuma etkisini (Yılmaz, 2009) geliştirmeye ilişkin etkileri incelenmiştir. Ayrıca yaratıcı okumaya dair geliştirilen ölçme araçlarının (Kasap ve Susar Kırmızı, 2017; Yurdakal & Susar Kırmızı, 2017) yanı sıra yaratıcı okumanın kuramsal boyutuna ilişkin de çeşitli araştırmalar mevcuttur (Aytan, 2014b; Aytan, 2014c; Çatuksöken, 2007; Ipsiroglu, 2000; Uzun, 2009). Yurt dışındaki çalışmalarda ise kuramsal bilgi verilen ve farklı düzeylerde yaratıcı okuma uygulamalarının etkililiğine dair çeşitli araştırmalar mevcuttur (Andresen ve Pawlak, 1976; Barrett, 2001; Dollins, 2016; Dunn, 1979; El-Hayek, 2016; Ericsson, 2013; Moorman ve Ram, 1994; Nardelli & Nardelli, 1955; Moorman & Ram, 1996; Ritchie vd., 2013; Tuzlukova, Eltayeb & Gilhooly, 2013; Wang, 2006).

Yaratıcı okumaya ders kitaplarında da yeterince yer verilmeyip daha çok teorik boyutu ele alınmakta (Edwin, 1965), öğrenciler yaratıcı okuma çalışmalarıyla yeterince karşılaşmamaktadır (Martin & Cramond, 1983). Oysaki okuma becerilerinin daha etkili bir şekilde gelişebilmesi için yaratıcı okumanın okul programlarına dâhil edilmesi gerekmektedir (Adams, 1968). Her yaş grubunda uygulanabilecek bir yöntem olan yaratıcı okuma (Moorman & Ram, 1994), yaratıcı düşünebilen özgün bireyler yetiştirilmesi için ders kitaplarında hak ettiği yeri almalı (Dawson, 2005), öğretim programlarına ve müfredata dâhil edilmelidir (Adams, 1968; Martin & Cramond, 1983; Wang, 2006). Yaratıcı okuma sahip olduğu bu üstünlüklere rağmen Türkçe Dersi Öğretim Programlarında yer bulamamış ancak Türkçe Dersi Öğretim Programı'nda (2018) Okuma Kültürü temasında yaratıcı okuma konusunun işlenebileceği belirtilmiştir. Yüksek bilişsel süreçlerin kullanımının gerçekleştirildiği bu okuma yöntemi en çok ihmal edilen okuma yöntemlerden biridir (Dunn, 1979; Gainsburg 1961; Smith, 1974). Ayrıca kendi içerisinde kompleks bir süreçten oluşan yaratıcı

okumanın aşamalardan biri olan eleştirel okumanın, yaratıcı okumayla ilişkisinin incelendiği herhangi bir araştırmaya da erişilememiştir. Her iki okuma türünün de daha yetkinlikle kullanılabilmesi için eleştirel okuma becerisiyle arasındaki ilişkinin incelenmesinin alan yazına olumlu katkılar sağlayacağı düşünülmektedir. Yaratıcı okumaya ilişkin ölçme araçlarının sınırlı olması sebebiyle (Kasap & Susar Kırmızı, 2017; Yurdakal & Susar Kırmızı, 2017) bu araştırma sadece ortaokul 5. sınıf öğrencileri üzerinde yürütülmüştür. Bu araştırmanın temelde okuma özelde ise eleştirel ve yaratıcı okuma becerilerinin gelişiminde alan yazına olumlu katkılar sağlayacağı düşünülmektedir.

Araştırmanın Amacı: Bu araştırmada ortaokul 5. sınıf öğrencilerinin eleştirel okuma becerilerinin, yaratıcı okuma sürecini değerlendirme becerilerine etkisi ve bu etkide cinsiyet değişkenin rolünün tespit edilmesi amaçlanmıştır.

Araştırmanın Yöntemi: Bu araştırma, tarama modellerinden ilişkisel tarama modelinde gerçekleştirilmiştir. Ortaokul 5. sınıf örnekleminde gerçekleştirilen araştırmanın çalışma grubu, seçkisiz örnekleme yöntemlerinden basit seçkisiz örnekleme yoluyla belirlenmiş olup katılımcılar; Rize ilinde üç farklı ortaokulun 5. sınıfında öğrenim gören 265 öğrenciden oluşmaktadır. Çalışma grubunun demografik özellikleri incelendiğinde; 127'si (%47.9) erkek, 138'i (%52.1) kız öğrencidir. Araştırmada değişkenlere ilişkin betimsel istatistiklerin hesaplanmasında ve değişkenler arasındaki ilişkilerin değerlendirilmesinde yapısal eşitlik modellemesi kullanılmıştır. YEM analizi öncesinde verilerin modeli destekleyip desteklemediğine ilişkin değerlendirmeleri yapmak amacıyla bu analizde yaygın olarak kullanılan iki aşamalı yöntem kullanılmıştır.

Araştırmanın Bulguları: Araştırma sonucunda hipotez modellerin tümünün geçerli olduğu; eleştirel okuma becerisinin, yaratıcı okuma sürecini değerlendirme becerisinin %57'sini açıkladığı, yaratıcı okuma sürecini değerlendirme becerisi üzerinde doğrudan ve yüksek bir etki oluşturduğu tespit edilmiştir. Kız öğrencilere ilişkin modelde eleştirel okuma becerisinin, yaratıcı okuma sürecini değerlendirme becerisinin %43'ünü, erkek öğrencilere ilişkin modelde ise %67'sini açıkladığı ve her iki modelde de doğrudan yüksek bir etki oluşturduğu tespit edilmiştir.

Araştırmanın Sonuçları ve Öneriler: Araştırma sonucunda eleştirel okuma becerisinin, yaratıcı okuma sürecini değerlendirme becerisinin önemli bir yordayıcısı olduğu ve eleştirel okuma becerisi geliştikçe yaratıcı okuma sürecinin değerlendirme becerisinin de gelişeceği söylenebilir. Bu iki değişken arasındaki ilişkin erkek öğrencilerde daha etkin bir şekilde açığa çıkmakla birlikte kız öğrencilerde bu etkinin oldukça yüksek olduğu söylenebilir. Bu sebeple eleştirel okuma becerisinin ve buna ilişkin deneyimlerin arttırılmasının yaratıcı okumanın da gelişimine katkı sağlayacağı söylenebilir.

Ortaokul 5. sınıf düzeyinde gerçekleştirilen çalışmaya ilişkin modelin geçerliliği ortaokul düzeyini kapsayan çalışmaların yanı sıra farklı örneklem düzeyindeki çalışmalarla da sınanabilir. Yaratıcı ve eleştirel okuma becerilerini etkileyen değişkenlere ilişkin deneysel çalışmaların yanı sıra uygulamaların etkililiği ve aksayan yönlerinin derinlikli olarak analiz edilmesi için de nitel araştırmalarla sonuçlar

değerlendirilebilir. Böylelikle birbiriyle dinamik bir ilişki içerisinde olan eleştirel okuma ve yaratıcı okuma becerisinin gelişimi ve beraberinde dil gelişimi daha üst seviyelere taşınarak daha başarılı nesiller yetişmesine olumlu katkılar sağlanabilir.

Anahtar Sözcükler: Yaratıcı okuma, eleştirel okuma, 5. sınıf, cinsiyet.

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Mobile Internet Experiences of the Children in Turkey and European Countries: A Comparative Analysis of Internet Access, Use, Activities, Skills and Risks*

Yigit Emrah TURGUT[1], Engin KURSUN[2]

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ABSTRACT

Purpose: This study aims to examine the current state of mobile Internet experience of the children in Turkey and to compare the Internet experiences of the children in Turkey to the children living in seven European countries included in the Net Children Go Mobile (NCGM) project.

Research Methods: In this study, a descriptive research design was employed and the participants consisted of 784 children between the ages of 9 and 16 from 12 different regions.

Findings: Results revealed that the ratio of Turkish children having Internet access in their own bedrooms and outside and also the ratio of them owning mobile devices, such as smartphones and tablets, is above the European average. It was seen that Turkish and European children used the Internet mostly for performing leisure and communicative activities. Although Turkish children's Internet use skills seemed to above the European average, it was seen that their skills towards safe Internet browsing like filtering unwanted content, blocking pop-up windows lacked behind their European counterparts. Thus, it was revealed that Turkish children were facing more Internet risks compared to the children in Europe.

Implications for Research and Practice: Future studies can utilize more detailed evaluation methods, such as performance tasks to assess the children's mobile device and Internet use. Researchers can also design applications and activities that aim to redirect the children's attention from using the Internet for entertainment and communication purposes to using it for research and study and then evaluate the effectiveness of the designs.

* This manuscript substantially derives from first author's dissertation study.

[1] Corresponding Author: Recep Tayyip Erdoğan University, TURKEY,
e-mail: yigitemrah.turgut@erdogan.edu.tr
ORCID: https://orcid.org/0000-0002-6306-4090
[2] Atatürk University, TURKEY, e-mail: ekursun@atauni.edu.tr
ORCID: https://orcid.org/0000-0002-5649-8595

Introduction

The number of Internet users has been increasing rapidly all over the world. Likewise, as of the end of 2019, the number of active Internet users in Turkey has reached to 59.3 million, which is approximately 72% of the country's population. Consequently, the country has exceeded the world average of active Internet users and ranked 31st among the other countries (We Are Social [WAS], 2019). The role of the ever-growing variety of mobile devices in the increase of Internet use in the World and Turkey cannot be denied. Especially the developments in mobile broadband technologies (e.g., 3G and 4G) have triggered the individuals' interest in and demand for mobile Internet (International Telecommunication Union [ITU], 2015; WAS, 2019).

As mobile devices and mobile Internet access continue to take more parts in our daily lives, they influence the children's lives to greater extents (Mascheroni & Ólafsson, 2014). Today's children referred to as digital natives by Prensky (2001), become acquainted with the Internet at a very early age and use online applications through touch-screen mobile devices, such as smartphones and tablets (Chaudron, 2015; Croll, 2016). Compared to desktop and laptop computers, mobile devices not only give children mobility and autonomy (Haudittai & Hinnant, 2008; Park, 2014), they also integrate online activities into everyday events children participate in (Barbovschi, O'Neill, Velicu, & Mascheroni, 2014; Livingstone, Mascheroni, & Staksrud, 2015). This allows children to spend more time with their friends and socialize, realize themselves through online experiences, and have fun (Vincent, 2015). Mobile Internet offers children the opportunities to read books and magazines whenever they want, find quick answers to things they are curious about, and study on their own (Eren, 2015; Vincent, 2015).

While providing facilities, such as flexibility of time and space and new communication environments, the children's widespread use of mobile devices for Internet access poses new risks (An, Morgenlander, & Seplocha, 2014). In the relatively conventional computer-mediated Internet access scenarios, children may isolate themselves from the social environment at fixed physical locations. On the other hand, mobile Internet access allows them to do so virtually anywhere, independent of their physical location (Kelleci, 2008; Net Children Go Mobile [NCGM], 2014). In addition to this, the studies reported that children with smartphones encounter online risks more often. Thus, they need new sets of skills to safely use the Internet (Mascheroni & Ólafsson, 2014; Smith et al., 2008). Not surprisingly, the children's use of mobile Internet is of considerable concern to parents, and such concerns may lead to arguments in the household (Genc, 2014; Kelleci, 2008; NCGM, 2014). According to a review of 175 studies conducted between 2001 and 2012 on the use of mobile Internet, mobile Internet has not reached the peak yet, even though it becomes increasingly common every passing day (Gerpott & Thomas, 2014). In fact, as of 2019, it is seen that one out of every two people in the world is a mobile Internet user (WAS, 2019). As a result, the children's negative experiences with mobile Internet may evolve into more complicated ones in the future. Hence, future studies should focus on identifying emerging risks, investigating them through various lenses, and providing guidance about possible new skills for safe mobile Internet use. While various international

initiatives conduct studies on the children's experiences with mobile Internet (e.g., the PEW Research Center in the US and the NCGM project group in Europe), in Turkey, there is a lack of small as well as large-scale studies investigating mobile Internet experiences of children aged 9-16 years. This study aims to present the current state of mobile Internet experiences of the children in Turkey and provide an opportunity to compare it to mobile Internet experiences of children in the seven European countries. In line with this purpose, the following research questions were formulated: In Turkey and seven European countries,

1. What are the levels of children's mobile Internet access and use?
2. What are the levels of children's skills regarding the mobile devices and Internet use?
3. What kinds of activities do children engage in online and what are their levels of engagement?

Method

Research Design

As this study aims to examine the mobile Internet experiences of Turkish children by collecting data from a large group, the descriptive survey method was chosen as the main methodological approach. This method is widely used in educational research and its main purpose is to identify and depict the current situation of a phenomenon (Creswell, 2012; Johnson & Christensen, 2004).

Research Sample

The stratified sampling method was used in participant selection to generate a representative sample of Turkish children and to comply with the methodology of the survey developed in the NCGM project. In this context, 784 9-to-16-years-old children from the 12 regions identified in the Turkish Nomenclature of Territorial Units for Statistics (NUTS) (TURKSTAT, 2005) were selected as participants. Each age level (9,10,11,12,13,14,15,16) and gender had an equal number of participants. Figure 1 summarizes the sampling approach employed in the selection of provinces, schools and children.

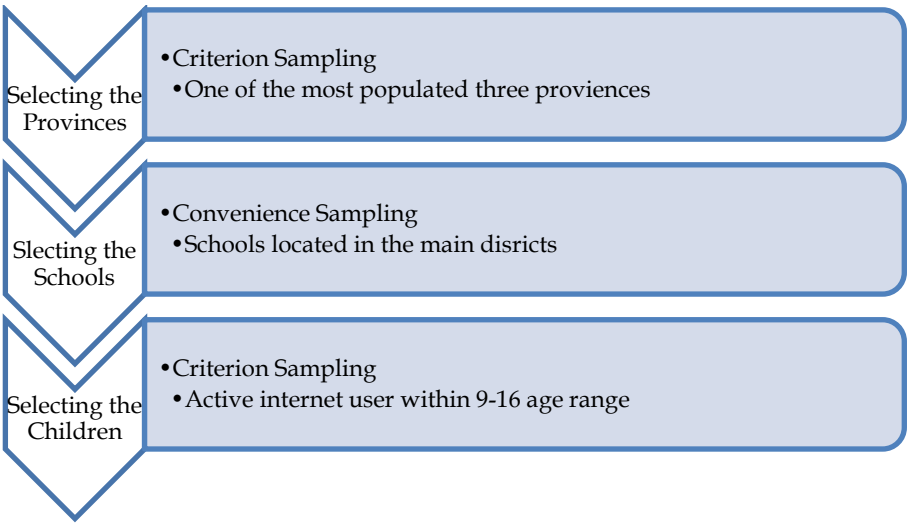

Figure 1. *Sampling Procedure*

Data Collection Tool

In this study, a questionnaire developed by the EU Kids Online (EUKO) study group within the scoped NCGM project was used. The EUKO study group consisted of 95 experienced researchers working in national project teams in 24 European countries, including Turkey (Livingstone, Haddon, Görzig, & Ólafsson, 2011). NCGM project was conducted in Denmark, Ireland, Italia, Romania, England, Portuguese and Belgium between 2012 and 2014. The survey and survey data of this project are available to everyone. To adapt the NCGM Questionnaire to Turkish, the present study employed Seker and Gencdogan's (2006) questionnaire adaptation procedure as listed below:

- Independent translations of the questionnaire to the target language (Turkish) by two language experts
- Comparison of the translations
- Back translation to the original language (Turkish into English)
- Review of the translated questionnaire by target language experts

Once the initial draft of the Turkish adaptation was generated, two experts from the Turkish team of the EUKO project group reviewed the questionnaire and provided feedback to guide revisions. After the evaluation of field experts, cognitive tests were conducted with eight children between ages 9 and 16, including one child from each age group, and the questionnaire items were examined and reorganized concerning understanding, remembering, judging and responding aspects. The pilot study has critical importance concerning the preliminary checking of the problems in the questionnaire before the actual implementation of the questionnaire (Buyukozturk, 2005; Teijlingen & Hundley, 2001). Thus, a pilot study was conducted with 80 children,

including five boys and five girls from each age group between ages ranging from 9 to 16. After conducting the cognitive testing and pilot study and receiving the Ministry of National Education's (MoNE's) permit for data collection, the final version of the questionnaire was established with 53 question roots.

Data Collection and Analysis

The original questionnaire was applied to 500 children in each of the seven European countries. In this study, the Turkish adaptation was applied to 784 children in Turkey. The data from Turkey were collected between April and June 2015. Data from Denmark, Ireland, Italy, Romania, and the UK were collected between May and June 2013, while data from Portugal and Belgium were collected between February and March 2014. Therefore, the data collection periods should be considered when comparing children's mobile Internet experiences across the countries.

After acquiring MoNE's permission to conduct this research, the researchers applied the questionnaire in the 12 selected provinces. The data collected through paper-and-pencil forms, then, were transferred to the SPSS program to calculate descriptive statistics, such as percentage, frequency, and arithmetic mean.

Results

The findings of this study were presented according to the research question investigating the children's mobile Internet experiences concerning access and use, activities, skills, and risks.

Access and Use

In this section, to investigate the multiple dimensions of the Internet access and use levels of children, the findings were organized into three categories, namely the place of use, the frequency of use and the device used.

Places Where Children Access the Internet

When examining the places where children had access to the Internet, organizing the findings in two overarching categories as in their own bedrooms and outside (e.g., school and other places away from home) may reveal the flexibility of the Internet use by children. In this respect, Figure 2 presents the findings regarding the places where children have access to the Internet on a daily basis. In Figure 2 and the following figures, Europe refers to the average of seven European countries participated in the NCGM.

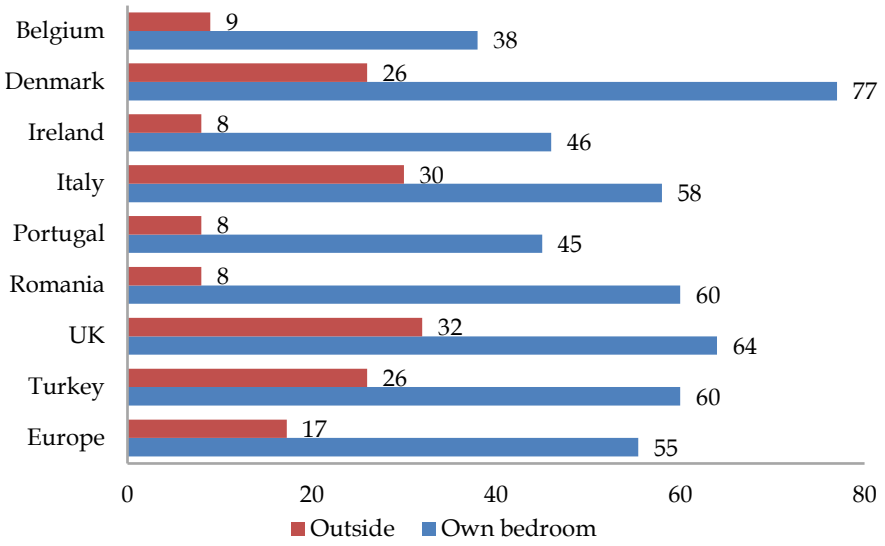

Figure 2. *Places Where Children have Access to the Internet*

In Turkey, the UK, Italy, and Denmark, the percentages of the children who had access to the Internet in their own bedrooms and outside were above the European average, while the percentages for Belgium, Ireland and Portugal were below the European average. In Romania, the gap between children's access to the Internet in their own bedrooms and outside was remarkably wider than the other countries. Besides, as Figure 3 indicates, the children in Turkey, the UK, Italy, and Denmark are likely to be more autonomous in their Internet use, considering the above-average use patterns.

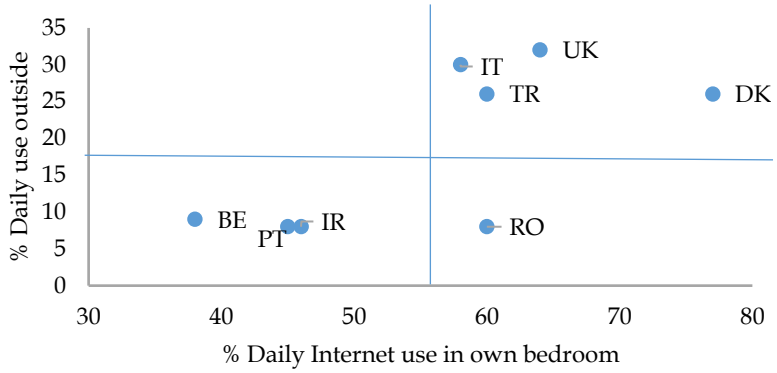

Figure 3. *Children's Internet Autonomy of Use*

Devices that Children Use to Access the Internet

The children having Internet access both within their own bedrooms and the outside indicates mobile device ownerships, such as smartphones and tablets. In this respect, the results of the analysis of children having Internet-enabled devices have been presented in Figure 4.

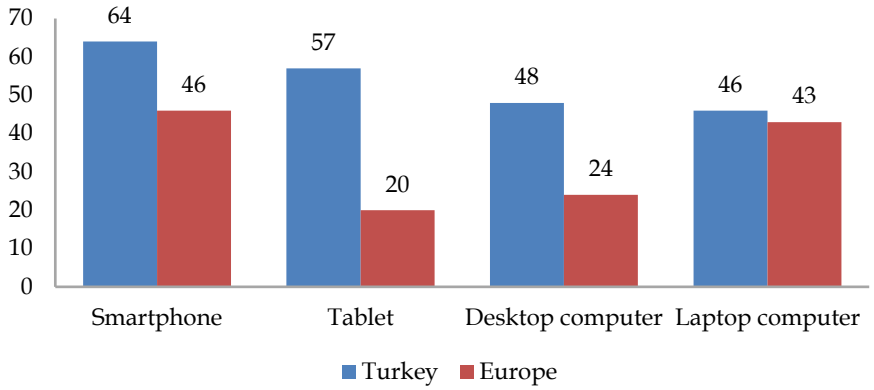

Figure 4. *Percentages of the Internet-Enabled Device Ownership*

As seen in Figure 4, the proportion of children in Turkey with mobile devices, such as smartphones and tablets, was also above the European average. It is especially remarkable that the percentage of Turkish children having tablets is almost three times the European average. Nonetheless, as seen in Figure 5, Turkish children first meet the Internet and own their first smartphones at almost the same ages as their European peers.

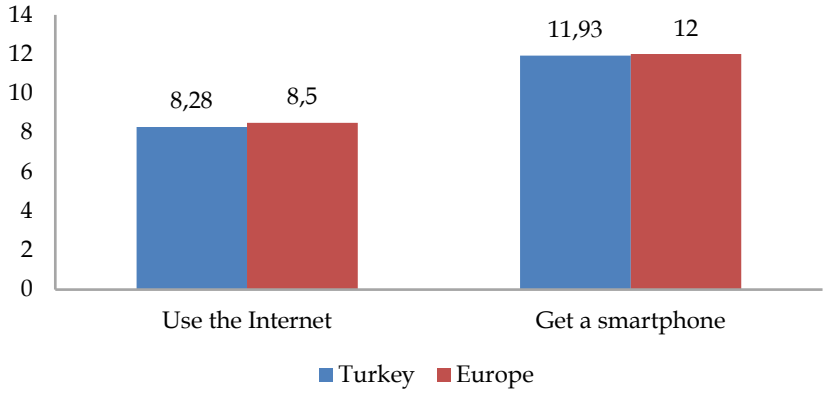

Figure 5. *Average Age of First Internet Use and Smartphone Ownership for Children*

The Frequency of Use of Devices for Internet Access by Children

Figure 6 shows the findings on the daily use percentages of smartphones, tablets and laptop computers for children to access the Internet.

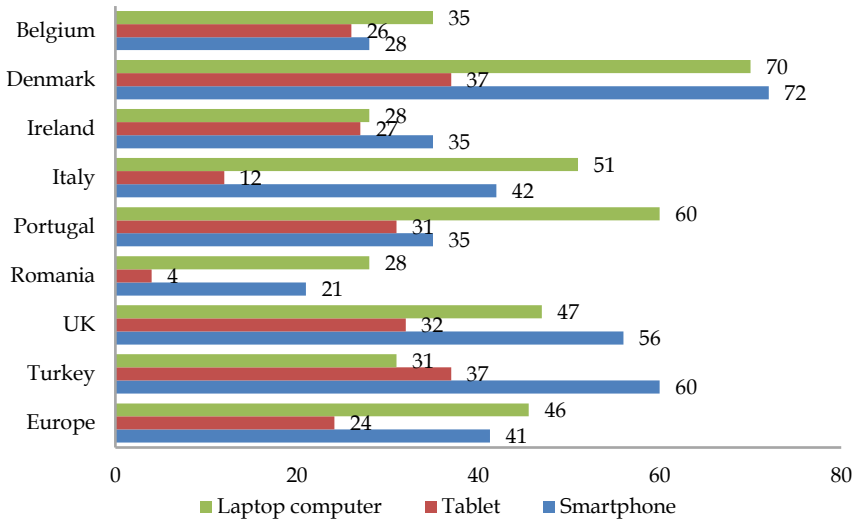

Figure 6. *Children`s Daily Use Percentages of Internet-Enabled Devices*

The percentage of daily use of smartphones and tablets for Internet access by Turkish children is above the European average. Furthermore, with 37% daily tablet use of children, Turkey has the lead along with Denmark. While the children in Turkey, the UK, Denmark and Ireland prefer smartphones to access the Internet, the children in Belgium, Italy, Portugal and Romania prefer laptop computers.

The children's use of mobile devices, such as smartphones and tablets, is an important element of the Internet's use on the move. As Figure 7 illustrates, the use of the Internet on the outside increases in conjunction with the children`s daily use of smartphones and the countries where children have the highest daily smartphone use and Internet access are Turkey, the UK, and Denmark.

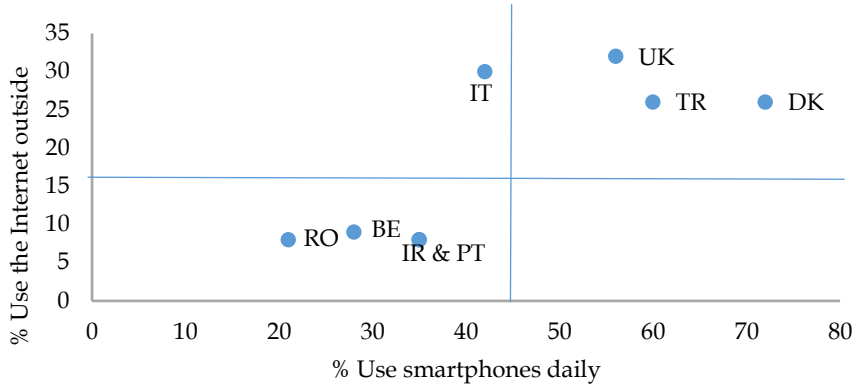

Figure 7. *Daily Smartphone Use and Outside Internet Access Percentages of Children*

Activities

In this section, findings on children's activities on the Internet are presented. Table 1 presents the analysis results of the activities that children do online with any kind of device.

Table 1

Daily Activities Children Perform on the Internet

	Turkey (%)	**Europe (%)**
Social networking	60	53
Watching movies and listening to music	53	53
Watching videos	44	53
Instant messaging	44	41
Use of the Internet for school works	40	29
Playing games with other people on the Internet	33	26
Downloading free applications	38	20
Uploading photos/videos to sharing sites	36	17
Visiting online chat rooms	19	16
Reading/watching online news	26	14
Commenting on a web site	31	12
Using file-sharing websites (Limewire, Kazaa)	6	9
Saving geographical location	21	9
Camera use for video calls	19	8

Table 1 Continue

	Turkey (%)	Europe (%)
Checking maps and schedules	13	6
Creating a character, pet animal or avatar	12	4
Reading e-book	16	3
Online shopping	6	2
Downloading paid applications	3	2
Scanning QR code or barcodes	5	1

As seen in Table 1, the children in Turkey and Europe mostly perform following activities on the Internet: social networking, watching movies and listening to music, watching videos, instant messaging, and other similar entertainment and communication activities. This shows that one in every two children in Turkey and Europe use the Internet for entertainment and communication purposes. Consequently, the children's use of the Internet for homework and research purposes does not take prominence.

It has also been seen that the percentage of Turkish children to perform mobile-device specific activities, such as downloading free applications and registering their geographical locations, is twice the European average. However, other activities specific to mobile devices have been observed to be the least frequently performed activities over the Internet for both Turkish and European children. In addition, the percentage of Turkish children performing activities intended for personal information sharing, such as photograph/video uploads and using the camera for video chat, found to be more than twice the percentage of European children performs such activities.

Skills

In this section, findings on the skills of children to use mobile devices and Internet technologies are presented. Children`s skills regarding mobile device use were investigated concerning downloading applications, setting geographical locations, connecting to the wireless networks and so on. The results relating to these skills are presented in Table 2.

Table 2

Children`s Skills on Mobile Device Use

	Turkey (%)	**Europe (%)**
Downloading application	91	93
Connecting to a wireless network from smartphone or tablet	87	89
Protection of smartphone with PIN and screen lock	82	88
Taking photos with smartphones and uploading them on social network	77	86
Finding information on how to use a smartphone	74	68
Turning off the function of displaying the geographical location	71	63
Updating location on the most used social network	63	79
Comparing different applications with the same function to find the most reliable one	62	66
Keeping the same document, contact list and application in all of the device being used (smartphone, tablet, PC)	57	57
Blocking pop-ups that promote applications, games and services	40	48
Blocking notifications from different applications	39	61

As seen in Table 2, the majority of children in Turkey and Europe are found to have skills, such as downloading applications, connecting to wireless networks, protecting phones with PINs and screen locks and taking photos with their smartphones and uploading them on social network sites. On the other hand, the skills that children in Turkey and Europe lack the most are blocking pop-ups that promote applications, games and services. In addition, while 61% of children in Europe could able to block notifications from different applications in mobile devices, this percentage was 39% in Turkey.

In this study, Internet use skills were evaluated concerning 12 Internet skills encompassing security, communication and critical thinking. The results relating to these skills are presented in Table 3.

Table 3

Internet Use Skills of Children

	Turkey (%)	**Europe (%)**
Skills relating to Internet use and critical thinking		
Comparing different website to assess the accuracy of the information	63	49
Adding a website to favorites	56	61
Filtering search results to prevent unwanted contents	34	31
Skills relating to safe Internet use		
Finding information relating to safe Internet use	71	54
Blocking messages from unwanted people	68	60
Changing personal settings on a social network profile	66	56
Blocking unwanted adverts, spams, e-mails	61	45
Deleting the history of visited websites	60	54
Blocking pop-up pages	34	44
Skills relating to communication		
Uploading photo, video or music on social network	75	63
Commenting on a forum, website or blog	54	56
Creating a blog	22	31

Looking at Table 3, it is seen that the Internet skills of children under three categories are really close to each other in Turkey and Europe. It was determined that children in Turkey and Europe had the least knowledge on Internet use skills, such as blocking pop-up pages, using filters and creating blogs. The data indicated that one in every three children had these skills. The averages for 12 Internet usage skills of children are presented in Figure 8.

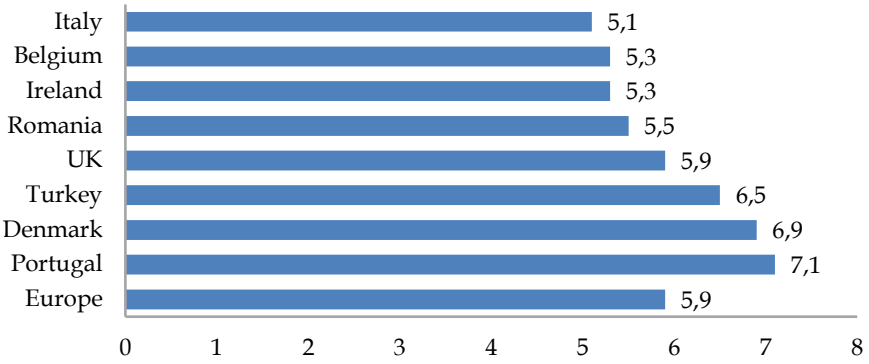

Figure 8. *Averages Internet Use Skills of Children*

It can be seen in Figure 8 that the average skill level of the Turkish children was 6.5, while the average for the European children was 5.9. Internet use skill average of children in Turkey had the third place after Portugal and Denmark.

Risks

This section focuses on the unwanted situations children encountered on the Internet, such as seeing sexually explicit photos, encountering saddening/rude people, making friends with strangers online and meeting with them offline settings, excessive use of the Internet and smartphone use, and so on. Due to ethical concerns, this part of the questionnaire was not applied to children at the age group of 9-10. Therefore, this part of the data was obtained from children in the age group of 11-16. The results relating to risks children encounter to on the Internet are presented in Table 4.

Table 4

Percentages of Children Encountering Online Risks

	Turkey (%)	**Europe (%)**
Seeing sexually explicit pictures	51	28
Encountering to saddening/rude people	45	23
Meeting new people over the Internet	38	26
Receiving sexually explicit messages	31	11
Meeting face-to-face with people they met on the Internet	21	12

Table 4 indicates that children in Turkey encounter more risks online compared to children in Europe. While one in every two children in Turkey comes across sexually explicit images and saddening/rude people, this ratio is one in every four children in

Europe. The percentage of children who states to have received sexually explicit messages is almost three times as high in Turkey than the European average.

Along with the increasing use of the Internet by children, analysis results relating to excessive Internet use are presented in Figure 9.

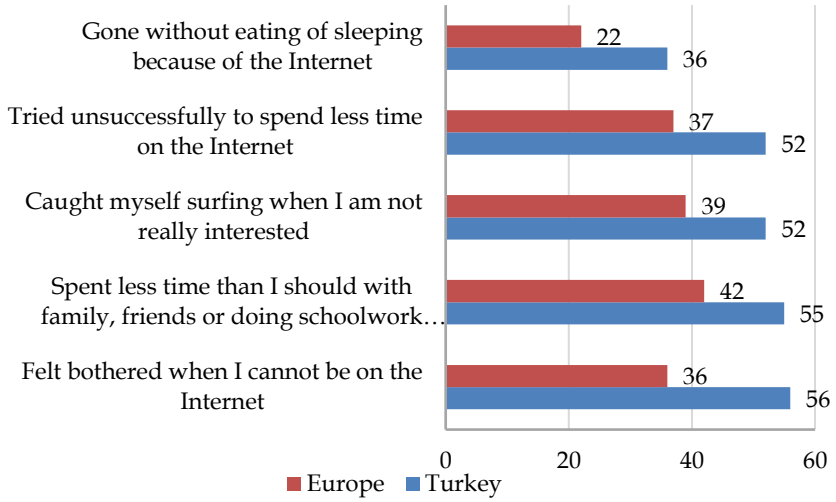

Figure 9. *Excessive Internet Use by Children*

It can be seen in Figure 9 that the children in Turkey tended to exhibit excessive Internet use behaviors more than the children in Europe. One in every two children in Turkey exhibited all excessive use behaviors except going without eating or sleeping because of the Internet, whereas, in Europe, one in every three children did so.

When Figure 10 is also examined, it was found that excessive phone use behaviors were more common among the European compared to the children in Turkey. In addition, both in Turkey and Europe, feeling the urge to check smartphones upon hearing something new and being sad for not being able to use smartphones due to an area without access or to battery problems were the most exhibited behaviors relating to excessive phone use. It was so much that almost three fourth of the children exhibited these behaviors.

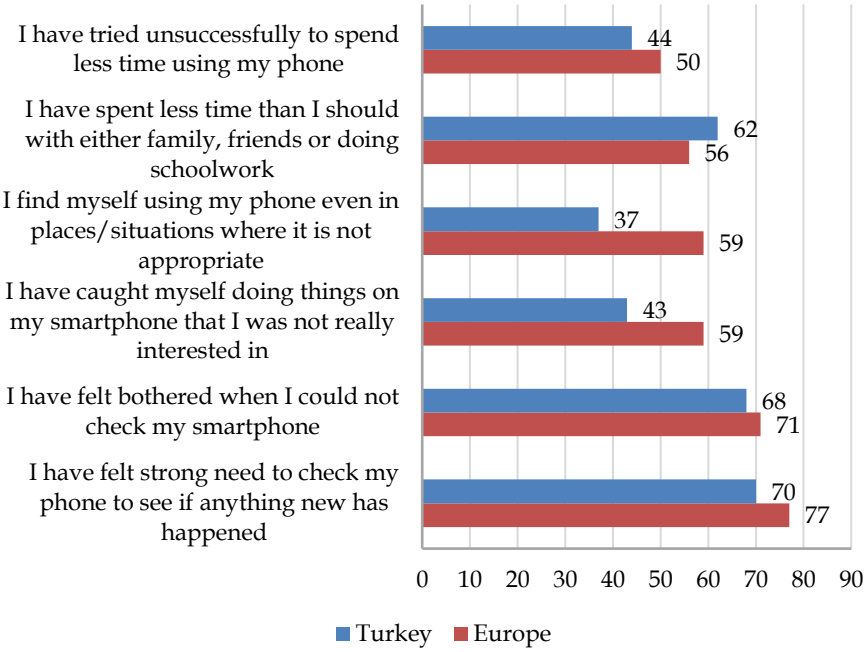

Figure 10. *Excessive Phone Use by Children*

The results relating to people with whom children share their negative experiences on the Internet are presented in Figure 11.

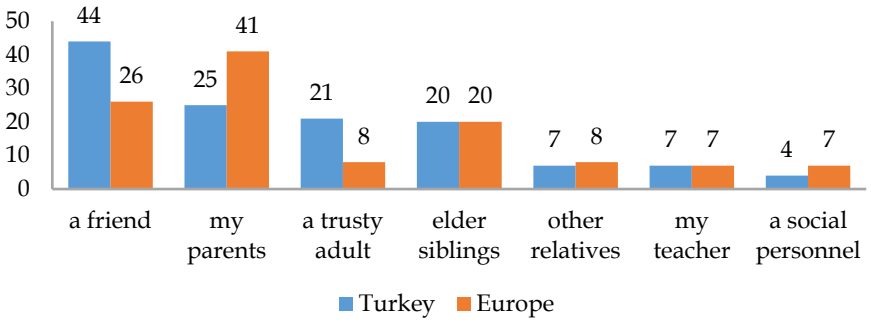

Figure 11. *People with Whom Children Share their Experiences Relating to Online Risks*

As seen in Figure 11, when the children in Turkey had a disturbing experience on the Internet, they shared it with their friends (44%), whereas the children in Europe shared it with their parents (41%). It was also confirmed that children in Turkey and Europe shared the risks on the Internet least with their teachers, social personnel and other relatives.

Discussion and Conclusion

The findings of mobile Internet experiences of children in Turkey are limited to the data obtained from schools located in the central districts of 12 provinces. Thus, comparisons relating to mobile Internet experiences of children should be evaluated considering the years when the data are collected from countries.

Internet Access and Use

Internet access of children in their own bedrooms and outside in Turkey are higher than the European average. This shows that children in Turkey have much more flexibility concerning Internet use. Lobe, Livingstone, Ólafsson and Vodeb (2011) stated that mobile devices that provide access to the Internet anywhere and anytime have an effect on the highlight that children have access to the Internet in their own bedrooms and outside. Indeed, it turns out that the proportion of children in Turkey with mobile devices, such as smartphones and tablets, is above the European average. It can be said that tablet distribution to children within the FATIH Project in Turkey (Eren, 2015; Ozkale & Koc, 2014) might have resulted in Turkish children gaining access to quite more tablets than their European peers. The FATIH Project aims to provide equal opportunities in education and improve the teaching and learning process through the use of Information and Communication Technologies (ICT) tools. The number of tablets distributed was 1.437.800 in 2015 (MoNE, 2018).

Both Turkish and European children own smartphones and start to use the Internet during their elementary school period. According to Chaudron (2015) and Croll (2016), children are becoming familiar with the Internet at very early ages and use online applications thanks to the touch screens of mobile devices, such as smartphones and tablets. In this context, the first age of having a smartphone and the average age of Internet users both in Turkey and Europe will likely to decrease even more.

Internet Activities

Children in Turkey and Europe mostly perform entertainment and communication activities. Consequently, the children's use of the Internet to do homework and conduct research remained at low levels. The extant literature also suggests that children mostly prefer activities for entertainment and communication purposes on the Internet (Akar, 2015; Ekici & Ucak, 2012; Malak, Khalifeh, & Shuhaiber, 2017). It has been seen that mobile devices, such as smartphones and tablets provide children with mobile and autonomous Internet access and allow them to perform online activities anywhere, compared to desktop and laptop computers (Chaudron, 2015; Hargittai & Hinnant, 2008; Park, 2014). In this context, mobile devices, such as smartphones and tablets can be said to have an effect on children to use the Internet for entertainment and communication. It has been observed that most common online activities carried out with mobile devices by children in Europe are watching videos and using social networks (Mascheroni & Ólafsson, 2014). Accordingly, it is believed that children develop habits of playing games and having fun with smartphones and tablets. Nonetheless, mobile devices have potential to be used beyond gaming and entertainment, such as discovering or developing oneself (Eren, 2015; Vincent, 2015).

To realize and utilize these potentials of mobile devices and the Internet, it may be beneficial to conduct in-class and extracurricular activities, seminars and educational games.

Social networking is found to be the most popular activity among children in Turkey and Europe alike. In the studies conducted with children at different age groups and in different countries, it was seen that majority of the children use social networks (Lenhart, 2015; Tomczyk & Kopecky´, 2016; Okumus, 2018). Since social networks provide a wealth of facilities, such as instant messaging, voice and video calls, sharing, and online gaming (Boyd & Ellison, 2007), they are likely to stay among the most activities children perform on the Internet.

Internet Skills

Most of the children in Turkey and Europe were found to have mobile-device-related skills, such as downloading applications, connecting to wireless networks, activating PIN/screen lock, taking photos and sharing them on social networks. Likewise, more than half of the children had basic Internet use skills, such as changing personal information on social networks, deleting web browsing history, adding web pages to favorites, and uploading pictures, music or video on social networks. These can be interpreted as a reflection of use of mobile device and the Internet by children and their interest in these technologies. Karahisar (2014) stated that the majority of the children developed their computer and Internet use skills by themselves. Additionally, it can be said that today`s children, also named as digital natives by Prensky (2001), develop these skills naturally since they were born into a technology-rich world and had a chance to meet mobile devices and the Internet at very early ages.

Although Internet use skills of children in Turkey are higher than the European average, their technical skills regarding safe Internet use, such as filtering unwanted contents, blocking pop-ups advertisements, paid applications, games and services are below the European average. As the children in Turkey are not aware of their incompetence in safe Internet use, they become more vulnerable to online risks. These children may benefit from technical-skill-development activities encouraging safe Internet use, such as editing web pages, developing mobile applications, and carrying out activities for children, to gain technical skills.

Risks of Internet

The results indicate that Turkish children encounter online risks more frequently than their European counterparts. This situation might be due to the higher Internet access and the use of percentages of children in Turkey. Moreover, the children's unmonitored and inappropriate uses of the Internet and mobile devices (Burnukara & Ucanok, 2010) and their lack of competence in Internet safety (Kasikci, Cagiltay, Karakus, Kursun, & Ogan, 2014) can render them open to online risks.

As to excessive Internet use, almost half of Turkish children and a third of Europe children exhibit excessive Internet use behaviors. In the study conducted with 2853 high school students, Yilmaz, Sahin, Haseki and Erol (2014) reported that 66.6% of the

children were addicted to the Internet on a moderate level. This suggests that Internet use among children in Turkey reached a critical level. The children' excessive use of the Internet might be due to the entertainment and communication activities they engage in online (Chang & Man Law; 2008; Eksi, 2012; Kocak & Kose, 2014) and mobile devices becoming widespread among children (Lenhart, 2015; O'Keeffe & Clarke-Pearson, 2011; Sonmez, 2013). The important communication and Internet facilities mobile devices offer may lead to excessive uses, which may easily reach to the level of addiction. In this context, it was found that children in Europe display excessive phone use behaviors more frequently than children in Turkey. Widespread smartphone use among children and parents' hardship in monitoring children's mobile device use might have a role in children's excessive use. In this sense, parents can convince their children of the necessity of limiting their screen time and Internet use, or they can also monitor how much time their children spend on the Internet by installing parenting applications, such as KidTime and Screen Time on their children's mobile devices.

When faced with disturbing content over the Internet, Turkish children share this experience mostly with their friends, while European children share such an experience primarily with their parents. In the literature, the studies report that online risks are mostly shared with parents and friends (Ayas & Horzum, 2013; Slonje & Smith, 2008). This can be explained by that children feel closer to their parents and friends and that they trust them. Aslan and Karakus Yilmaz (2017) stated that in addition to increasing children's awareness of online risks, we should make other parties in their social environments aware of safe Internet use because coping with disturbing content on the Internet is a process that involves every actor present in the social environment.

Future studies can investigate the activities children do online and the risk they encounter, focusing specifically on Internet access through mobile devices. Future studies can design applications and activities that aim to redirect the children's attention from using the Internet for entertainment and communication purposes to using it for research and study, and then evaluate the effectiveness of the designs. Qualitative studies can be conducted to create in-depth accounts of the online risks that children encounter, their coping strategies, and the support they receive from the social environment.

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Türkiye ve Avrupa'daki Çocukların Mobil İnternet Deneyimleri: İnternet Erişim, Kullanım, Etkinlikler, Beceriler ve Risklerin Karşılaştırmalı Analizi

Atıf:

Turgut, Y.E., & Kursun, E. (2020). Mobile internet experiences of the children in Turkey and European countries: A comparative analysis of internet access, use, activities, skills and risks. *Eurasian Journal of Educational Research* 88, 225-248. DOI: 10.14689/ejer.2020.88.10

Özet

Problem Durumu: Çocuklar arasında internet erişimi noktasında mobil cihazların yaygınlaşması her ne kadar zaman ve mekân esnekliği, yeni iletişim ortamları vb. gibi imkânlar sunsa da yeni riskleri de beraberinde getirmektedir. Mobil internet kullanan çocukların internette daha fazla risklerle karşılaştıkları ve güvenli internet kullanımına yönelik yeni becerilere ihtiyaç duydukları görülmektedir. Mobil internet kullanımının giderek yaygınlaşmasına rağmen henüz tepe noktasına ulaşmadığı düşünüldüğünde yakın gelecekte çocukların mobil internet kullanımıyla birlikte yaşayabilecekleri olumsuz durumların daha da artarak karmaşık bir hale gelmesi muhtemeldir. Bu nedenle, yapılacak çalışmalar yeni risklerin tanımlanması, farklı boyutlarıyla değerlendirilmesi ve bu risklere yönelik sahip olunması gereken yeni becerilerin neler olacağı hususunda yol gösterici olması gereklidir. Bu bağlamda Amerika'da PEW Araştırma Merkezi Avrupa'da ise Net Children Go Mobile (NCGM) proje grubu çocukların mobil internet deneyimlerine yönelik çalışmalar gerçekleştirirken Türkiye'de 9-16 yaş grubu çocuklara yönelik makro ve mikro ölçekte herhangi bir çalışma yapılmadığı görülmektedir.

Araştırmanın Amacı: Bu çalışmada, Türkiye'deki çocukların mobil internet deneyimlerine yönelik mevcut durumu ortaya koymak ve Türkiye ile NCGM projesinde yer alan 7 Avrupa ülkesindeki çocukların internet deneyimlerini karşılaştırmak amaçlanmıştır.

Araştırmanın Yöntemi: Çalışmada nicel araştırma yöntemlerinden tarama araştırma modeli tercih edilmiştir. Türkiye'deki çocukların evrenini temsil edebilecek bir örneklem oluşturmak için tabakalı örnekleme yöntemi kullanılmıştır. Bu bağlamda, Türkiye İstatistiki Bölge Birimleri Sınıflandırmasına göre 12 bölgeden 9-16 yaş aralığındaki 784 çocuk, yaş gruplarına ve cinsiyetlerine göre eşit sayıda dağılacak şekilde çalışmaya dahil edilmiştir. Çalışmada NCGM projesi kapsamında EU Kids Online (EUKO) çalışma grubu tarafından geliştirilen anket kullanılmıştır. Elde edilen veriler SPSS programına aktırılmış olup verilerin çözümlenmesinde yüzde, frekans, aritmetik ortalama gibi betimsel istatistik teknikleri kullanılmıştır.

Araştırmanın Bulguları: Türkiye'deki çocukların kendi odaları (%60) ve dışarıdaki (%26) internet erişimlerinin Avrupa ortalamasının üstünde olduğu ortaya çıkmıştır. Çocukların akıllı telefonlara sahip olma oranları Türkiye'de %64 iken Avrupa'da %46'dır. Türkiye'deki çocukların tabletlere sahip olma oranı ise (%57) Avrupa'nın yaklaşık 3 katı (%20) olması dikkat çekicidir. Türkiye, İngiltere, Danimarka ve İrlanda'daki çocuklar günlük internet kullanımları için en fazla akıllı telefonları tercih

ederken Belçika, İtalya, Portekiz ve Romanya'daki çocukların ise dizüstü bilgisayarları tercih ettiği ortaya çıkmıştır. Bununla birlikte, Türkiye ve Avrupa'daki çocukların interneti ilk kez yaklaşık 8,5 yaşında kullandıkları, ilk akıllı telefonlarına da 12 yaşındayken sahip oldukları görülmüştür.

Türkiye ve Avrupa'daki çocukların internette günlük bazda en fazla sosyal ağları kullanma, çevrimiçi film izleme veya müzik dinleme, internette video klip izleme ve anlık mesajlaşma gibi eğlence ve iletişim amaçlı etkinlikleri gerçekleştirdikleri görülmüştür. Bu durum Türkiye ve Avrupa'daki yaklaşık her iki çocuktan birinin interneti eğlence ve iletişim amaçlı kullandığını göstermektedir. Bunun bir yansıması olarak çocukların interneti ödev ve araştırma yapmak için kullanımlarının ikinci planda kaldığı ortaya çıkmıştır. Türkiye'de çocukların ücretsiz uygulama indirme (%38) ve coğrafi konum kaydetme (%21) gibi mobil cihazlara özgü etkinlikleri gerçekleştirme oranları Avrupa ortalamasının iki katı olduğu ortaya çıkmıştır. Mobil cihazlara özgü diğer etkinlikler hem Türkiye'de hem de Avrupa'da çocukların internette en az gerçekleştirdikleri etkinlikler arasında yer aldığı görülmüştür.

Türkiye ve Avrupa'daki çocukların büyük bir kısmının uygulama indirme, kablosuz ağlara bağlanma, PIN/ekran kilidi koyma, fotoğraf çekip sosyal ağlarda paylaşma gibi mobil cihazlara özgü becerilere sahip olduğu ortaya çıkmıştır. Benzer şekilde çocukların yarısından fazlasının sosyal ağlarda kişisel ayarlarını değişme, ziyaret ettikleri web sitelerinin kaydını silme, web sitelerini sık kullanılanlara ekleme, sosyal medyaya resim, müzik veya video yükleme gibi temel internet kullanma becerilerine sahip oldukları görülmüştür. İnternet kullanımına yönelik 12 beceriye ilişkin ortalamalara bakıldığında, Türkiye'nin 6,5 ortalaması ile Avrupa ortalamasının (5,9) üstünde, ülkeler arasında Portekiz ve Danimarka'dan sonra üçüncü sırada yer aldığı görülmüştür. Buna rağmen Türkiye'deki çocukların arama yaparken istenmeyen içerikleri filtreleyebilme, reklam içeren açılır pencereleri, uygulamalardaki uyarıları ve pop-up sayfaları bloke edebilme gibi güvenli internet kullanımına yönelik becerilerinin Avrupa'daki çocukların gerisinde kaldığı ortaya çıkmıştır.

Türkiye'deki çocukların Avrupa'daki çocuklara kıyasla internet riskleriyle daha fazla karşılaştıkları ortaya çıkmıştır. Türkiye'de yaklaşık her iki çocuktan birisi ahlaka aykırı resimlerle ve üzücü/kırıcı kişilerle karşılaşırken, Avrupa'da bu oran her dört çocuktan biridir. Türkiye'de ahlaka aykırı mesajlar aldığını belirten çocukların oranı Avrupa ortalamasının neredeyse üç katıdır. Ayrıca aşırı internet kullanmaya yönelik davranışları Türkiye'deki çocukların, aşırı telefon kullanmaya yönelik davranışları ise Avrupa'daki çocukların daha fazla sergiledikleri ortaya çıkmıştır. Türkiye'deki çocuklar internette rahatsız edici bir durumla karşılaştıklarında bunu en fazla arkadaşlarıyla (%44), Avrupa'daki çocuklar ise ebeveynleriyle (%41) paylaştıkları tespit edilmiştir. Ayrıca Türkiye ve Avrupa'daki çocukların internette karşılaştıkları riskleri en az öğretmenleri, sosyal görevliler ve başka birileriyle paylaştıkları görülmüştür.

Araştırmanın Sonuçları ve Önerileri: Bu çalışmada, Türkiye'deki çocukların mobil internet deneyimlerine yönelik mevcut durumu anketler aracılığıyla toplanan verilerle

ortaya koyulurken NCGM projesinde yer alan aynı veri toplama aracıyla çalışmalar yürüten 7 Avrupa ülkesindeki çocukların deneyimleriyle karşılaştırılmıştır.

Türkiye'deki çocukların kendi odalarında ve dışarıdaki internet erişimleri, akıllı telefon ve tablet gibi mobil cihazlara sahip olma ve bu cihazları günlük kullanım oranları Avrupa ortalamasının üstünde olmasının bir yansıması olarak Danimarka ve İngiltere ile birlikte Türkiye'deki çocukların internet erişim ve kullanım esnekliğinin daha fazla olduğu sonucuna varılmıştır. Bu kullanım esnekliğiyle birlikte, hem Türkiye hem de Avrupa'daki çocukların internette daha çok eğlence ve iletişim amaçlı etkinlikler gerçekleştirmesi mobil cihazların oyun ve eğlencenin ötesinde öğrenme, kendini keşfetme veya geliştirme vb. noktalarda sunduğu fırsatların kaçırılmasına sebep olmaktadır. Çocukların internet ve mobil cihazlara olan ilgisi ve kullanımlarının bir yansıması olarak bu teknolojileri kullanmaya yönelik temel becerilerinin geliştiği ancak güvenli internet kullanımına yönelik becerilerin yeterince gelişmediği sonucuna varılmıştır. Özellikle Türkiye'deki çocukların internet kullanım esnekliğinin Avrupa ortalamasının üstünde olması ve güvenli internet kullanım becerilerinin de Avrupa ortalamasının altında olması göz önünde bulundurulduğunda Türkiye'deki çocukların Avrupa'daki çocuklara kıyasla internette risklerle daha fazla karşılaşmaları olması beklenen muhtemel bir sonuçtur. Çalışmanın sonuçları doğrultusunda uygulamaya yönelik şu önerilerde bulunulabilir:

- Çocuklara internet ve mobil cihazların bireylere öğrenme, kendini keşfetme veya geliştirme noktasındaki potansiyelini anlamaya ve kullanmaya yönelik seminerler, ders içi ve ders dışı etkinlikler, eğitsel oyunlar düzenlenmesi faydalı olabilir.
- Çocukların güvenli internet kullanımı becerilerini kazanmasına yönelik web sayfaları düzenlenmesi, mobil uygulamalar geliştirilmesi ve okullarda etkinlikler yapılması faydalı olabilir.
- Ebeveynler mobil cihaz ve internet kullanımında zaman sınırının gerekliliğini çocuklarına açıklayarak ikna edebilir ya da çocuklarının mobil cihazlarına KidTime, Screen Time gibi zaman sınırlama uygulamaları yükleyerek mobil internette geçirdikleri süreleri kontrol altına alabilirler.

Çalışmanın sonuçları doğrultusunda araştırmaya yönelik şu önerilerde bulunulabilir:

- Çocukların sadece mobil cihazlar ile internete erişimleri temel alınarak internette gerçekleştirdikleri etkinlikler ve karşılaştıkları riskler incelenebilir.
- Çocukların eğlence ve iletişim amaçlı internet kullanım algılarının araştırma ve ödev yapmaya yönlendirecek uygulamalar ve etkinlikler tasarlanıp bunların etkililiklerini ortaya koyan çalışmalar gerçekleştirilebilir.
- Çocukların internette karşılaştıkları riskleri, risklerle başa çıkmak için yaptıklarını ve sosyal çevrelerindeki bireylerden aldıkları desteği derinlemesine ele alan nitel çalışmalar gerçekleştirilebilir.

Anahtar Sözcükler: Çocuklar, mobil internet, internet erişimi ve kullanımı, internet becerileri, internet etkinlikleri, internet riskleri

Submission Checklist
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