ULUSLARARASI EĞİTİM ARAŞTIRMACILARI DERGİSİ (UEADER)

INTERNATIONAL JOURNAL OF SCHOLARS IN EDUCATION (IJSE)

ISSN: 2667-4998

CİLT/ VOLUME: 5 SAYI / ISSUE: 2 TARİH / YEAR: ARALIK (DECEMBER) 2022

CİLT / VOLUME: 5 ***SAYI / ISSUE***: 2

ARALIK 2022 / DECEMBER 2022

Uluslararası Eğitim Araştırmaları Dergisi (UEADER) ücretsiz yayım yapan hakemli bir dergidir.

Dergide yayımlanan makalelerin fikri ve mülki sorumluluğu yazarlara aittir.

International Journal of Scholars in Education is a peer-reviewed free journal.

The authors have the intellectual and civil responsibility of the articles published in the journal.

İletişim Bilgileri / Contact Information

Internet adresi/Web: https://dergipark.org.tr/ueader

E posta adresi/E-mail: dburak@kilis.edu.tr / ijseonline@gmail.com

Telefon numarası: + 90 530 343 67 67

Adres/Address: Kilis 7 Aralık University Faculty of Education Department of Elementary Education No: 202, 79000, Kilis, Turkey

ULUSLARARASI EĞİTİM ARAŞTIRMACILARI DERGİSİ (UEADER)

INTERNATIONAL JOURNAL OF SCHOLARS IN EDUCATION (IJSE)

ISSN: 2667-4998

2022 KİLİS, TURKEY

İÇİNDEKİLER/ CONTENTS

ARAŞTIRMA MAKALELERİ/ RESEARCH ARTICLE

Research Article
Received: 11.08.2022
Accepted: 23.12.2022
Published: 31.12.2022

Citation: Şahin, S., Doğan, M. F., & Gürbüz, R. (2022). Examining teacher interventions in teaching mathematical modeling: A case of middle school teacher. *International Journal of Scholars in Education*, *5*(2), 60-79. http://dx.doi.org/10.52134/ueader.1160828

Examining Teacher Interventions in Teaching Mathematical Modeling: A Case of Middle School Teacher*

Seda ŞAHİN**, Muhammed Fatih DOĞAN***, Ramazan GÜRBÜZ****

***Abstract*:** The teachers' pedagogical understanding of modeling applications is one of the most critical issues in teaching mathematical modeling. The interventions used by the teacher during the implementation of the tasks are the mirror of their pedagogical knowledge. For this reason, teacher interventions, which have a decisive effect on defining the teacher's role in teaching mathematical modeling, are a crucial issue to investigate. This study examines the types of interventions used by a middle school mathematics teacher who completed professional development in mathematical modeling. The data was collected in an eighth-grade classroom consisting of twenty students. The mathematical modeling task, called Intersection Arrangement, was implemented for 2 hours, and both video and audio recordings were used to collect data. All recordings were transcribed and analyzed using the content analysis method, supported by observer notes and student worksheets. The results revealed that the teacher mostly had effective environmental and classroom interaction interventions. The teacher avoided having content-oriented or strategic interventions or did not intervene during the modeling process. These intervention types might be because of the teacher's unwillingness to affect the modeling process. On the other hand, the fact that the teacher was more active in the presentation and evaluation stage supports his hesitations and difficulties about where and how to intervene in the modeling process. The relevant literature and the results of this research show that teachers must have unique pedagogical knowledge in teaching mathematical modeling.
Keywords: Mathematical modeling, teacher intervention, classroom implementation.

Matematiksel Modelleme Öğretiminde Öğretmen Müdahalelerinin İncelenmesi: Bir Ortaokul Öğretmeni Örneği

***Öz*:** Matematiksel modelleme öğretiminde en önemli konulardan biri matematiksel modelleme uygulamalarında öğretmenin sahip olması gereken pedagojik bilgidir. Ders uygulaması sırasında öğretmenin kullandığı müdahaleler ise pedagojik bilgisinin dışavurumudur. Bu sebeple matematiksel modelleme öğretiminde öğretmen rolünün tanımlanmasında belirleyici etkiye sahip olan öğretmen müdahaleleri araştırılması gereken önemli bir faktördür. Bu çalışmada matematiksel modelleme eğitimine katılan bir ortaokul matematik öğretmeninin eğitimden sonra sınıf içi matematiksel modelleme uygulamalarının birinde kullandığı müdahale türleri incelenmiştir. Sekizinci sınıf öğrencilerinden oluşan 20 kişilik bir sınıfta "Kavşak Düzenleme" probleminin (2 ders saati) uygulamasına ait videolar transkript edilmiş, gözlemci notları ve öğrenci çalışma kağıtları ile desteklenerek içerik analizi yöntemi ile analiz edilmiştir. Elde edilen bulgular öğretmenin en çok duyuşsal müdahaleler ile ortam ve etkileşime yönelik müdahalelerde bulunduğunu göstermektedir. Öğretmenin içeriğe yönelik müdahalelerden kaçınması, stratejik müdahalelerde bulunmaması ya da müdahale etmemesi ise öğretmenin modelleme sürecini etkilemek istememesinden kaynaklandığı düşünülmektedir. Öte yandan sunum ve değerlendirme aşamasında daha etkin olması modelleme sürecinde nerede nasıl müdahale edeceği konusunda tereddütler ve zorluklar yaşadığını desteklemektedir. Yapılan çalışmalar ve bu araştırmanın sonuçları matematiksel

* Data in this study was taken from a research project that was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under grant 117K169. The views expressed do not necessarily reflect the official positions of the TUBITAK. This article is approved by the Ethics Board of the Education Science and Social Work Institute at Erciyes University, TURKEY. The permission date 23/02/2016, no 12.
** Asst. Prof. Dr., Kilis 7 Aralık University, Kilisli Muallim Rıfat Faculty of Education, ORCID: 0000-0003-3202-8852, e-mail: seda.sahin@kilis.edu.tr
*** Assoc. Prof. Dr., Adıyaman University, Faculty of Education, ORCID: 0000-0002-5301-9034, e-mail: mfatihdogan@adiyaman.edu.tr
**** Prof. Dr., Adıyaman University, Faculty of Education, ORCID: 0000-0002-2412-5882, e-mail: rgurbuz@adiyaman.edu.tr

modellemenin öğretiminde öğretmenlerin özel bir pedagojik bilgiye sahip olmaları gerektiğini ortaya koymaktadır.
Anahtar Kelimeler: Matematiksel modelleme, öğretmen müdahalesi, sınıf içi uygulamalar.

Introduction

The importance of mathematical modeling in mathematics education is increasing in Turkey, as in many countries, and modeling skills are becoming an essential part of curricula. Despite the increase in the variety and quality of studies on mathematical modeling, this needs to be adequately reflected in classroom practices. There may be many reasons for this, but one of the most important is that mathematical modeling differs from traditional problem-solving. Compared to traditional problem solving, mathematical modeling has a complex structure and a cyclical process that may cause a cognitive obstacle (Galbraith & Stillman, 2006), and this is a common problem that students have difficulties in the modeling process (Tropper et al., 2015). Difficulties experienced in teaching mathematical modeling are not limited to student difficulties; teachers also experience various problems in this process (Borromeo Ferri, 2018; Tropper et al., 2015). Considering that the most critical factor in having effective teaching is teaching practices (in-classroom practices) (Blum & Borromeo Ferri, 2009), the teachers have a crucial role in this process (Niss et al., 2007; Blum & Leiss, 2005). Research on the issues that the teacher's role in implementing mathematical modeling problems draws attention to *the balance* between students' independent work and teachers' directly guiding them. (e.g., Borromeo Ferri, 2018; Blum & Borromeo Ferri, 2009; Leiss, 2007). One of the difficulties teachers experiences while enacting the task is teachers' decisions about whether or how to intervene during an autonomous activity such as mathematical modeling (Leiss & Wiegard, 2005). Thus, it is essential to eliminate the teachers' lack of knowledge in choosing the appropriate method when following the students' solution processes and intervening in their difficulties (Blum & Leiss, 2005). The relevant research on teachers' pedagogical approaches while enacting mathematical modeling activities and methods of identifying and responding to emerging student difficulties (e.g., Blum, 2005; Blum & Leiss, 2003; Borromeo Ferri, 2018; Garfunkel et al., 2016; Leiss & Wiegand, 2005; Stender, 2018) point out recommendations that might serve as a guide for teachers on enacting modeling activities and the types of interventions that the teachers may have during those activities. The results from all these studies show that a *balance between "teacher guidance" and "independent student work"* should be achieved based on successful practices. In this context, strategic interventions that give students metacognitive hints are sufficient to establish the *balance.* The strategic interventions might be such as "Imagine the situation," "What are you aiming for?", "What is still missing?", "Does this result fit real life?" and should be interventions that do not violate the students' independent work (Blum & Borromeo Ferri, 2009). Of course, there is no set of rules to follow in teaching mathematical modeling, and it is not true that one intervention is always more effective than the other. However, strategic support based on the correct diagnosis has a decisive effect on the students' success (Stender & Kaiser, 2016). The important thing is that the teacher evaluates the situation within the context and uses the most appropriate intervention (Blum & Leiss, 2003; Blum & Borromeo Ferri, 2009; Leiss & Wiegard, 2005). Presenting an intervention framework to teachers is the first and most crucial step in understanding the situations that the teacher will face (Leiss & Wiegard, 2005). Because even the best and most experienced teachers have the space for improvement, criteria (such as intervention framework) in quality mathematics teaching should be a part of teacher education (Blum & Leiss, 2003). The purpose of this study is to examine the interventions of a mathematics teacher who attended a mathematical modeling workshop and discuss these interventions' effects. This research aims not only to reveal teacher interventions but also to show how mathematical modeling activities are enacted in the classrooms. Thus, the research question is, "What are the types of interventions a mathematics teacher uses during the classroom implementation of the mathematical modeling activity?".

Literature Review and Theoretical Framework

Teacher support is indispensable in the mathematical modeling process so that students can work as autonomously as possible and be successful in mathematical modeling problems based on real situations. However, how this support can be realized is not a fully answered question (Stender, 2018). In research examining the role of the teacher in managing the whole process in mathematical modeling practices (e.g., Blum, 2005; Borromeo Ferri, 2018; Manouchehri et al., 2020; Leiss & Wiegand, 2005) and in research on teacher interventions that can be demonstrated when faced with student difficulties (e.g., Didiş et al., 2016) emphasized that teachers should have pedagogical competence in teaching mathematical modeling. Manouchehri et al. (2020) investigated the nature of teacher interventions in the modeling process and the effects of these interventions on fifth-grade students' modeling practices. They revealed that the interventions directly affected students' reasoning, structuring, mathematical work, and testing of their ideas.

One of the teacher competencies in teaching mathematical modeling, which Borromeo Ferri and Blum (2009) laid the foundations for and which Borromeo Ferri (2018) examined in detail, is the instructional dimension. The components of this competency are classified as (a) planning a lesson based on mathematical modeling activity, (b) implementing the activity, and (c) making appropriate interventions during the implementation and giving support and feedback to the students. In the instructional dimension, the competencies of making and implementing a lesson plan on mathematical modeling problems are at the forefront. This is a critical competency for maintaining the balance between theory and practice. The instructional dimension covers all practices, including how teachers enact modeling activities in the classroom, support students during the implementation, and give feedback. Borromeo Ferri (2018) defined competence directly related to this teaching competence as the diagnostic dimension. The diagnostic dimension includes the ability of teachers to see the difficulties that arise in the mathematical modeling process and to evaluate mathematical modeling activities. Diagnosing the students' difficulty is the first step in providing appropriate support and feedback interventions to students during instruction. Diagnosis provides an understanding of the students' solutions, and only after diagnosing the difficulty teachers may give individual support, feedback, or intervention to their students.

Deciding which activity to implement, recognizing different models and possible students difficulties that may be encountered during the modeling process, and deciding how to implement the activity are included in the lesson planning process. In particular, anticipating students' difficulties is essential for effectively implementing the activity. Because anticipating such difficulties enables teachers to understand student questions or their explanations during the implementation and to have effective intervention (Borromeo Ferri, 2018; Leavitt & Ahn, 2013; Stender, 2018). In addition, teachers' knowledge and interpretation of the activity directly affect students' diagnostic and intervention actions in the problem-solving process (Blum & Borromeo Ferri, 2009; Blum & Leiss, 2005; Krauss et al., 2008). The first step in implementing the mathematical modeling activity is ensuring that all students can access the problem text and understand it individually (Blum & Borromeo Ferri, 2009). While the teacher or volunteered students can read the problem situation, all students may be asked to read the problem individually (Blum, 2011; Borromeo Ferri, 2018; Leavitt & Ahn, 2013; Schukajlow et al., 2012). It is vital to ensure that students understand the problem and form their ideas before starting group work. Students may work on modeling activities individually, but it is more appropriate to have students work in groups as this process is open to interpretation, idea generation, and discussion (Borromeo Ferri, 2018; Didiş Kabar et al., 2021; Ikeda et al., 2007; Koellner-Clark & Lesh, 2003; Zawojevski et al., 2003). One of the issues that the teacher should pay attention to is that group discussions are not teacher-oriented; to be student-centered. In this way, students will freely explore the problem situation and have the opportunity to discuss their ideas. Thus, the teacher should

minimize the time she is involved in the group discussion (Blum & Borromeo Ferri, 2009; Leavitt & Ahn, 2013; Stender & Kaiser, 2016) but should not completely isolate herself from the practice (Blum & Leiss, 2005). The success of students who work independently with teacher support and those who work entirely alone is not the same. Students who lack the teacher's support may have motivational, social, and cognitive problems that may cause them to be unsuccessful (Blum & Leiss, 2005). For this reason, the teacher should adjust the level of helping students well (Blum, 2011; Stender & Kaiser, 2016;). This support should be adapted based on the students' performance (Van de Pol et al., 2010). Teachers should decide which intervention to use and at what level by evaluating the existing situation (Leiss & Wiegand, 2005). For example, in the study of Leiss and Wiegand (2005), the teacher preferred not to intervene and only observed in a situation where students could find solutions independently. However, when the teacher thought that the students could not reach the desired solution by discussing, the authors showed examples that the teacher intervened in the content by explaining.

The teacher must be open to all students' ideas during the implementation. Mathematical modeling problems differ from traditional problems, and students should not be directed to use a particular method (Garfunkel et al., 2016; Leavitt & Ahn, 2013). Students should experience complexity and uncertainty about which variables to use and how to use them. Students should be allowed to express themselves to clarify these ambiguities while walking around the groups. When students are asked to explain, expressing their thoughts aloud enables them to review or clarify their ideas (Stender, 2018; Stender & Kaiser, 2015; Stender & Kaiser, 2016). This intervention is the most used and influential teacher intervention in Stender and Kaiser's (2016) experimental research. Manouchehri et al. (2020) also determined that the most used intervention by the teacher in the fifth-grade students' modeling process was asking questions for explanation (30.2%). At the same time, the teacher has an idea about students' thoughts and works with this intervention, and it has a diagnostic role in making a different intervention when necessary (Stender & Kaiser, 2015). If the student is taking the wrong path or making a meaningless explanation, instead of saying that the student's ideas are not correct, the teacher might say, "I do not quite understand what you mean." Such a prompt might enable students to reinterpret their ideas. This way, the student or her groupmates can realize the inconsistency or mistakes and make the necessary changes (Leavitt & Ahn, 2013). Deci et al., (1999) emphasize that the feedback given to students should be wrong or correct and informative about how to proceed. In addition, when faced with such a situation, teachers may encourage students to think about it by presenting the student idea to group discussion with questions such as "What do you think about your friend's idea? Do you agree with her?". In the modeling process, questions that support the reasoning, rather than guiding questions, should be preferred, enabling students to connect their mathematical model with the real-world context. However, such interventions are less frequently used by teachers. In the studies of Manouchehri et al. (2020), the interventions for discussion (3.5%) were the least preferred. In summary, the main criterion that the teacher will pay attention to, including giving information or explanation to the students during the implementation phase of the activity, should be to contribute without affecting the students' modeling process.

Reporting is the last step in the modeling process. Although presenting students' reports and discussing their models is a neglected stage in classroom practices, its necessity cannot be ignored (Hestenes, 2010). Because at this stage, the student groups can recheck their model's functionality while explaining what, why, and how they handled it in the modeling process. At the same time, presenting their models allows them to communicate mathematically with their friends (Garfunkel et al., 2016; Hestenes, 2010). For this reason, when students finish their solutions, it should be ensured that they share their models with their classmates. If time is sufficient, all groups may present their models (Garfunkel et al., 2016). However, if there is no such opportunity, it is sufficient for the teacher to have the groups that have different models present their group works. First, the teacher should clearly state the expectations from students in their presentations. When students complete their solutions, they should prepare their presentation

by knowing what is asked from the presentation (Borromeo Ferri, 2018; Leavitt & Ahn, 2013). It is crucial to hold a question and answer session at the end of each presentation with the whole classroom participation. This will enable the students to listen to better understand the presented model and the opportunity to look at the presentation and models prepared by the students presenting from a different perspective. Thus, teachers should encourage students to ask questions and participate in discussions (Leavitt & Ahn, 2013).

Analytical Framework

The relevant research on teachers' role and interventions in teaching mathematics, specifically in teaching mathematical modeling, classified teachers' interventions under different categories. Leiss et al., (2010) classified teacher interventions under four main categories: collecting information (e.g., what data is given? What the problem ask for?), selecting information (e.g., What is the most important part here?), linking information (e.g., link information from different sources.) and knowledge of the process (e.g., put yourself in the given situation and think about it.). Leiss and Wiegand (2005) compiled research on teacher interventions in mathematics teaching. They classified all types of interventions into four categories: affective (e.g., increasing motivation), metacognitive (e.g., encouraging thinking), related to content (e.g., providing an explanation), and related to the organization (e.g., guiding discussion). The researchers defined a fifth category as a prerequisite for these four categories: diagnostic intervention. This intervention means that teachers choose the most appropriate intervention during the current situation. When the teachers cannot make the correct diagnosis, this may lead them to have an ineffective intervention; thus, an accurate diagnosis is a prerequisite for successful intervention (Stender & Kaiser, 2016). Leiss and Wiegand (2005) emphasize that the correct intervention is as necessary as the correct diagnosis. Having information about students' achievement levels or personal characteristics is as important as a diagnostic intervention in determining the proper intervention. There are also parallel factors that influence teachers' interventions. Leiss (2005) lists these factors as the timing of intervention, the type of problem students engaged in, the level of intervention, and the intervention method. Blum and Leiss (2005) examined teacher interventions during the mathematical modeling process and classified the interventions as interventions for content, environment and interaction, motivation, and metacognition. Metacognitive or meta-level interventions are similar to strategic intervention concepts used by Stender (2018), defined as support that enables students to think independently at a high level. Stender (2018) emphasizes that strategic interventions correspond to the steps of the mathematical modeling cycle. For example, "What does the mathematical result you found mean in the real world?" is one of the reference questions in strategic intervention, the steps of modeling cycles for the interpretation/evaluation or validation. Blum and Borromeo Ferri (2009), in their project (DISUM, COM ^{2}), in which they examined teacher interventions, found that spontaneous teacher interventions were mostly content or environment-oriented and reported that no interventions aimed to ensure students' independence. Stender (2018) stated that in cases where motivational and strategic interventions are insufficient, strategic intervention should be made regarding the content, which is the most challenging intervention for teachers. Blum and Borromeo Ferri (2009) and Leiss (2007) stated that more than the teacher's experience is needed to diversify the intervention types or use the appropriate one as the interventions were content-oriented.

This study follows Borromeo Ferri's (2018) teacher competencies framework in teaching mathematical modeling (for detailed information, see Borromeo Ferri, 2018, p.5) and utilizes the research on teacher interventions (Borromeo Ferri, 2018; Blum & Leiss, 2005; Leiss & Wiegard, 2005; Stender, 2018). Accordingly, the types of interventions for the analytical framework of this research are *diagnostic intervention* (*from* Leiss & Wiegard, 2005), *affective intervention* (*from* Blum & Leiss, 2005; Leiss & Wiegard, 2005), *environment and interaction-oriented intervention (from* Blum & Leiss, 2005), *content-oriented intervention (from* Blum & Leiss, 2005; Leiss &

Wiegard, 2005) *and strategic intervention (from* Blum & Leiss, 2005; Leiss & Wiegard, 2005; Stender, 2018).

Method

This study aims to determine the types of intervention teachers use in a lesson in which the mathematical modeling problem is enacted. This research objective focused on just one of the classroom implementations of a larger project called *Designing, Applying, and Evaluating a Learning Environment Through Mathematical Modeling: Interdisciplinary Transition*. A case study methodology as a qualitative research design was used to identify teacher interventions (Denzin & Lincoln, 2005).

Participants

The participants of this study were a mathematics teacher with six years of experience participating in mathematical modeling workshops and twenty 8th Grade students. The names of the participants in the study are pseudonyms.

Data Collection

The teacher training program, which included theoretical and practical lessons on the theoretical structure of mathematical modeling, the characteristics of modeling problems, planning a lesson to be conducted with these problems, and implementing the lesson, lasted *six* weeks (for detailed information, see Sahin, 2019). After receiving theoretical training on implementing the mathematical modeling problems, the participant teacher conducted a small teaching experiment (4 students from 8th grade) to practice how to implement modeling tasks. Then, the participant teachers and researchers involved in the project analyzed the small teaching experiment. The teaching experiment video was evaluated from different aspects, such as the teacher's classroom and time management, teacher-student interaction, and student-student interaction. The teaching experiment, in which the teacher had the opportunity to evaluate himself, contributed to the teacher's experience in enacting modeling tasks before moving on to the whole class implementation.

The whole class implementation continued for four weeks. One of the researchers participated in all classroom sessions as an observer. There were, in total, four mathematical modeling problems enacted each week for two hours. This study focuses on one of the problems called the "Intersection Problem[1]" which was implemented in the second week for two hours (see Appendix). The students worked on the problems in groups of four formed by the teacher. All sessions were video and audio recorded, and the recordings were for the whole classroom and the group work so that each group's work could be examined in detail.

Data Analysis

All the recordings of the implementation of the problem were transcribed, and the sections where teacher-student interaction was specified. These sections were analyzed using descriptive analysis (Mayring, 2015). The coding scheme, taking into account the relevant literature used in the analysis for the categories, explanations, and sample intervention types, is given in Table 1.

[1] This problem was desingned by participants of *Designing, Applying, and Evaluating a Learning Environment Through Mathematical Modeling: Interdisciplinary Transition Project* (Gürbüz et al., 2018, pp. 101-102).

Table 1
Coding Scheme for Teacher Interventions

Type of intervention	Explanation	Example Intervention Type
Diagnostic intervention	Preliminary intervention to determine the most appropriate response to the situation	Can you explain what you are doing here?
Affective intervention	Trigger intervention that will keep students in their work	Read more carefully what is asked in the problem.
Environment and interaction-oriented intervention	Intervention that supports students' communication with each other	Do you agree with your friend's opinion? Why?
Content-oriented intervention	Situational intervention that will affect the modeling process	It might be easier if you make a circle instead of a rectangle.
Strategic intervention	Intervention in students' metacognitive thinking	Do you think this idea is suitable for real life?
No-intervention	Being unresponsive to the situation or making evasive explanations	You should have known the answer to that.

A consensus was reached by discussing the different codings. The coding was done separately by the researchers, and the level of consistency was checked by the cross-comparison method. In addition, the observer researcher's field notes and the students' solution papers supported the analysis to increase the comments' consistency level by approaching the data in depth and holistically.

Results

This section presents the findings of teacher interventions with examples from the sections where teacher-student interaction happened. First, the following descriptive information is necessary to help readers imagine the classroom atmosphere: Before starting the lesson, the teacher determined the groups and arranged the classroom setting. In the first part of the lesson, before handing out the problem, the teacher started with a short reminder. Since the students had experience engaging in the mathematical modeling problems from the previous class, the teacher should have talked about how to engage in group work and lesson structure.

1 **Teacher**: All, you are in a group of four. You may have different ideas,
2 but in the end, we want your group's conclusion that you all agree on. Okay?
3 You can discuss the question among yourselves, argue, and scribble, but
4 first of all, you need to read the question I handed out. Everyone should read the question individually.
5 If there is a point that you do not understand, ask for clarification on the question in advance.
6 ***After a few minutes…***
7 **Teacher:** Yes, did you read the question?
8 (some of the class said yes, and some said no)
9 **Teacher:** Is there anything not understood here?
10 **Melih:** Sir, will you give the area of this here? (showing the intersection in the picture)
11 **Teacher:** No. You will try to find the area. So you see the picture there. Based on that,
12 you can make a logical conclusion.
13 **Ali:** (showing the intersection picture to the Teacher) Teacher, are we going to deal with this?
14 **Teacher:** Yes, we will plant flowers there. You will plant the inside of the intersection you see.
15 A student: Sir, there is no information, no information. No meter information, nothing, Sir.
16 **Teacher:** Maybe not. What I want from you is to be able to guess it.

The teacher, who wanted each student to read the problem individually, distributing the problem to all students. From the teacher's first explanations (1st-3rd lines), he emphasized that

he encouraged students to work in groups (*environment and interaction-oriented intervention*) but first wanted that they should understand the problem individually before moving on to group work (lines 3rd-5th) (*affective intervention*). After giving his students a few minutes to read and understand the problem, he asked the class if they understood the problem (*diagnostic intervention*). When one of the students asked about the intersection area, the teacher effectively intervened with the student (lines 11-12). The lack of numerical data in the problem generally needed to be clarified for the students. When a student expressed this confusion, the teacher avoided giving a guiding explanation and again made an affective intervention (line 16). After this dialogue, the teacher started the group work by stating that the flower types and unit prices are given in the Appendix and that the unit represents a flower seedling.

During the implementation, the teacher followed each group's work by observing both from a distance and closely. The teacher, who preferred not to be involved in the discussions between the students, mainly intervened when they asked questions. For example, the third group discussed how to calculate the area covered by the flowers, but when they could not agree, they wanted to ask the teacher:

1 **Ahmet:** Sir, can you look? What would the area covered by the flowers be?
2 **Melih:** Sir, the area covered by the flowers?
3 **Teacher:** (To the whole class) All, we have all passed this intersection dozens of times. We have seen it in bloom, too. I have an approximation of the area covered by the flowers there.
4 **Ali:** I do not solve this question (in a way that the teacher will not hear).
5 **Melih: T**here is no such thing; we will solve it.

As seen in this dialogue, the teacher did not explain to the students in the group but the whole class (3rd line). This explanation, considered an affective intervention, was not sufficient or meaningful for the students (4th-5th lines).

While the teacher followed the groups' solutions, he watched the students in the fifth group without interfering in the discussion about whether they should use the flowers with the lowest cost or make a design they wanted and determine the cost accordingly, but after a while, he was included in the discussion at the request of the students.

1 **Adil:** Which is the cheapest?
2 **Ferit:** Violet.
3 **Adil:** We can have violets.
4 **Barış:** He did not say anything like that.
5 **Adil:** How do we do it conveniently, then?
6 **Barış:** For one thing, he never said anything about the most convenient or the cheapest. Why are you saying such a thing?
7 **Adil**: Look, it says to determine the cost.
8 **Barış:** Okay, it says, determines the cost. It does not mean it is cheap. He asks how we
9 determine the cost.
10 **Ferit:** We will choose the cheap one. Cheaper is better.
11 **Barış:** Okay, it says to determine the cost; it does not say to do what is cheapest.
After a few minutes…
12 **Barış:** (He turns to the teacher when he cannot convince his friends) It did not give any information.
13 **Adil:** Yes, Sir. There needs to be more information.
14 **Teacher:** Guys, there is enough information. You have to conduct some of this information yourself. Isn't it?
15 **Barış:** Teacher, how do I know how much space this tassel flower occupies?
16 **Teacher:** From your picture. You are smart kids. You have a photograph.
17 **Barış:** Sir, it did not say the cheapest either.

The students tried to determine the variables in the modeling process. However, they could not succeed because of the difficulties they experienced in understanding the problem. Especially in the first part of the dialogue (Lines 1-11), when Barış could not convince his friends after the differences of opinion among the students, he turned to the teacher. Barış and his other friend asked the teacher for help because they believed there was insufficient information on the problem (Lines 12-13). The teacher had an affective intervention here. However, it is clear from the next student question that this intervention was insufficient for the students (Line 16). Upon this, the teacher again made a motivating affective intervention (You are smart kids) and a content-oriented intervention to give the students a clue that they could benefit from the flower pictures in the problem. The problem that the students experienced in the understanding step, which is the first step of the modeling process, was not resolved, which led to in-group conflict for a while. Eventually, they decided that the least cost would be the most appropriate solution and created a suitable model.

The students tended to continue with the solution by getting approval from the teacher about the correctness of their ideas throughout the modeling process. In such cases, the teacher made affective interventions that encouraged students to do what they thought without directing them. For example, while calculating the radius of the intersection, a student from the first group asked the teacher whether it would be correct to determine the diameter after counting the paving stones surrounding the intersection and calculating the circumference of the intersection. Before this question, the student shared his opinion with his group of friends but wanted to ask the teacher before having a final decision.

1 **Gazi:** Sir, can't we first count these (paving stones), calculate the circumference, and then find the radius?
2 **Teacher:** Count. Why not count?

As in this short dialogue, even if the students discussed their ideas in the group when they could not convince each other, they tended to ask the teacher for their ideas, which they believed to be correct, with the desire to always get approval from the teacher. In such cases, the intervention shown by the teacher was generally affective, short-answer interventions (yes, you are right, you are right, etc.).

While walking around the class, the teacher observed that the students were trying to remember the area formula of the circle and arguing among themselves. However, he did not directly interfere with any group. After the first group decided that the radius of the intersection in the picture was six meters on average based on the dimensions of the car and the paving stones in the picture, they asked the teacher for help because they could not remember the area formula of the circle. The following dialog was recorded at this time:

1 **Metin:** Sir, is not the area (area of a circle) diameter x pi?
2 **Mustafa:** Area is radius x radius x pi
3 **Teacher:** We learned this topic last year.
4 **Metin:** Radius squared x pi squared.
5 **Mustafa:** (turning to Ali) No. Isn't it radius equal to 6? 6 x 6 = 36. It will be 36 x 3.
6 **Teacher:** (He asks the class to listen to him) If you remember last year, which most of you do not remember… The area of a circle with a radius of r is πr^2 (written on the board). You can approximate the value of Pi.

The teacher did not first intervene in the students' questions regarding the area formula of the circle (Line 3) and then make a statement to the whole class and remind them about what they learned in the previous year. While following the groups, the teacher noticed that most could not remember this formula and argued among themselves, but he did not intervene. The teacher intervened in this difficulty by explaining to the whole class together after the first student

question (Line 6). This intervention, which is necessary for students to continue their work, was considered a content-oriented intervention.

The teacher mainly had affective interventions during the implementation but also used different interventions, albeit in small numbers. While visiting the groups, he encouraged students to work together. For example, when the fifth group said that they completed the solution, the teacher visited the group, and the following dialogue took place:

1 **Ferit:** Sir, we are done.
2 **Teacher:** Very nice. Check your solution. Maybe you can come up with a better idea.
3 **Adil:** Sir, we thought a lot. As a result, we have an approximate result.
4 **Teacher:** Did Hüseyin have any contribution? (Hüseyin was a student who did not care much about the problem during the process) Hüseyin seemed to be dealing with the phone all the time.
5 **Group:** He helped a lot (with a sarcastic tone).
6 **Ferit:** Honestly, I did it alone, Sir.
7 **Teacher:** If you think you did most of it, discuss it with your group and get their opinion.

The following dialogue occurred between the researcher and the fifth group: in this dialogue, the teacher had one affective intervention to the group who said that they finished their solutions in 20 minutes (Line 2) and had one environment and interaction-oriented intervention (Line 7). The indecision experienced by this group at the understanding stage of the problem was reflected in the whole process, and two students wanted to avoid contributing to the solution because of the disagreement between the group members. This can be seen from the above dialogue; the teacher was also aware of this situation. Since the teacher did not interact with their work after completing their group solution, the students wanted to interact with the researcher in the classroom.

1 **Group:** Sir, can you look? This is how we did it (they show their solution).
2 **Researcher:** Did you plant one flower per square meter?
3 **Group:** Yes.
4 **Researcher:** What do you think it will look like? Just imagine. There is one flower in 1 square meter.
5 One flower per 1 square meter…
6 **Group:** (no answer)
7 **Researcher:** So how much is 1 square meter?
8 **Ferit:** Something like this (drawing an imaginary square on the table with an average size of 50 cm)
9 **Adil:** Something like this (drawing an imaginary square with dimensions similar to Ferit's)
10 **Researcher:** Ferit, How long can 1 meter be?
11 **Ferit:** 1 meter… something like this (it shows 50 cm on average)
12 **Researcher:** What do you think?
13 **Mert:** I think that is it.
14 **Adil:** Sir, something like this (he shows an average length of 50 cm with his hand)
15 **Researcher:** How did you calculate?
16 **Adil:** Spanning.
17 **Researcher:** How many cm is your (hand) span?
18 **Adil:** I do not know, but it is about 25 cm.
19 **Ferit:** If it is 25 cm, it will be 50 cm by two spans. We planted a flower in this area. It already takes up space.
20 **Researcher:** Wait a minute. I could not understand this. You took one side 50 cm. Then did you take the area 50 cm by 50 cm?
21 **Ferit:** Yes, sir, something like that (other students also approve). This is how I planted it. (showing the picture).
22 **Researcher:** Well, let us review it. Discuss again. Does it make sense to you? Write your report later.

The researcher's interventions in this dialogue were not analyzed as teacher interventions. However, they were shared because it reveals how effective teacher intervention is in mathematical modeling practices. The researcher first made a diagnostic intervention (Line 1) and then strategic interventions (Lines 3-4 and 6) to determine why the students thought this way. The researcher also observed the students' disagreement and lack of communication in the group. Therefore, the researcher asked the other group members to express their thoughts and asked them to justify them. Then, the researcher asked students to explain their models. The students' idea of planting one primrose per square meter did not fulfill the reality creteria for their model. Although the students made acceptable estimates while calculating the length of the vehicles, they needed to transition from the length to the concept of area. The researcher made strategic interventions that would enable the students to notice the inconsistency in their thoughts after they showed the average length of one side to be 50 cm (Lines 7-8) and experimentally tested this with the spanners (Lines 15-19) in their figurative representation of a unit square with a side of 1 m (Lines 20-22) but the intervention was unsuccessful (Lines 20-22). The researcher tried not to interfere with the students' models directly and to preserve her status as an observer and asked the students to review their models by enabling them to think metacognitively with strategic interventions. If the teacher, instead of the researcher, asked those questions, he could be aware of these difficulties and have had affective interventions to eliminate them.

The teacher periodically reminded the students about the time to complete the problem at the beginning of the class (40–45 minutes) and gave the remaining time to finish their solutions. The teacher ended the implementation part of the problem after assuring all groups had finished their solutions to the problem.

The presentation and evaluation phase was launched after completing the problem-solving and reporting processes. At this point, the teacher requested each group to choose a student or students to present, and the presentation was ordered per the students' preferences. When necessary, other students in the group helped their friends. As a result, everyone in the group participated in the presentations. The teacher made the whole class listen to the students during the presentations and encouraged them to give feedback or ask questions. Following the presentations by the two groups, the instructor led a general class discussion and requested feedback from the students on the groups' models.

The teacher frequently used affective interventions during the implementation phase, but diagnostic and strategic interventions were used in place of those interventions during the presentation and evaluation phase. He stressed the steps of choosing the variables and making assumptions while asking the students to describe how they came up with a solution. He then demonstrated diagnostic interventions with questions to challenge the students' reasoning. For example, the dialogue with the third group about how the intersection area is calculated, which he asked all groups, is as follows:

1 **Melih:** (…) We found the intersection area to be 27 square meters. We got radius three.
2 **Teacher:** How did you find it? What was your starting point? What did you base your ideas on?
3 **Melih:** Sir, there was a car.
4 **Teacher:** Then you took the car as half a meter.
5 **A student from the class:** No, Sir, it cannot be that small.
6 **Teacher:** Did you take the car as your reference point?
7 **Melih:** Yes.
8 **Teacher:** How many meters did you get the length of the car?
9 **Melih:** We got as 2 meters.
10 **Teacher:** Hmm (obviously not convinced). So, taking the length of the car by 2 m, did you consider it side by side, or did you stack the car on top of each other?

11 **Melih:** Teacher, if we got the length of the car as two meters, there is already one meter part left.
12 **Teacher:** Hmm, got it. Yes, after that.

The teacher's inquiry on how they initially determined the area of the intersection (Line 2) was considered a diagnostic intervention. When the student said that they took the length of the car as a criterion, the teacher did not find the group's assumption appropriate for real life and asked the group, "I suppose you took the car for half a meter?". This intervention was coded as a content-oriented intervention. In the continuation of the speech, they said that they took the length of the car as 2 meters, which is inappropriate for real-life situations. The teacher's speaking style indicates that, although being aware of this, he continues without intervening. When the teacher inquired about the other groups' calculations for the intersection area, the first group again engaged in the following dialogue with the teacher:

1 **Teacher:** I was wondering how the other groups found the area. Any other ideas? Let us give Gazi a voice.
2 **Gazi:** Sir, we calculated by counting the pavements.
3 **Teacher:** By pavement, do you mean stones?
4 **Gazi:** Paving stone.
5 **Teacher:** Yes, how did you calculate from there?
6 **Gazi:** We calculated each pavement as half a meter.
7 **Teacher:** Okay, you have calculated half a meter each.
8 **Gazi: As** you can see from here, it is the radius. We counted this place and found its area accordingly.
9 **Teacher:** Did you count and find the radius?
10 **Gazi:** Teacher, we counted and found the circumference. Then from there, we find the radius and find the area.
11 **Teacher:** So, what did you find in the area?
12 **Gazi:** 108.
13 **Teacher:** Did you find 108? They found almost the same result with a different method (as Group 5).
14 **Gazi:** we counted 72 of them that we can see. It is 36 meters. It has a circumference of 36 meters. When we divide it by three, we get pi as 3, so the diameter is 12, and the radius is 6 meters.

The teacher asked first to describe how they solved the problem to help the other students understand the solution; rather than as a diagnostic intervention, the teacher asked first to describe how they solved the problem. The teacher determined what this group did while following their modeling process during the implementation phase. However, the teacher guided them to explain in detail to the whole class to ensure everyone understood their solution clearly. Therefore, depending on the teacher's intention, this intervention is called environment- and interaction-oriented. While explaining the models of all groups and encouraging others to understand and ask questions, the teacher asked students to compare their solutions and models with other groups. These environment and interaction-oriented interventions were not used to find the best or the most accurate model by comparing the students' models but were used so that they could see the deficiencies and mistakes in their solutions. For example, the teacher, who realized during the implementation phase that the fourth group calculated the intersection area as 50 square meters, wanted to let them see their mistakes by asking them to present their solution. The conversation that follows is captured at this moment.

1 **Teacher:** Now, what caught my attention is this. Some of you thought about the area and said, for example, there should be one flower in 1 square meter; some of them found it by thinking about the distance, not the area. Let us also ask how other groups found the radius. How did you find the radius?
2 **4th group members:** Sir, we took a wild guess.

3 **Teacher:** Did you guess without knowledge, or do you say it is (this) because of (this)?
4 **4th group members:** Sir, we guessed the radius but chose the most logical one.
5 **Teacher:** You say you had a wild guess but also chose the logical one… a wild guess
6 means: "I have no idea; I could not make any sense." What is the logic in this?
7 **4th group members:** Sir, now it cannot be 108 square meters, so this is the intersection. It would be ridiculous.
8 **Teacher:** For example, would it be absurd if I said it is 100 meters?
9 **4th group members:** Yes.
10 **Teacher:** Why? Maybe that car is 20 meters long? So why would it be silly? Because I thought about my car, and 100 meters would be ridiculous. What number of square meters did you accept, then?
11 **4th group members:** around 50 square meters.
12 **Teacher:** Did you start from the radius, or did you guess the area directly?
13 **4th group members:** We tried to guess by looking at the area.

As seen in the conversations above, the fourth group was asked to find their mistake based on the criteria and solution strategies that the other groups had. The teacher, who made a strategic intervention by asking them to justify their solution, thought 108 square meters was a large area for an intersection. The teacher emphasized the importance of making logical assumptions without questioning the reason behind that idea. The teacher turned to the second group's solution without intervening when the students said they only made a wild guess. In the second group, the students calculated the intersection area as 27 $m^{2,}$ considering that the radius would be 3 meters. After this dialogue, the other students had to reconsider the relevance of their models for real-life:

1 **Teacher:** How did you find the girls? Did you base the length of this pylon on the car?
2 **Group 2:** It seems so.
3 **Teacher:** It seems so. Understood. Like the other group, you made a decision rather than having data.
4 **Group 4:** Sir, if they found 108 square meters, this intersection would be half as much as our house.
5 **Teacher:** Hmm… That also makes sense to me now.
6 **Group 3:** Sir, they are telling the truth.

The second group was also unsuccessful in justifying their models, using estimated values without any criteria when determining the intersection area. On the other hand, the fourth group students criticized that the first and fifth groups' models were inappropriate for real life (Line 5). The teacher gave a reaction in which he agreed with this criticism. However, students in other groups also supported this idea. The teacher did not have a classroom discussion as the time was over for the lesson.

During the presentation and evaluation stage, where all groups were allowed to explain their models, the evaluation of the models was made relatively through the discussions during the presentation. However, the lesson was finished without a precise evaluation of the models and implementation. The types of intervention used by the teacher throughout the implementation are predominantly affective interventions. The environment and interaction-oriented interventions were the second most common ones, but content-oriented and diagnostic interventions were less used. The type of strategic intervention for students' metacognitive thinking was used only once during the implementation. Furthermore, there were situations where the teacher did not intervene during the implementation. All intervention types and frequencies used by the teacher throughout the implementation are given in Table 2.

Table 2
Types of Interventions Used and Frequency of Use

Type of intervention	Explanation	Frequency (n)
Diagnostic intervention	Preliminary intervention to determine the most appropriate response to the situation	3
Affective intervention	Trigger intervention that will keep students in their studies	9
Environment and interaction-oriented intervention	Intervention that supports students' communication with each other	5
Content-oriented intervention	Situational intervention that will affect the modeling process	3
Strategic intervention	Intervention in students' metacognitive thinking	1
No-intervention	Being unresponsive to the situation or making evasive explanations	5

The total number of interventions used during the implementation of the Intersection Arrangement problem was determined as 26. These intervention types are predominantly affective (n=9); strategic intervention (n=1) is the least used.

Discussion and Conclusion

One factor that directly affects the teaching of mathematical modeling is in-class practices. Thus, the teacher must be competent in implementing mathematical modeling problems (Borromeo Ferri, 2018). Teacher interventions evaluated within the scope of this competency should support students' modeling skills and mathematical learning. Considering the open-ended nature of mathematical modeling problems, it is difficult for teachers to intervene immediately and accurately to every different idea and solution approach. The teacher's intervention repertoire and practice experience will increase the rate of making the right interventions (Krauss et al., 2008). This study aims to determine the types of interventions a teacher employs when implementing the mathematical modeling problem in the preparation, application, presentation, and evaluation stages.

As mentioned earlier, the Intersection Arrangement Problem is the second mathematical modeling problem implemented in this class. Therefore, the students partially know that the mathematical modeling problem differs from other problems. In addition, the teacher made brief reminders before the lesson about the implementation time for the mathematical modeling problem and how to work together (group work). The teacher divides the students into groups of four (Borromeo Ferri, 2018; Ikeda et al., 2007) and considers the students' characteristics and performances while forming the groups (Berry, 2013; Garfunkel et al., 2016; Zawojevski et al., 2003). However, despite the teacher's attention, one group (Group 2) remained relatively passive when solving the mathematical modeling problem compared to the other groups. In another group (Group 5), communication problems were observed among students. There may be various reasons for experiencing such difficulties, such as the problem's difficulty or the students' problem. On the other hand, the teachers' consideriations of forming the groups may need to be more suitable for a lesson on the mathematical modeling problem. As in Leavitt and Ahn's (2013) studies, students may have behaviors such as a different way of participating, level of contribution to the group, and leadership role during mathematical modeling activities than in a regular classroom.

The teacher made deliberate and effective interventions when presenting the problem during the implementation of the mathematical modeling problem. Understanding the problem situation by all students is the fundamental element of the model-building process. After reading the problem, the students stated that although they understood the problem, they were unable to solve it because they believed the information provided needed to be more and more. This situation, which can be defined as "missing data" for students, is one of the challenges encountered in many studies (e.g., Borromeo Ferri, 2020; Sahin et al., 2019). Borromeo Ferri (2020) also obtained similar results in examining a ninth-grade teacher's implementation of a mathematical modeling problem and revealed that the teacher made small non-directive interventions. This study determined that the teacher had similar interventions, which were called affective interventions. The teacher's pre-lesson preparations for presenting the problem and his foresight into potential student questions may have contributed to his affective intervention during the preparation stage.

The teacher walked around the classroom, examined every group, and generally preferred to monitor the work from a distance, as advised in the second stage of the modeling cycle, which aims to solve the problem (e.g., Blum & Borromeo Ferri, 2009; Leavitt & Ahn, 2013; Stender & Kaiser, 2016). He only listened to the students' work in the parts where he asked them to describe what they had done. However, this diagnostic intervention is one of the central interventions that will allow students to review their thoughts and assist the teacher in determining how and at what level to intervene (Stender & Kaiser, 2016); the primary motivation for the teacher to act in this way is to maintain the students' highest level of freedoms. Because following this interaction, the students were frequently blocked from their circumstances by powerful interventions that motivated them. This could result from the teacher education program's emphasis on fostering an environment in the classroom that supports students' independent work by avoiding directive interventions. There are, however, more effective ways for the instructor to entirely stepback during the implementation (Blum & Leiss, 2005). However, the relevant literature showed that the teacher should be a guide in creating such an environment in their teaching, and it is shown theoretically and practically that it is critical to establish a *balance with strategic interventions* (Blum & Borromeo Ferri, 2009; Borromeo Ferri, 2018; Leiss, 2007; Stender, 2018, 2019). As a natural consequence, it is crucial that the teacher not only intervene when students ask for help in the modeling process but also create a learning environment where they can put forward their ideas and question and discuss other ideas. However, many of the teacher's interventions during the implementation stage were reactions to the students' request for assistance and did not reach the level of strategic intervention. Leiss (2010) also stated that teachers do not prefer to use strategic interventions and found that such strategies remained in the background for teachers.

One of the difficulties encountered during the implementation phase was that the students had difficulties transferring the formulas/operations they knew mathematically to solve real-life problems. Such problems when bridging the real-world and the mathematical world are typical difficulties in other studies (e.g., Borromeo Ferri, 2020). An example of these difficulties was their inability to adapt the area formula of the circle, which should be used in solving the problem, despite having seen it in previous lessons. Similarly, the fact that students (Group 5), who did not have any problems in mathematical operations related to calculating the area of the square, took the side length of a square area of 1 m^2 as 50 cm during the modeling process was a difficulty they experience while passing from the mathematical world to the real world. The teacher did not notice this difficulty experienced by the students or did not intervene. While dealing with this challenge, the students wanted to share their models with the observer researcher. The researcher, with strategic interventions, tried to have the students question their ideas. However, cognitive inquiries were insufficient for students to understand their mistakes, as the researcher refrained from intervening due to his role as an observer. This situation, which the teacher ignored or failed to notice during the implementation phase, emerged once again during the presentation and evaluation phase. Here, the teacher only asked why they made such a design. However, he needed

more information about its applicability in real life because he did not question it mathematically. When the other students were asked about planting a flower in their models in an area measuring 1 m^2, they were informed that this distance was improper. However, the presentation was finished without adequate discussion. This is a remarkable example of how a mathematical difficulty can be revealed through mathematical modeling and how important the teachers' interventions are in this process.

During the presentation and evaluation phase, the teacher asked the two groups to present their works and ensured that the other groups shared their ideas about the presented models. The teacher used more diagnostic and strategic interventions at this stage than the implementation process. While questions such as "What did you do here?" were only asked to follow how the students carried out the modeling process, questions such as "Why do you think so?" were used within the scope of the diagnostic intervention during this phase and continued with strategic interventions. The teacher specifically stressed and intervened when the students' theories regarding how the radius of the intersection was determined during the presentation and evaluation stage. This is crucial to the problem's solution since identifying the intersection area with reasonable assumptions allows models to form that apply to real-world situations. However, the model's appropriateness for the real world is affected by variables including planting distance, flower orders, and flower cost. The teacher's concentration may improve the students' ability to express their unique thoughts on factors and assumptions that are significant to them. As a result, the teacher's knowledge and expectations about the activity directly affect the diagnosis and intervention practices in the problem-solving process (Blum & Borromeo Ferri, 2009; Blum & Leiss, 2005; Bozkurt & Özbey, 2019; Krauss et al., 2008). For example, when Blum and Leiss (2005) asked the students what they wanted to say with a word in the problem text during the classroom implementation of a modeling problem, the teacher explained the problem in his way, and this situation led to the students to a standard model.

During the presentation and evaluation stage, the teacher felt more freedom to make changes. This is because the teacher withdraws from the problem-solving process to not interfere with the students' modeling process. Nevertheless, once the students had created their models, the possibility of interference with their models may no longer exist. Teachers frequently struggle with knowing when and how to intervene in implementations of mathematical modeling (Leiss & Wiegard, 2005). However, because mathematical modeling problems are a unique form of the problem and require distinct competencies, learning them takes time for both students and teachers (Borromeo Ferri, 2020; Sahin, 2019). However, considering the learning outcomes, many studies, such as this study, showed that mathematical modeling problems are worth implementing in the classroom. Successful implementation of modeling problems would require teachers to have theoretical understanding and practical ability in mathematical modeling, particularly to maintain a *balance* between students' independent work and guidance (Blum & Borromeo Ferri, 2009; Borromeo Ferri, 2018; Leiss, 2007). When assessing the teacher's interventions overall, the teacher took a more active role in the planning, implementation, and evaluation phases and presented a planned approach while selecting the different types of interventions. However, it is noteworthy that he primarily played the role of an observer during the implementation phase, followed the students' suggestions without interfering, only intervened when the students asked him to, and employed affective interventions. Considering that the intersection problem was the second problem the teacher presented to the class, the teacher attempted to maintain a balance despite his hesitation. This assertion is supported by the fact that he focused more on affective interventions and avoided or did not have content-oriented interventions. While the teachers focused on what the students did in the implementation phase, it was focused on how they did in the presentation and evaluation phases. On the other hand, his inexperience may contribute to his limited use of strategic interventions. The relevant research showed (e.g., Blum & Borromeo Ferri, 2009; Leiss, 2007; Sahin et al., 2020) that although teachers are experienced, they tend to make content and environment-focused interventions rather

than strategic ones and need support in deciding on the best type of intervention. This could result from the teacher's intervention spectrum having expanded in line with their experiences and shifting from affective to strategic interventions. In the project of which this study is a part, the teacher implemented many modeling problems in the classroom. For this reason, it is crucial for teachers to practice mathematical modeling, assess themselves, and improve in order to provide high-quality mathematics instruction.

The results of this study, as discussed in detail above, are consistent with the results of other studies in the literature. The results show that the teacher's ability to enact mathematical modeling problems directly affects students' acquisition of mathematical modeling competencies. It is typical for the teacher to experience some difficulties in this process. For example, the teacher's refraining from intervening, not directing students, and not participating in group discussions without students' demand was among the teacher's difficulties in this study. Establishing the *balance* between "not violating the independence of students" and "guiding" them depends primarily on the teacher' theoretical competence. In this regard, the teacher needs to have knowledge about the problems to be enacted in the class and the types of interventions that can be used. Using appropriate intervention types at the right time is within the teacher's pedagogical knowledge. In the studies conducted (e.g., Blum & Borromeo Ferri, 2009; Leiss, 2007; Temurtas et al., 2021), the fact that even experienced teachers have difficulties in determining the appropriate intervention type in mathematical modeling practices, as in this study, reveals that special pedagogical knowledge is required in the teaching of mathematical modeling. However, before having the knowledge to implement, teachers need to have more detailed content knowledge about mathematical modeling. Thus, studies that examine the modeling process more comprehensively are needed.

References

Berry, B. (2013). An investigation of teachers' shared interpretations of their roles in supporting and enhancing group functioning. *Modeling Students' Mathematical Modeling Competencies: ICTMA 13,* (pp. 471-480). Dordrecht.

Blum, W. (2005). Opportunities and problems for "Quality Mathematics Teaching" – the SINUS and DISUM Projects. In M. Niss et al. (Eds.), *Regular Lectures at ICME-10*.

Blum, W. (2011). Can modelling be taught and learnt? Some answers from empirical research. *Trends in teaching and learning of mathematical modelling* (pp. 15-30). Springer.

Blum, W., & Ferri, R. B. (2009). Mathematical modelling: Can it be taught and learnt? *Journal of Mathematical Modelling and Application, 1*(1), 45-58.

Blum, W., & Leiss. D. (2003). Diagnose- und Interventionsformen für einen selbstständigkeitsorientierten Unterricht am Beispiel Mathematik – Vorstellung des Projekts DISUM. In H. W. Henn (Ed.), *Beiträge zum Mathematikunterricht* (pp. 129-132). Franzbecker.

Blum, W., & Leiss, D. (2005). "Filling Up" -the problem of independence-preserving teacher interventions in lessons with demanding modelling tasks. *CERME 4–Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education* (pp. 1623-1633).

Borromeo Ferri, R. (2018). *Learning how to teach mathematical modeling in school and teacher education.* Springer.

Borromeo Ferri, R. (2020). Make mathematical modeling marvelous! Follow teacher Mr. K. for your lesson tomorrow. *The New Jersey Mathematics Teacher, 78*(1), 44-53.

Borromeo Ferri, R., & Blum, W. (2009). Mathematical modelling in teacher education–experiences from a modelling seminar. *Proceedings of CERME, 6*(2046-2055).

Bozkurt, A., & Özbey, N. (2018). The effect of guided discovery process on gifted students' mathematical modeling skills. *International Congress on Gifted and Talented Education Proceedings Book* (pp. 44-53). Malatya, Turkey.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627.

Denzin, N., & Lincoln, Y. (2005). Introduction: the discipline and practice of qualitative research. In N. Denzin, & Y. Lincoln (Eds.) *Handbook of qualitative research* (3rd ed.) (pp. 1-32). Sage.

Didiş, M. G., Erbaş, A. K., & Çetinkaya, B. (2016). Investigating prospective mathematics teachers' pedagogical approaches in response to students' errors in the context of mathematical modeling activities. *İlköğretim Online, 15*(4), 1367-1384. http://dx.doi.org/10.17051/io.2016.75429

Didiş Kabar, M. G., & Erbaş, A. K. (2021). Pre-service secondary mathematics teachers' anticipation and identification of students' thinking in the context of modelling problems. *International Journal of Mathematical Education in Science and Technology, 52*(2), 208-236.

Galbraith, P., & Stillman, G. (2006). A framework for identifying student blockages during transitions in the modelling process. *ZDM*, *38*(2), 143-162.

Garfunkel, S. A., Montgomery, M., Bliss, K., Fowler, K., Galluzzo, B., Giordano, F., ... & Long, M. (2016). *GAIMME: Guidelines for assessment & instruction in mathematical modeling education*. Consortium for Mathematics and its Applications.

Gürbüz, R., Doğan, M. F., Çalık, M., Çelik, D., Şahin, S., Çavuş Erdem, Z., Temurtaş, A., & Doğan C. (2018). Modelleme etkinlikleri hazırlama süreci [The process of completing the modeling operations]. In R. Gürbüz & M. F. Doğan (Eds.), *Matematiksel modellemeye disiplinler arası bakış: Bir STEM yaklaşımı* [*An interdisciplinary perspective on mathematical modeling: A STEM approach*] (pp. 97-159). Pegem Akademi.

Hestenes, D. (2010). Modeling theory for math and science education. *Modeling Students' Mathematical Modeling Competencies* (pp. 13-41). Springer.

Ikeda, T., Stephens, M., & Matsuzaki, A. (2007). A teaching experiment in mathematical modelling. In C. Haines, P. Galbraith, W. Blum, & S. Khan (Eds.), *Mathematical modelling (ICTMA 12). Education, engineering and economics* (pp. 101–109). Horwood Publishing.

Koellner-Clark, K., & Lesh, R. (2003). A modeling approach to describe teacher knowledge. In R. Lesh, & H. M. Doerr (Eds.), *Beyond constructivism: A models and modelling perspective on mathematics problem solving, learning, and teaching* (pp. 159–173). Lawrence Erlbaum.

Krauss, S., Brunner, M., Kunter, M., Baumert, J., Blum, W., Neubrand, M., & Jordan, A. (2008). Pedagogical content knowledge and content knowledge of secondary mathematics teachers. *Journal of Educational Psychology, 100*(3), 716.

Leavitt, D. R., & Ahn, C. M. (2013). A middle grade teacher's guide to model eliciting activities. *Modeling students' mathematical modeling competencies* (pp. 353-364). Springer.

Leiss, D. (2005). Teacher intervention versus self-regulated learning? *Teaching Mathematics and Its Applications: International Journal of the IMA, 24*(2-3), 75-89.

Leiss, D. (2007). *"Hilf mir, es selbst zu tun": Lehrerinterventionen beim mathematischen Modellieren*. Franzbecker.

Leiss, D., Schukajlow, S., Blum, W., Messner, R., & Pekrun, R. (2010). The role of the situation model in mathematical modelling—Task analyses, student competencies, and teacher interventions. *Journal für Mathematik-Didaktik, 31*(1), 119-141.

Leiss, D., & Wiegand, B. (2005). A classification of teacher interventions in mathematics teaching. *ZDM*, *37*(3), 240-245.

Manouchehri, A., Bekdemir, M., & Yao, X. (2020). Facilitating modelling activities in a grade 5 classroom. *Mathematical Modelling Education and Sense-making* (pp. 187-197). Springer.

Mayring, P. (2015). Qualitative content analysis: Theoretical background and procedures. *Approaches to qualitative research in mathematics education* (pp. 365-380). Springer.

Niss, M., Blum, W., & Galbraith, P. (2007). Introduction. In W. Blum, P. Galbraith, H. W. Henn, & M. Niss (Eds.), *Modelling and applications in mathematics education: The 14th ICMI study* (pp. 3-32). Springer Science + Business Media, LLC.

Sahin, S. (2019). *Investigation of mathematical modeling problem posing competencies of mathematics teachers* [Unpublished doctoral dissertation]. Adıyaman University, Adıyaman, Turkey.

Sahin S., Cavus Erdem Z., & Gurbuz R. (2020). STEM eğitiminde disiplinlerarası matematiksel modelleme etkinliklerinin uygulanması [Application of interdisciplinary mathematical modeling activities in stem education]. In Y. Dede, M. F. Doğan, & F. Aslan Tutak (Eds.), *Matematik eğitiminde etkinlikler ve uygulamaları [Activities and applications in mathematics education]* (pp. 317-341). Pegem Akademi.

Sahin, S., Dogan, M. F., Cavus Erdem, Z., Gurbuz, R., & Temurtas, A. (2019). Prospective Teachers' Criteria for Evaluating Mathematical Modeling Problems. *International Journal of Research in Education and Science*, *5*(2), 730-743.

Schukajlow, S., Leiss, D., Pekrun, R., Blum, W., Müller, M., & Messner, R. (2012). Teaching methods for modelling problems and students' task-specific enjoyment, value, interest and self-efficacy expectations. *Educational Studies in Mathematics*, *79*(2), 215-237.

Stender, P. (2018). The use of heuristic strategies in modelling activities. *ZDM*, *50*(1-2), 315-326.

Stender, P. (2019). Heuristic strategies as a toolbox in complex modelling problems. *Lines of inquiry in mathematical modelling research in education* (pp. 197-212). Springer.

Stender, P., & Kaiser, G. (2015). Scaffolding in complex modelling situations. *ZDM*, *47*(7), 1255-1267.

Stender, P. & Kaiser, G. (2016). Fostering modeling competencies for complex situations. In C. Hirsch (Ed.), *Mathematical modeling and modeling mathematics*: *Annual perspectives in mathematics education* (pp.107-115). NCTM.

Temurtas A., Sahin S., Cavus Erdem Z., Gurbuz R., & Dogan M. F. (2021). Ortaokul seviyesinde matematiksel modelleme uygulamaları [Mathematical modeling applications at secondary school level]. In E. Bukova Güzel, M. F. Doğan, & A. Özaltun Çelik), *Matematiksel modelleme: Teoriden uygulamaya bütünsel bakış [Mathematical modeling: a holistic view from theory to practice]* (pp. 229-246). Pegem Akademi.

Tropper, N., Leiss, D., & Hänze, M. (2015). Teachers' temporary support and worked-out examples as elements of scaffolding in mathematical modeling. *ZDM*, *47*(7), 1225-1240.

Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher-student interaction: A decade of research. *Educational Psychology Review*, *22*(3), 271-296.

Appendix

Intersection Problem

Osman Bey, who works in Adıyaman Municipality, uses various flowers to decorate the intersections with different motifs so that the city has a beautiful appearance. The intersection seen in the photo above will be decorated with different kinds of flowers and motifs by Adıyaman municipality. The municipality asks for your help as a mathematician in this regard. Your task is to determine the number and cost of flowers needed to be able to line the intersection with flowers. Prepare a report detailing how you determined the number and cost of flowers.

NOTE: Do not take into account the bloom times when creating your model. Plants will be planted by the municipality to bloom in the same period. The unit price of the flowers to be used is given in the table.

Name of flower	Image of flower	Unit price	Name of flower	Image of flower	Unit price
Violet		**40 kr**	**Coxcomb**		**50 kr**
Tulip		**60 kr**	**Primrose**		**75 kr**
Hyacinth		**60 kr**	**Chrysanthemum**		**50 kr**

Research Article
Received: 07.11.2022
Accepted: 23.12.2022
Published: 31.12.2022

Citation: Sağlam, Y. (2022). Dialogic or authoritative talk: Which one is more Comprehensible?. *International Journal of Scholars in Education*, *5*(2), 80-89. http://dx.doi.org/10.52134/ueader.1200632

Dialogic or Authoritative Talk: Which one is more Comprehensible?

Yilmaz SAGLAM*

***Abstract*:** The present study sought to explore whether a text supported primarily with dialogic talk is more comprehensible than a text supported with an authoritative one. A phenomenological case study approach was utilized in gathering and analyzing the data. The students' lived experiences with dialogic and authoritative talks were our focus of concern. A total of 14 college students participated in the study. Individual interviews were conducted, recorded, and transcribed. The transcriptions were later analyzed inductively to discover patterns in the data. The results indicated that dialogic talk was found comprehensible by all participating students without any exception. The authoritative talk, on the other hand, was found incomprehensible. According to the students, the dialogic talk is easy to understand because it is written in a step-by-step fashion, comprises daily life words or recognizable with ease, is about a hands-on activity, and is student inclusive. They, further, indicated that the authoritative talk was incomprehensible because it involves technical terms, is superficially written, does not involve experimentation, and does not encourage students to take part.
Keywords: Authoritative talk, comprehensibility, dialogic talk, dialogic teaching.

*Professor, Kilis 7 Aralık University, Kilisli Muallim Rifat Faculty of Education, ORCID:0000-0002-5076-8339, ysaglamdr@gmail.com

Introduction

It is no doubt that today in many parts of the world, monologic teaching is still popular and in use (Molinari & Mameli, 2010). This way of teaching views learning as a transmission of information from teacher to learner and see the learner as a passive recipient. This classical way of teaching, unfortunately, lowers the quality of education. In these classrooms, talking takes place between teacher and students, but it overwhelmingly involves sharing, agreeing, and repeating scientific definitions or facts, excluding those that are not familiar with this technical language. The monologic teaching, because of this, has low quality of the talk. In those classroom environments, only one voice is heard, which is the voice of science. The voices of students (students' personal views) could not be heard. Dialogic teaching, on the other hand, involves multi-voices, encouraging, and welcoming divergent viewpoints. No judgment takes place. This high-quality talk between students and teacher was found to be of crucial educational importance (Mercer et al., 2019).

High-quality dialogue also enhances students' thought processes or mental development. According to Vygotsky (1929, 1930, 1978, 1981), under the guidance of an adult, children learn via imitation. They not only imitate what adult does but also the way they think. To him (1978, 1981), meaning primarily originates from social relations and becomes one's own on the psychological plane via internalization. That is, a child's early talk previously addressing the adult on a social plane later turns inward. This inner talk then mediates the child's thinking (Ibid, 1930). That is, the utterances once arising from adult-child communication begin to re-emerge in the child's inner dialogue, and guide and mediate the child's thinking. Exploring and sharing students' ideas in the classroom, encouraging them to participate in discussions, criticizing, reasoning, and making comments on surfacing ideas, listening to others, demanding alternative solutions, and reaching an agreement are important tenets of classroom dialogue (Dawes et al., 2000). These fundamental actions have a valuable impact on students' thought processes.

In the present study, talk is viewed as a dialogue between teachers and students. A dialogue, in contrast to a monologue, according to Bakhtin (1981), involves multi-voices interacting freely and intentionally. This interaction of voices, to him, creates a dialogue. This perspective, therefore, values the pupil's voice in a particular classroom setting, in which students are expected to articulate their own thoughts rather than replicate words taken from a book. The Education Endowment Foundation (EEF, 2019) recently reported that research results indicated that dialogic teaching led children to advance in language, mathematics, and science. It was further reported that dialogic teaching caused a positive impact on children's confidence and engagement. However, many teachers lack an understanding of the importance of teaching through dialogic talk and the skills required for planning effectual whole class dialogue (Lyle, 2008). Further to that, there are very few studies in the literature about the impact of this type of discourse on students' cognitive development. The present study, thus, aimed to reveal the comprehensibility power of dialogic talk if any.

Theoretical Framework

Dialogic and Authoritative Talk

The idea of dialogic words was first expressed by Mikhail Bakhtin (1981), a Russian linguist and philosopher. To him, unlike others, one can hear many voices in Dostoyevsky's novels. That is, the voices of the characters in Dostoyevsky's novels could be heard independently of the author's voice giving rise to revealing different world views throughout the text. According to Bakhtin, this state of polyphony is distinctive and valuable. To him, in texts,

there are two types of words: authoritative and internally persuasive (dialogic) ones. In authoritative words, there is only one single voice heard, meaning is fixed and not flexible as it comes into contact with other voices. It is further located in a distanced zone, static, and does not allow inter-animation with other voices. However, in an internally persuasive one, at least two voices are heard. It reflects many voices, allows dialogic inter-animation, is not fixed, and is able to reveal new ways to mean.

Inspired by Bakhtin's idea on texts, in 1991, James V. Wertsch documented a relationship between mind, meaning, and dialogue. To him, meaning comes into existence only if two or more voices come into contact. Therefore, meaning-making, according to him, is a dialogic process. He views dialogic talk as speech communication, a chain of utterances addressing one another continuously, filled with dialogic overtones. To Wertsch, understanding, and meaningfulness always involve this addressivity. In this communication pattern, every utterance is a response to a preceding one and has the potential of expecting and confronting counter-words coming from others in contact. Therefore, according to him, dialogicality involves at least two voices freely coming into contact in a sphere of communication and an utterance, a link in the chain of speech communication, is the basic element of concern in the development of meaning or cognitive development of the learner. That is, any true understanding stems from a dialogic inter-animation of voices. An authoritative talk, on the other hand, focuses on recalling scientific facts (Lyle, 2008).

In 1998, this approach to discourse was used by Forman, McCormick, and Donato as a theoretical framework to analyze classroom talk at the middle school level. In the following dialogue, taken from that study, the capital letter *T* stands for teacher, and the letter *S* stands for students. In this dialogue, a group of students is trying to appreciate the perimeter of *Figure 20*, which is not depicted here and has 20 hexagons contiguous to one another. To illustrate, *Figure 3*, depicted below, has 3 hexagons contiguous to one another.

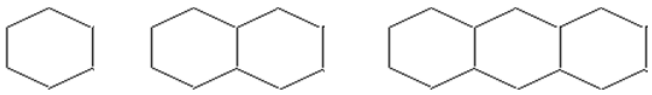

Figure 1 **Figure 2** **Figure 3**

Dialogue 1

35	**T:**	Figure 20, Jimmy.
36	**Jimmy:**	20? Well, see on figure 20 you would count, you see, the sides, each side like for here and here (Points to the end hexagons of Figure 3) it'd be 5. And so you'd take 2 … you would subtract 2 from 20, which would be 18, and you would multiply 18 by 4, because that's all the s-, cause all the sides in the middle have 4 sides and then you would add 10 from the sides.
37	**T:**	OK, so you'd add 10 from the sides. I am sorry Jimmy.
38	**Jimmy:**	And you would multiply the middle by 4.
39	**T:**	And how many in the middle?
40	**Jimmy:**	It would be 18 times 4 and then you'd add 10 and that'd be your answer.
41	**T:**	And add 10. So you could do that for any number I give you.
42	**Jimmy:**	Yeah.

The dialogue above is authoritative because there is only one voice is heard, which is the voice of science. One might oppose this assertion and allege that other than the teacher's voice, Jimmy's voice could be heard, and his ideas could easily be followed in the dialogue. However, a close look indicates that the teacher and Jimmy's utterances are indeed scientific belonging to the language of mathematicians. They seem to share a mutual understanding of a

math solution strategy. When reading it for the first time and being not familiar with this sort of math solution strategy, you might feel alienated. The utterances *you, would subtract 2 from 20, which would be 18, and you would multiply 18 by 4, because that's all the s-, cause all the sides in the middle have 4 sides and then you would add 10 from the sides (Turn 36); OK, so you'd add 10 from the sides (Turn 37); you would multiply the middle by 4 (Turn 38), and It would be 18 times 4 and then you'd add 10 and that'd be your answer (40)* are scientific echoing the words of math. Therefore, in this dialogue, you hear only one voice, the voice of mathematicians. This scientific voice is authoritative, located in a distanced zone, and not disputable, and belongs to no one. That is, the words of math are certain, not questionable or fallible, and belong to the language of mathematics authorities.

Dialogue 2

01	**T:**	Alright hon. (*Previous student sits down*) Let's listen to some other people's ideas so that you'll get it. Eric, what did you discover?
02	**Eric:**	I discovered that it was 6.
03	**T:**	You discovered what was 6?
04	**Eric:**	I mean around the hexagon is 6.
05	**T:**	OK, get up there and tell us that (*Eric goes to overhead projector (OHP)*)
06	**Eric:**	Around the edges, it's 6 (*Points to right most hexagon of figure 3*).
07	**Eric:**	OK, the first one has 6 around it (*Points to figure 1*) and then you take away 1 (*Point to the meeting place in Figure 2 and then to the perimeter of the figure*) because right here it meets. So it'd be 5 plus 5 which is 10. So it adds up to 6 plus 4 is 10 (*Points to figure 2*) so the answer is 4 on each one. You add 4 on each one.
08	**T:**	Alright, just write 10 under that and then show me how when you get to (*Eric writes 10 under figure 2*) OK, so then are you saying for every block that's added it's gonna to go up 4.
09	**Eric:**	Yeah, on here it's 6,6,6, (*Points all three hexagons in Figure 3*) take-away, you take away these ones (*Points to meeting places*) because they meet so it'd be 14. Because here's 5- Wait, no, let's see (*Counts the sides that do not touch another hexagon on the first hexagon of figure three*), it's 5, 5, 5 it'd be 15.
10	**T:**	You have 15. Take a look at your middle one there, honey.
11	**Eric:**	Yeah, OK, I see.
12	**T:**	How many sides in the middle one?
13	**Eric:**	The middle one has 2. So it doesn't have it. So it's 14 because both of the sides meet so it'd be 14.

The dialogue above is on the other hand dialogic. Contrary to the preceding one, there are two voices heard: the teacher's and Eric's voices. Eric's voice involved such utterances as *around the edges (Turn 6); the first one has 6 around it (Turn 7); right here it meets (Turn 7); you take away these ones because they meet (Turn 9) and take look at your middle one there (Turn 10).* As seen in the dialogue, other than the teacher, Eric's own voice could be heard. His utterances are not fully scientific and highly contextualized, which allows one to easily follow and appreciate his ideas. The utterances are freely developed, understandable, open to the participation of others, and disputable. Further to those, the talk involved '*addressivity*'. It involved a chain of utterances addressing one another continuously in the dialogue, in which Eric's responses addressed the teacher, and the teacher's responses in return addressed him, making different voices come into contact.

Research Question

The following question in the present study is the one for which we seek a scientific answer: Is dialogic talk more comprehensible than authoritative talk?

Method

Two types of dialogue were created according to the theoretical framework addressed above. Dialogue I stands for dialogic talk and Dialogue II stands for authoritative talk.

Dialogue I. Dialogic talk

Teacher: (The teacher brings a balloon to the class. He inflates the balloon and dips it into a container of hot water. The students witness the balloon growing in the hot water). Guys, why do you think the balloon gets larger when it is dipped into hot water?
Student 1: Because when it's hot, the balloon gets bigger. The temperature increases.
Teacher: Good. Any other thoughts?
Student 7: The hot water caused the balloon to inflate.
Teacher: Good, how did the hot water cause the balloon to inflate?
Class: (Silence)
Teacher: What kind of heat exchange occurs when we put the balloon in hot water?
Student 8: There is a heat transfer from the hot water to the balloon.
Teacher: What's inside the balloon?
Student 1: There is air, is not there?
Teacher: Well, what is air made of?
Student 4: Various gases.
Teacher: Good, what do you think will happen to the gas particles if the gas in the balloon gets heat?
Student 3: Their temperature rises.
Student 5: They move faster.
Teacher: Good, what happens if they move faster? Imagine them as tiny balls.
Student 2: They try to get out. They press the balloon from the inside and push the inside out. They exert a pushing force.
Teacher: What will happen next?
Student 2: The balloon enlarges.
Teacher: In science, we call this phenomenon expansion of gases.

Dialogue II. Authoritative talk

Teacher: Kids, what do you think EXPANSION means? How can a balloon inflate in hot water be explained?
Student 1: When the balloon heats up, the plastic part softens. As the outside of the balloon softens, it expands.
Teacher: Incorrect, you should think a little more.
Student 2: Heat causes an increase in the kinetic energy of the gas in the balloon. Kinetic energy causes the balloon to inflate.
Teacher: Right, well done… Is there anyone else wants to say this?
Student 7: When the balloon heats up, since the kinetic energy of the gas in the balloon will increase, the pressure inside the balloon increases.
Teacher: Right. The pressure increases. Want to say anything else?
Student 5: Heat causes expansion and an increase in the internal pressure of the gas.
Teacher: Well done, right…

The first dialogue started with a hands-on activity *(immersing the balloon in a cup filled with hot water)* that made the dialogue highly contextualized. In other words, it started with the description of an experiment. This created a context and thus a meaningful ground for teachers and students to talk about. In the dialogue, moreover, the students' responses did not involve solely scientific language. By not judging students' responses as right or wrong, the teacher tolerated and welcomed this language, encouraging students to participate. Thus, throughout the dialogue, one can easily hear the voices of the students such as *The hot water caused the balloon to inflate (Student 7, line 6); There is a heat transfer from the hot water to the balloon*

(Student 8, line 8) and so forth. Furthermore, the dialogue involved addressivity. It involved a chain of student-teacher utterances, a woven, addressing one another continuously in the dialogue. On the other hand, Dialogue II did not involve any experiment. There was no concrete situation to talk about not allowing social interactions between the students and the teacher. By saying, incorrect, you should think a little more (Dialogue II, line 3), the teacher judged the student's response as inappropriate and seemed to demand a scientific explanation, a scientifically acceptable view. The teacher seemed to value scientific language over students' voices. Throughout the dialogue, we hear a solely scientific voice such as *Heat causes an increase in the kinetic energy of the gas in the balloon (Student 2, line 6); When the balloon heats up, since the kinetic energy of the gas in the balloon will increase, the pressure inside the balloon increases (Student 7, line 9-10).* This belonged to the language of scientists. This language was highly appreciated by the teacher, respected by all, and found not disputable. It was in a distanced zone, not reachable by those that are alien to this genre. Also, we did not see a chain of student-teacher utterances. Rather, questions and responses took place with no top-down linkage.

A phenomenological case study approach (Patton, 2002, ss 104-107) is adopted in gathering and analyzing the data. In this approach, the investigator wonders about the participants' lived experiences of a phenomenon. We, therefore, wondered about students' lived experiences with Dialogue I and Dialogue II. In other words, we tried to explore the nature or meaning of students' own experiences. In order to discover their experiences, we conducted in-depth interviews. A total of 14 first- and second-year college students (10 female and 4 male) participated in the study and volunteered for an interview. Since secondary school curricula involve thermal expansion, it is a familiar term for all the participating students. Individual interviews were conducted. The students were asked to read the dialogues and select the more comprehensible one. They were not informed about which dialogue is dialogic or authoritative. Thereafter, they were asked to provide a reason for their choice. Specifically, they were asked. "Why do you think the dialogue, which you have just picked, is more comprehensible?" The interviews were recorded and, later, the interview transcripts were inductively analyzed (Patton, 2002; Saglam & Kanadli, 2021). We looked for meaningful patterns in the data. The following codes and categories were established from the students' statements. Table 1 depicts categories, codes, definitions, and students' excerpts.

Table 1
Operational Definitions for Codes Emerged from the Data

Category I: The properties making ***the dialogic talk (Dialogue I)*** comprehensible according to the students

Code	**Definition**	**Student's excerpt**
1. Daily life	The statements that indicate that the words used are daily life/plain	*The other one (Dialogue I) has more daily life words*
2. Experimental	The statements that indicate that the instruction involves hands-on activities	*It is more understandable because it is done by experiment*
3. Stepwise	The statements that indicate that statements are given in a step-by-step fashion/a detailed way/ are written fluently	*It is given in a step-by-step way as if climbing up a ladder*
4. Welcoming	The statements that indicate that students are encouraged to participate/join in the discussion	*It encourages students to participate*
5. Scientific language	The statements that indicate that the words used are too technical/professional/abstract	*In this dialogue (Dialogue II), scientific expressions are used.*
6. Superficial	The statements that indicate that the	*This is superficially written*

	words used are not given in a detailed/thorough way	
7. Excluding	The statements that indicate that students that possess incorrect ideas are excluded to participate in the discussion or The statements that indicate that students are not given adequate time to brainstorm/think	*It does not encourage students to participate*
8. Abstract	The statements that indicate that there is no concrete situation for students to talk about	*There is no experimentation here*

To find out whether the coding is reliable, the researcher re-coded the data four times at different points in time and the average intracoder reliability of 94 % was calculated. According to Miles & Huberman (1994), this indicates a strong agreement for codes.

The Results

The results indicated that all 14 participating students found the dialogic talk more comprehensible than the authoritative one. The students attributed the comprehensibility of dialogic talk to several attributes, which were coded, and the codes are depicted in Figure 1 below.

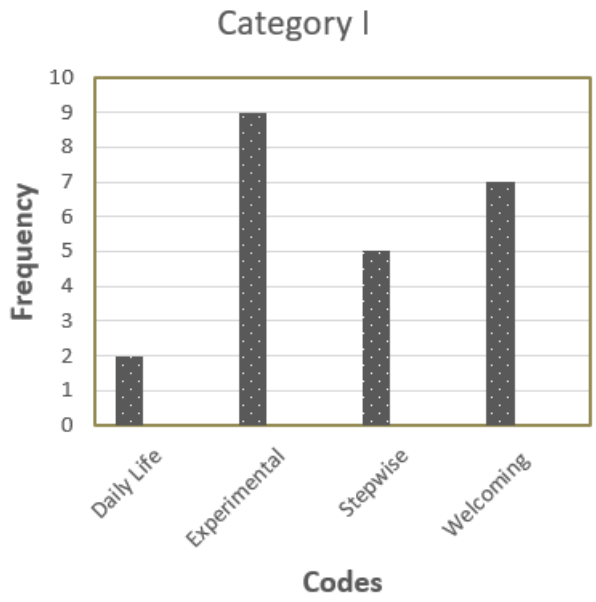

Figure 1**.** The codes making Dialogic talk comprehensible according to the students

The daily life code emerged from the students' statements twice. The students thought that the words used in Dialogue I are from daily life. And this made Dialogue I more comprehensible than Dialogue II. Further, according to the graph, the codes of experimental, stepwise, and welcoming emerged from the students' statements nine, five, and seven times respectively. To the students, Dialogue I is more comprehensible because it includes a hands-on activity, is written in a stepwise fashion, and encourages students to participate in the dialogue.

On the other hand, the students viewed Dialogue II as incomprehensible and provided several reasons, which were coded and depicted in Figure 2.

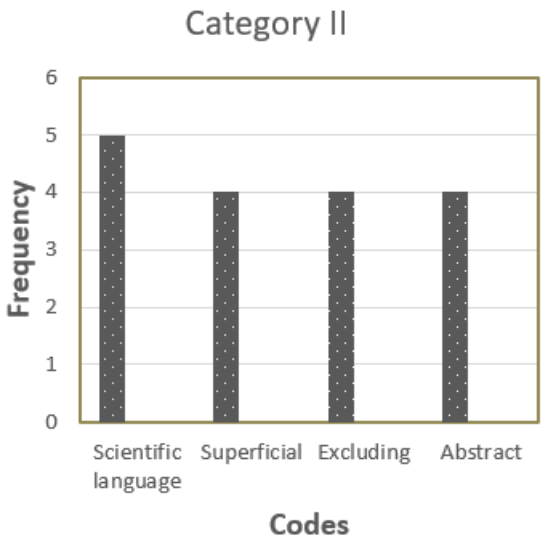

Figure 2. The codes making Authoritative talk incomprehensible according to the students

The code, scientific language, emerged from the students' statements five times. The students thought that the words used in Dialogue II are more technical than the first one. This technical language yet made it incomprehensible. Further, according to the graph, the superficial, excluding, and abstract codes merged from the students' statements four times. To the students, Dialogue II was incomprehensible because it is written in a superficial fashion, it does not encourage students that do not know the answer to participate, and it has not got a concrete experiment leading students to imagine or appreciate what happens.

Discussion and Conclusion

The results indicated that dialogic talk is found more comprehensible compared with the authoritative one by all the participating students without any exception. In other words, the results indicated that a text supported heavily with the dialogic talk was more comprehensible than one supported solely with an authoritative one. According to the students, the dialogic talk is comprehensible because it is written in a step-by-step fashion, comprises daily life words, is about a hands-on activity, and encourages students to take part. They further indicated that the authoritative talk is incomprehensible because it involves technical terms, is superficially written, is not encouraging students to participate, and does not involve a concrete experiment. These findings were surprisingly similar to the theoretical claims. Even though students' explanations involved distinct terms, what they meant was very similar to the theoretical ones. For instance, the students found the authoritative talk too technical to comprehend. This was a theoretical claim made by Mikhail Bakhtin (1981). To Bakhtin, authoritative talk is located in a distanced zone and does not allow inter-animation with other voices. In other words, authoritative talk allows those that are familiar with the scientific language to partake and keep out those that are not familiar with it.

Every scientific discipline possesses its own unique language. Mathematics with its specific terms (i.e. function, range, coordinate system), science with its distinctive concepts (i.e. density, bonding, momentum), and social studies with its exceptional terminology (i.e. ethnography, anthropology, politics) have got their own language. In the areas of all human

activity, language is used in the form of utterances (Bakhtin, 1986), including science disciplines. Language comes alive in the form of utterances. The utterances differentiate in divergent disciplines and create their own speech genre, for instance, many types of business documents, military commands, or verbal signals in the industry (Ibid, 1986). Every science discipline in a similar fashion possesses a unique type of genre. It is quite complex, formed over a long period of time, is culturally shaped, is extremely foreign to novices, and requires time and cognitive involvement for adaptation. However, in a classroom milieu, genre can potentially be foreign to some students and could alienate them from participating in classroom dialogues. We, now, have evidence that technical or scientific genre causes alienation or incomprehension. This alienation may cause some students, especially those who need extra support: (1) to feel that they do not belong to the class, (2) to have an opinion that the classroom conversations are difficult and incomprehensible, and (3) to believe that they cannot succeed no matter what they do. This might eventually turn into an increase in anxiety in the classroom, cause fear of failure, and increase the dropout rate. On the other hand, a comprehensible classroom talk can facilitate those that are unfamiliar with the scientific language to participate in classroom dialogues. This might create a feeling of belongingness and self-efficacy. Further, being physically present in discussions also means being mentally involved in the learning environment, which might cause an improvement in language and cognitive development. This might generate a positive inner cycle. The cognitive improvement, feeling of belongingness, and enjoyment in return might lower anxiety, increase the feeling of self-efficacy, and decrease the dropout rate.

In conclusion, while providing a very limited scale of empirical data, the findings of the current study provided evidence for the comprehensibility of the dialogic talk and incomprehensibility of the authoritative one. The comprehensibility power of dialogic talk offers learning opportunities and calls teachers' attention to its practical importance of it. Also, professional development programs should include dialogic discourse in their program and inform and educate teachers about it.

References

Bakhtin, M. M. (1981). *The dialogic imagination: Four essays by M. M. Bakhtin.* University of Texas Press.

Bakhtin, M. (1986). The problem of speech genres. *In Speech genres and other late essays* (pp. 60-102). University of Texas Press.

Dawes, L., Mercer, N., & Wegerif, R. (2000*). Thinking together: Activities for teachers and children at key stage 2.* Questions Publishing Co.

EEF. (July 2011). *Dialogic teaching, education endowment foundation* (EEF). https://educationendowmentfoundation.org.uk/

Forman, E. A., McCormick, D. E., & Donato, R. (1998). *Learning what counts as a mathematical explanation*, *9*(4), 313-339.

Lyle, S. (2008). Dialogic teaching: discussing theoretical contexts and reviewing evidence from classroom practice. *Language and Education*, *22*(3), 222-240.

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital technology in the classroom. Some educational implications of a continuing line of inquiry. *International Journal of Educational Research, 97,* 187-199.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Sage Publications.

Molinari, L., & Mameli, C. (2010). Classroom dialogic discourse: An observational study. *Procedia Social and Behavioral Sciences, (2),* 3857–3860.

Patton, M. Q. (2002). Variety in qualitative inquiry: Theoretical orientations. In C. DD. Laughton V. Novak, D. E. Axelsen, K. Journey & K. Peterson (Eds.), *Qualitative research & evaluation methods* (pp. 75–138). Sage Publications.

Saglam, Y., & Kanadli, S. (2021). *Nitel veri analizinde kodlama* [*Coding in qualitative data analysis*]. Pegem Akademi

Vygotsky, L. S. (1929). The Problem of the cultural development of the child. *Journal of Genetic Psychology, 36,* 415-434.

Vygotsky, L. S. (1930). *Mind and society.* Harvard University Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Harvard University Press.

Vygotsky, L. S. (1981). The genesis of higher mental functions. In J. V. Wertsch (Ed.), *The concept of activity in soviet psychology* (pp. 144-188). M.E. Sharpe.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Harvard University Press.

Research Article
Received: 19.08.2022
Accepted: 27.12.2022
Published: 31.12.2022

Citation: Kurt, F. & Batdı, V. (2022). Analyzing the effect of coding-based applications on retention scores through the mixed-meta method. *International Journal of Scholars in Education*, *5*(2), 90-100. http://dx.doi.org/10.52134/ueader.1164479

Analyzing the Effect of Coding-Based Applications on Retention Scores through the Mixed-Meta Method

Fatih KURT*, Veli BATDI**

***Abstract*:** In this study, it is aimed to examine the studies on coding-based applications through the mixed-meta analysis method. The effect of coding-based practices on retention scores was examined using the meta-analysis method at first step. Following the first step, a meta-thematic analyzes of the qualitative studies were carried out on behalf of the effectiveness of coding-based applications and results regarding the relationship and effectiveness of coding-based practices with retention were reached. 10 studies on the effectiveness and retention of coding-based practices were attained through the scanning databases regarding document review. According to the results from meta-analysis, effect size (g=1.48 – huge) of coding-based applications had a significant difference in favor related practices. In addition, it has been determined that coding-based applications are effective teaching methods when studies based on participants' opinions in line with the themes and codes were examined within the framework of meta-thematic analysis. The results of the research revealed that meta-analysis and meta-thematic analysis findings are compatible with each other and that coding-based practices contribute to easy, effective and enjoyable learning, positively influence students' cognitive development processes, improve their skills, and affect them to come up with new products. Additionally, it has been concluded that the proper usage of the related applications can increase retention. It has been observed that coding-based applications contribute to analytical and multi-dimensional thinking, possess problem-solving property, are easy to reinforce, and provide retention.

Keywords: Coding-based applications, meta-analysis, meta-thematic analysis, retention

* Teacher, Ministry of Education, Turkey ORCID: 0000-0003-0129-4752, fakurto@hotmail.com
** Assoc. Prof. Dr., Gaziantep University, Turkey, ORCID: 0000-0002-7402-3251, veb_27@hotmail.com

Introduction

For centuries, human beings have been in search of both to meet their needs and to make new discoveries. The industrial revolution has an important place in the process that started with the hunting period and continued until the technological developments that we cannot keep up with today. Industry 4.0, which draws attention as the last stage of the industrial revolution, is a revolution that started under the leadership of Germany and started to take place all over the world in the following process. The main working areas of Industry 4.0 are artificial intelligence, robotic activities, 3D printers, coding, biotechnological activities, nanotechnology and space technology. Industry 4.0 can be defined as an intelligent production period in which all objects, whether living or non-living, can interact with other objects using an internet connection (Aksoy, 2017). With the development of Industry 4.0, computer science has taken its place among the indispensables of human life. For this reason, the use and integration of computer science in educational environments attracts more and more attention every day. The fact that computers and education are so intertwined is undoubtedly that computer skills, which are likely to be one of the features to be sought in the workforce need in the coming years, will contribute greatly to the economic and technological progress of all countries.

Teaching with Computer and Coding

Computer instructional technology includes all kinds of materials and objects in the learning and teaching processes. Among the learning processes, computer science can take place in different ways. When it comes to teaching with computer sciences, various applications draw attention. These applications can be grouped under two different headings as computer-based teaching and computer-assisted teaching (Göksoy & Yılmaz, 2018). In the process of teaching knowledge, the computer is considered a functional tool for the repetition of the subject, as well as supporting the given information and providing a better understanding. Computer-based teaching is used to design, manage and implement teaching activities, to monitor and evaluate students, and to collect and store data about students. Computer-assisted education, on the other hand, helps education and training processes to be used efficiently and effectively due to the advantages it brings. Thanks to computer-assisted teaching, students can carry out learning activities regardless of time and place, without the need to contact a teacher or an instructor. For this reason, computers should be seen as tools that facilitate and support learning in educational processes (Göksoy & Yılmaz, 2018). In teaching processes in which computer science is used, one of the important factors that enables learning to take place is software. The quality of the software and its contribution to learning are possible with a properly planned ideal coding. The ability to code, or in other words to program, draws attention as a very important skill in computer science. According to Askar and Davenport (2009), students who receive coding education in pre-school periods may have difficulties in their educational activities when they start school. In addition, some of the concepts and processes they encounter while learning coding seem abstract due to their presence in the pre-operational period, and therefore they may encounter problems in applying what they have learned. In order to eliminate this problem and to ensure the permanence of coding teaching, different media tools are blended together and visual coding tools are created. However, "programming languages with a predominance of visual tools are becoming increasingly common for students who are just getting acquainted with coding (Çakır, 2020). In addition, when the coding platforms developed for children are examined, it is striking that they are easier to understand and use fun platforms instead of a complex structure as in traditional programming languages. Therewithal, the basic philosophy of coding at an early age will contribute to success in other fields. If we were to make a simple definition about coding, we can use the phrase that 'coding is the work of programming the computers to perform the desired tasks'. From this point of view, we can conclude that computer systems will not have an effect where coding is not used correctly.

Coding is just as important as math, science and reading skills. Being able to develop coding skills also means developing skills such as analyzing information and technological systems, producing solutions for existing problems and working collaboratively with the team while solving the problem (Kaya & Alpan, 2020). The features of the coding contribute to the originality and permanence of the works that emerge as a result of coding. In this context, coding education has taken its place in 21st century education practices as it encourages students to research and discover new things, to gain knowledge in terms of technological values and to contribute to their teamwork skills. Coding applications used in education activities not only make the learning situation more permanent and meaningful, but also provide creative solutions to existing problems (Altay, 2019).

Retention and Coding

The activities to be determined during the coding studies are of great importance for the results that will emerge as a result of the studies. In particular, robotic coding activities should be evaluated in a wide range in order to be inclusive and respond to the needs of students (Talan, 2020). The effectiveness and retention of the education will be incomplete since the applications that the teachers will make by using the coding tools, without considering the needs of the students in the coding lessons, will only be for the students who are related to science, mathematics and technology. Failure to take into account the needs will ensure more active participation of male students in coding practices and no application will be made in the learning environment for female students. In addition, the use of ready-made coding kits causes a narrowing of the group to be studied (Secer, 2020).

Among the variables that enable students to encode a new information in a more meaningful way, it is the persistence variable that draws the most attention. Facts play an important role in learning situations. Knowing the relationships between facts, concepts and principles is an important factor that supports the permanence and transfer of learning. The permanence of any learned information can be achieved by coding the information. Correct coding of information is one of the factors that make it easier to remember when needed (Telli, 2016).

Purpose and Significance of the Research

The main purpose of this research is to examine the effects of coding-based applications on retention scores and the related studies on the effectiveness of coding-based applications in detail. When the literature is examined, it is seen that there are studies on coding and coding-based applications (Büyükkarci, 2019; Çakır, 2020; Karalar & Özdemir, 2013; Sayın, 2020; Talan & Batdı, 2022; Yüksel & Gündoğdu, 2018). In this study, it was aimed to find different and common features related to the core subject of the research by comparing the meta-analysis and meta-thematic analysis findings as a result of the mixed-meta method. In addition, by using different analysis methods together, it was desired to obtain a holistic result on the related research subject. This study, which we have been conducted on the effect of coding applications on retention scores and the effectiveness of coding applications, is important in terms of getting more detailed results, unlike the previous studies. This study, thus, can fill the gap in the literature on the subject and can be a guide for future studies that are suitable for similar content. In line with the purpose of the research, the following sub-purposes were determined:

- Determining the effect size of coding applications on retention scores,
- Identifying the effectiveness of coding applications by examining the studies based on the opinions of the participants in line with the themes and codes determined in the meta-thematic analysis based on the document analysis.

Method

In the study, the mixed-meta method consisting of two stages was used in order to determine the effect of the coding applications on the retention scores. In this context, the determination of the effect of coding applications on the retention scores was carried out within the scope of the mixed-meta method by making meta-analysis with the quantitative method and meta-thematic analysis with the qualitative method. Herein, we can define the mixed-meta method as a method based on document analysis, which includes the analysis of the data obtained by quantitative and qualitative methods with a holistic perspective. If we are to make a more comprehensive explanation of mixed-meta method, we can say that CMA/MetaWin etc. programs are made use of while analyzing the quantitative data, on the other hand, Nvivo/Maxqda etc. programs are used while analyzing the qualitative data. The fact that the products offered by these programs we mentioned allow us to combine and examine a new study shows that the mixed-meta method is a comprehensive and content-rich method. In short, we can define the mixed-meta method as a combination of meta-analysis and meta-thematic analysis based on document analysis. While conducting a mixed-meta study, it should be noted that the studies to be used in the analysis include quantitative (meta-analysis) and qualitative (meta-thematic analysis) data published by having scientific qualifications (Batdı, 2020). Since both meta-analysis and meta-thematic analysis were carried out in the analysis process of this study, the method will be conveyed with the processes carried out under two main headings.

Meta-Analysis Process

In the quantitative dimension of the research, meta-analysis was used to determine the effectiveness of coding applications on retention. Meta-analysis, also called the synthesis of quantitative research, creates a visual summary evaluation by making inferences from the data values of previous studies related to the research subject to be examined (Cooper et al., 2009). As one of the positive aspects of meta-analysis, it can be said that the results of different studies are richer, have wider content than a single study and can be generalized compared to the results of a single one (Borenstein, et al., 2007). Meta-analysis can be described as a re-synthesis of previous quantitative research. It can be defined as a statistical technique used to bring together the results of different studies on a particular subject and add a new interpretation (Crombie & Davies, 2009).

The databases of the Council of Higher Education, Google Scholar, Taylor & Francis Online, Web of Science, ScienceDirect and ProQuest Dissertations & Theses were searched in order to reach the studies on the effect of coding-based applications on retention scores. In the scanning, "The effect of coding-based applications on retention scores", "The effect of robotic Educational", "The effects of robotic coding", "The impact of robotic", "The effectiveness of robotic" were the key words/expressions used. Studies including the effects of coding-based applications on retention scores, covering the data necessary for analysis, applying the pretest and posttest experimental design were included in the analytical process. While determining the studies included in the analysis process, articles published in peer-reviewed scientific journals, master's and doctoral theses published in Turkish and English were included. 11 data out of 6 studies were determined within the framework of the relevant inclusion criteria from 740 studies reached as a result of the search.

Meta-Thematic Analysis Process

A meta-thematic analysis, which has a qualitative dimension as a complement to the quantitative dimension, has been added in order to be able to examine the research subject in more detail and to expand the scope of the study. While applying the meta-thematic analysis process, it is aimed to re-evaluate the results obtained from the qualitative studies determined according

to certain criteria regarding the subject content of the relevant research and to gather the themes and codes revealed as a result of the evaluation activities. In other words, meta-thematic analysis is the examination of documents and studies with a qualitative dimension based on document analysis, the analysis of verbal and textual findings, and the bringing together of all these qualitative findings with themes and codes (Batdı, 2019). In this research, the study of determining the effectiveness of coding applications was carried out by making meta-thematic analysis. The data obtained to determine the effectiveness of the use of coding applications were examined by document analysis. Document analysis can be defined as a systematic and planned process, which is carried out to examine existing documents in detail by working with written or digital materials, allowing to accumulate knowledge from these documents and to make sense of existing documents (Corbin & Strauss, 2008). In this context, qualitative studies, which included participant views, were examined in order to determine the effectiveness of coding applications. The obtained data were collected for the purpose of the research. While examining the qualitative dimension of the research, 4 studies in which the themes and codes were taken and related quotations were included were considered. Codes and themes have an important place in the meta-thematic analysis process. In this respect, 5 themes such as "permanence", "mental effect", "skill", "learning" and "application" were created, and the themes and codes were grouped and modeled.

Results

In this section of the study, the results obtained from meta-analysis and meta-thematic analysis processes were explained under two titles. At first, the meta-analysis findings of the studies regarding the effectiveness of coding-based applications were presented and interpreted. The next stage includes the findings and comments obtained as a result of the meta-thematic analysis of the studies related to coding-based applications.

Meta-Analytical Results

In the first part of the study conducted through a mixed-meta analysis, the findings obtained as a result of the meta-analysis are presented in Table 1. When the relevant findings are evaluated in the light of the data, the effect size the coding-based applications on retention is found to be 1.48 [1.14; 1.82]. This effect size value regarded as a large level according to the Thalheimer and Cook's (2002) classification. According to this result, it can be stated that the effect of coding-based applications on retention has a positive effect. In addition, when the test type scores were examined, a significant difference was found (p<.05).

Table 1
Meta-Analysis Results

Test Type	Models			95% Confidence interval		Heterogeneity		
		n	g	Lower	Upper	Q	p	I^2
Retention	**FEM**	11	1.39	1.20	1.59	31.00	.001	67.74
	REM	11	1.48	1.14	1.82			

When the data in Table 1 are examined according to the random effects model, with an average effect size of 1.48, it can be said that the effect of coding-based applications on retention is more effective than traditional teaching methods. Moreover, the result is seen to be in favor of coding-based applications. When the heterogeneity test type value is examined, it is recorded that the effect sizes of retention (Q=31.00; p<.05) are heterogeneously distributed. On the other hand

the I^2 value (67.74%) indicates that the observed 68% variance is due to the true variance among the available studies (Cooper et al., 2009).

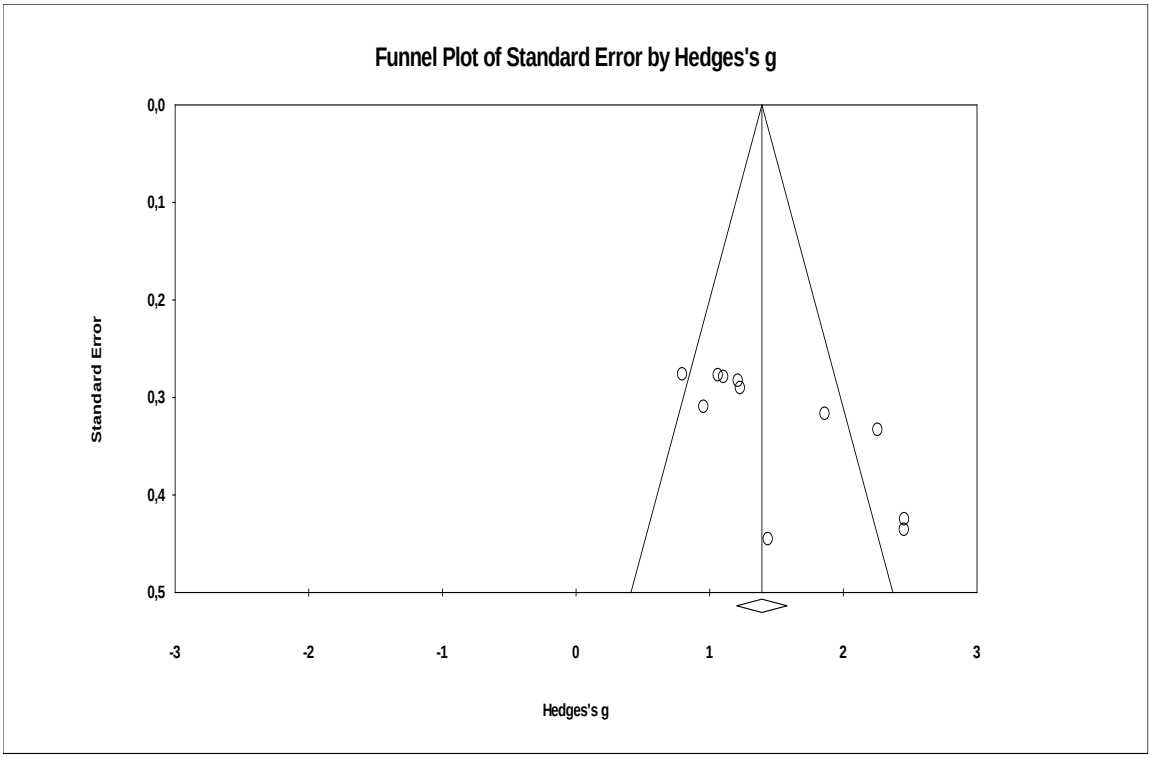

Figure 1. Funnel plot

As shown in Figure 1, it was determined that the majority of the 11 data included in the analysis process indicated a distribution towards the middle part of the graph. In order to avoid publication bias, it is expected that related studies will spread symmetrically on both sides of the vertical line indicating the combined effect size (Borenstein et al., 2009). The same case is seen above which means a reliable analysis has been carried out. In addition, Orwin's Fail-Safe N calculation was made to test the publication bias. The Fail-Safe N calculation reveals the number of studies that may be missing in a meta-analysis (Borenstein et al., 2009). In the related study, this value was calculated as 630. So, it can be stated that the values revealed are a high figure within the framework of the research. Based on the high values specified, it can be concluded that the analysis transactions performed are reliable.

Meta-Thematic Findings

In the second stage of the research, a meta-thematic analysis was carried out by conducting document analysis. The obtained data were presented as a model and interpreted. The themes and codes obtained as a result of the analyzes are specified in the model. As seen in the model, the codes created regarding the effectiveness of the coding-based applications were presented under the sub-themes of the main theme in Figure 2.

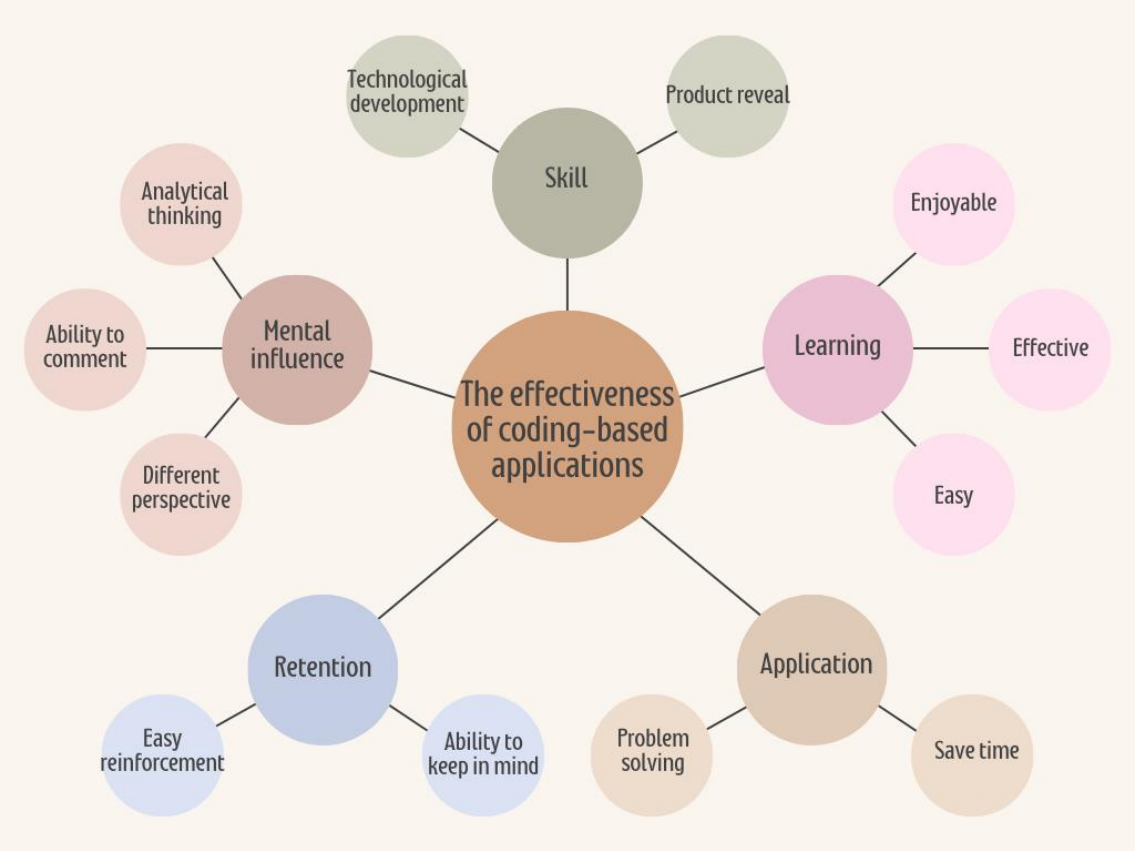

Figure 2. Effectiveness of coding-based applications

In Figure 2, some of the codes related to the effectiveness of coding-based applications can be expressed as "analytical thinking, mental influence, problem-solving orientation, product design". In the context of the related theme, the following expressions can be presented that were quoted from the study encoded as M1-p. 371: "*I didn't forget what I did in the previous work.*", as M2-p. 548: *"…plugging and running things, then coding them parts gives us something more visual. A product emerges. I like it*."; and as M3-p. 789 *"…helps me find a solution, and I can establish different perspectives.*" These expressions are taken as a reference and the codes were created around these sentences. Moreover, in the M4-p.728 coded study the expressions like "*Absolutely usable. It can be taught by making the child love the lessons. The combination of the two courses makes the teaching permanent.* " and in the 10272872-p. 50 coded study, the statements like "*I believe that it will have a great impact, especially in areas that require thinking skills. I think children will have simpler and more practical thinking skills*." can be presented as referenced phrases while determining the codes. With these relevant quotations, it can be said that coding-based applications contribute to analytical and multi-dimensional thinking, are problem-solving oriented, and are easy to reinforce, and provide retention.

Discussion and Conclusion

In this study, the mixed-meta method, which consists of two stages, was used in order to determine the effect of the coding-based applications on retention scores. The mixed-meta method, which emerged with the analysis of documents, is a method that allows to reach results through enriched content by analyzing quantitative data (meta-analysis) via CMA/MetaWin programs and qualitative data (meta-thematic) via Nvivo/Maxqda programs (Batdı, et al., 2021).

In this context, a quantitative meta-analysis was conducted in order to determine the effect of coding-based applications on the retention scores. In addition, the mixed-meta method was carried out by performing meta-thematic analysis with qualitative method in order to determine the effectiveness of coding-based applications in terms of participants' views.

The results of the meta-analysis were discussed by comparing them with the results available in the literature. When the relevant findings are examined and evaluated, the effect size value of the coding-based applications on retention scores were calculated to be 1.48 [1.14; 1.82]. The effect size value attained a result of the analysis was found to be at a large level according to the Thalheimer and Cook's (2002) classification. According to this result, it can be stated that the effect of coding-based applications on retention has a positive effect. In addition, when the test type scores were examined, a significant difference was found ($p<.05$). As a result of the analysis regarding the random effects model; with the mean effect size of 1.48, it can be said that the coding-based applications is more effective than traditional teaching methods.

In line with the aims of the meta-thematic research, the analysis of 4 studies, which were achieved through document analysis, was made by content analysis. As a result of the meta-thematic analysis, a large number of codes related to the effectiveness of coding-based applications have been reached. As a result of the codes, it was concluded that coding-based applications have effects such as making learning more permanent and providing more effective learning, contributing to mental development and bringing advantages in terms of practice. When the literature is examined, it is seen that there are similar studies on coding applications (Büyükkarci, 2019; Çakır, 2020; Karalar & Özdemir, 2013; Sayın, 2020; Talan, 2020; Yüksel & Gündoğdu, 2018). For instance, Büyükkarci (2019) recorded in his study that coding-based applications improve students' problem solving and math skills. Moreover, in his research, Sayın (2020) stated that teachers' interest in coding-based practices is increasing day by day. The fact that the applications based on coding had a positive effect on the retention scores in the current study can be interpreted as the fact that the teachers' interest in coding may increase over time which were reached in the conclusion of Sayın's study and this result is also in parallel with the results obtained in the present study.

The current study, which we conducted on the effect of coding-based applications on retention scores, is important in terms of obtaining more detailed results, unlike previous studies. This study is expected to fill the gap in the literature on the related research subject and may be a guide for future studies that are suitable for similar content. As a result of the analyzes, it was concluded that coding-based applications contributed to easy, effective and enjoyable learning, had a positive effect on the mental development processes of the students, on their skill development, and increased the permanence with the right application methods. Ceylan (2020), in his study regarding the permanence of coding applications, evaluated the practices from the students' point of view, and as a result of this evaluation, the students stated that coding-bsed applications were instructive, suitable for their level, excited them, and positively affected their interest and attitudes towards the lessons. In addition, students stated that it would be beneficial to apply this method in all courses. In another research, Şahbaz (2021) examined the effect of the coding applications included in the scratch program. As a result of the applications carried out in this program, it was revealed that the applications had a positive effect on the students. In order to increase this effect, he suggested that the trainings given can be supported with robotic coding applications (Şahbaz, 2021).

The application-based approaches in today's technology world are thought to be an effective teaching approach in terms of facilitating learning and retention of knowledge. The inclusion of coding applications in the curriculum is not yet at a desired level. It is thought that the active use of new curriculum arrangements and coding practices, especially in primary school and even in pre-school period, will have positive effects on students in the following years. When

coding applications are mentioned, only applications related to informatics and technology courses come to mind. However, using coding applications in other branches such as science, mathematics, music, and visual arts is also important in terms of increasing the memorability of the activities. In addition, the use of coding practices in all courses will be beneficial in terms of an interdisciplinary approach. The active use of coding practices by teachers will contribute positively to educational processes. For these reasons, it is recommended to carry out activities to increase the proficiency levels of teachers about coding practices, to increase the interdisciplinary effectiveness of coding practices and to associate them with the cases in daily life. It is obvious that serious steps can be taken in order to raise solution-oriented, productive and interpretive generations thanks to the change of perspectives of individuals with coding practices.

References

*(*Studies Included in Analysis*)

*Baysal, E. A., Ocak, G., & Ocak, İ. (2020). The views of high school students about coding and Arduino. *Elektronik Sosyal Bilimler Dergisi*, *19*(74), 777-796. http://dx.doi.org/10.17755/esosder.625496

*Erdener, K., & Gür, H. (2019). Students' views towards using the dynamic software Geometer's Sketchpad in middle school mathematics classrooms. *Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 21*(1), 364-377. http://dx.doi.org/10.25092/baunfbed.548536

*Karademir, T., Cesur, A., Büyükergene, G., Kaba, Ö. S., & Kesici, Y. (2018). Technological rythms: Use of robotic applications in music education. *Ilkogretim Online*, *17*(2), 717-737. http://dx.doi.org/10.17051/ilkonline.2018.419045

*Özkandemir, O. (2019). *İlkokul müzik derslerinde robotik ve kodlama programlarının kullanılmasına yönelik örnek bir çalışma* [*A sample study on the use of robotics and coding programs in primary school music lessons*]. (Unpublished doctoral dissertation). İstanbul: Marmara University.

*Secer, M. (2020). *The effects of Arduino based coding and paper-pencil based coding activities on students' computational thinking skills, problem solving skills and stem attitudes in information technologies and software lesson*. (Unpublished doctoral dissertation). Mersin: Mersin University.

*Sezgin, E. M. (2002). *The effects of multimedia courseware designed based on dual coding theory in science teaching on academic achievement, performance level and retention of learning*. (Unpublished master thesis). Adana: Çukurova University.

*Şahbaz, A. F. (2021). *The effect of robotic coding-based scratch programme on achievement, achievement level and retention*. (Unpublished master thesis). Sivas: Sivas University.

*Telli, E. (2016). *The effect of semantic encoding strategy instruction on achievement and retention in E-learning environments*. (Unpublished doctoral dissertation). Ankara: Hacettepe University.

*Uzun, A. & Uz, R. (2018). Learner characteristics and opinions about embedded systems and robotic applications course: Towards the design of instruction. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, *31*(2), 533-559. http://dx.doi.org/10.19171/uefad.505611

*Zeybek, G. (2021). The Effect of the layered curriculum on students' academic achievement and retention of learning. *ie: Inquiry in Education*, *13*(1), 13.

Aksoy, S. (2017). Değişen teknolojiler ve Endüstri 4.0: Endüstri 4.0'ı anlamaya dair bir giriş [Changing technologies and Industry 4.0: An introduction to understanding Industry 4.0.]. *Sosyal Araştirma Vakfı Katkı*, *4*, 34-44.

Altay, G. (2019). The effects of Arduino use on academicachievements of and on attitudes towards computer programming of high school students. (Unpublished master thesis). İzmir: Ege University.

Askar, P., & Davenport, D. (2009). An investigation of factors related to self-efficacy for Java Programming among engineering students. *Online Submission*, *8*(1). 26-32.

Batdı, V. (2019). *Meta-tematik analiz: Örnek uygulamalar [Meta-thematic analysis: Example applications]*. Anı Yayıncılık.

Batdı, V. (2020) The use of technology in language teaching to foreigners: A mixed-meta method. *Milli Eğitim Dergisi*, *50*(1), 1213-1244. http://dx.doi.org/10.37669/milliegitim.942631

Batdı, V., Öztaş, C., & Talan, T. (2021). Analysis of constructive approach applications in science lesson through mixed-meta method. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, *1*(40), 33-44. http://dx.doi.org/10.14582/DUZGEF.2021.175

Borenstein, M., Hedges, L. V., & Rothstein, H. R. (2007). *Meta-analysis: Fixed affect vs. random effects*. https://www.meta-analysis.com/downloads/M-a_f_e_v_r_e_sv.pdf

Borenstein, M., Hedges, L. V., Higgins, J. P. & Rothstein, H. R. (2009). *Introduction to Meta-Analysis*. John Wiley.

Büyükkarci, A. (2019). *The effect of 5e model enriched with coding on 4th grade mathematics achievement, permanence and attitude*. (Unpublished doctoral dissertation). Burdur: Mehmet Akif Ersoy University.

Ceylan, V. K. (2020). *The effect of scenario based learning scratch curriculum on students' computational thinking skills and learning outcomes of problem solving and programming unit*. (Unpublished doctoral dissertation). Aydın: Aydın Adnan Menderes University.

Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). *The handbook of research synthesis and meta analysis* (2nd ed.). Russell Sage Publication.

Corbin, J., & Strauss, A. (2008). *Techniques and procedures for developing grounded theory: Basics of qualitative research* (3rd ed). Sage.

Crombie, I. K., & Davies, H. T. (2009). *What is meta-analysis*?. Hayward Medical Communications.

Çakır, B. (2020). Impact of coding training on metacognitive awareness and creative problem-solving skills of secondary school. (Unpublished master thesis). Aydın: Aydın Adnan Menderes University.

Göksoy, S., & Yılmaz, İ. (2018). The opinions of information relations teacher and their students with regard to lessons of robots and decoding. *Düzce Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *8*(1), 178-196.

Karalar, H., & Özdemir, S. (2013). Impact of guidance in semantic web based instruction on attainment and retention. *Uluslararası Türk Eğitim Bilimleri Dergisi, 1*, 1-16.

Kaya, A., & Alpan, G. (2020). Gamified coding education: A proposal of learning management. *Journal of Technology Applications in Education, 1*, 1-25. http://dx.doi.org/10.29329/jtae.2020.283.1

Sayın, Z. (2020). The determination of teachers' trends in coding education. *Journal of Instructional Technologies and Teacher Education, 9*(1), 52-64.

Talan, T. (2020). Investigation of the studies on educational robotic applications. *Journal of Education for Life*, *34*(2), 503-522. https://doi.org/10.33308/26674874.2020342177

Talan, T., & Batdı, V. (2022). Evaluating coding-based entertainment applications in the context of 21st century skills according to teachers' opinions. *International Journal of Scholars in Education*, *5*(1), 14-24. http://dx.doi.org/10.52134/ueader.1098111

Thalheimer, W., & Cook, S. (2002). *How to calculate effect sizes from published research articles: A simplified methodology*. A Work-Learning Research Publication.

Yüksel, S., & Gündoğdu, K. (2018). The effect of jigsaw technique in teaching Scratch Program on attitude, achievement, and retention of knowledge. *Ege Eğitim Dergisi*, *19*(1), 245-261. http://dx.doi.org/10.12984/egeefd.340362

Research Article
Received: 22.11.2022
Accepted: 27.12.2022
Published: 31.12.2022

Citation: Yılmaz, Z. A., & Yaşar, M. D. (2022). Examination of prospective teachers' creative comparisons for the concept of "science education". *International Journal of Scholars in Education, 5*(2), 101-116. http://dx.doi.org/10.52134/ueader.1208416

Examination of Prospective Teachers' Creative Comparisons for the Concept of "Science Education"

[*]Zeynel Abidin YILMAZ, [**]Mehmet Diyaddin YAŞAR

***Abstract*:** Determination of prospective teachers' metaphoric perceptions of science education will contribute to the more effective and efficient organization of science education and the organize and structure of its teaching. In this aspect, this research aimed at determining prospective teachers' metaphoric perceptions toward science education in terms of various variables. This research was conducted on 301 prospective teachers. In this research, a phenomenological study, which is one of the qualitative research designs, was adopted. A creative comparison form was used as a data collection tool. The content analysis method, which is one of the qualitative data analysis methods, was used to analyze the collected data. As a result of this study, the creative comparisons of prospective teachers for science education were gathered under 5 categories: emotion, color, game, transportation vehicle, and technological tool. Prospective teachers produced several metaphors according to these categories. And some suggestions were made based on the results.
***Keywords*:** Creative comparisons, phenomenology, prospective teachers, science education.

* Assoc. Prof. Dr. Zeynel Abidin Yılmaz, Kilis 7 Aralık University, ORCID: 0000-0003-0150-8810, e-mail: z07yilmaz@gmail.com
** Assoc. Prof. Dr. Harran University, ORCID: 0000-0001-7512-580X, e-posta: mdiyaddinyasar@harran.edu.tr

Introduction

Turkish education system, science lessons have been more difficult for students to understand than other lessons every semester (Yılmaz & Batdı, 2016). For this reason, in science education, it is important to increasingly concretize the abstract expressions, which are difficult to understand, with different methods and techniques, and to make them easier to understand (Arslan & Bayrakçı 2006; Hançer et al., 2007). To overcome these difficulties, researchers have made use of simulation, analogy, animation and simulations, and various methods and techniques such as concept maps, conceptual change texts, the six thinking hats technique, station project-based, cooperative learning, and 5E teaching model. Here, the main objective is to raise science-literate individuals within the science education program of the students (Minister of National Education [MNE], 2018). Science literacy requires individuals to understand and use the scientific concepts in the social, cultural, economic and decision-making process. One of the important dimensions of science literacy is to learn the scientific concepts. Concept learning is important in creating scientific principles by classifying the structures with similar characteristics and associating them with other concepts (Çepni et al., 1997). In today's understanding, teaching of the Science course is based on making the information meaningful and experiential for the students rather than the evaluation of the student's level of knowledge (MNE, 2018). The most important aim of the Science course is to train students to be science-literate. In this sense, it has been necessitated to use new methods and make explanations according to the multiple intelligence level while teaching science. If students are raised as science-literate individuals, they can find rational, logical and concrete solutions to the problems that they face in daily life by scientific means. Hence, students know how to access information and gain the ability to produce new information. In the process of acquiring these skills, it is important to endear the Science course to the students (Dönmez, 2017).

Scientific concepts are typically abstract constructs and they are difficult for students to understand` may be more appropriate than this sentece (Çepni & Keleş, 2006). Among the reasons for having difficulty, it can be stated that students cannot make information meaningful since they cannot establish a connection with another situation in their minds (Çepni & Keleş, 2006). Science teachers should be conscious about this issue and benefit from different methods in their lessons. The main objective of the Science course is to provide basic knowledge and skills about environment, earth, physics, chemistry, biology, astronomy, science and engineering applications during the primary and secondary education. It is possible to increase meaningful learning when students are enabled to establish the relationships between the concepts in their minds instead of perceiving the concepts as they are so that these skills can be gained by the students. When students visualize concepts in their minds, they can establish relationships between the concepts more easily. The aim of the Science course is to concretize it by associating abstract information with daily life, so as to make it concrete, understandable and clear (Jaakkola & Veermans, 2018). Thus, students' interest in learning increases; accordingly, they feel more curious when they associate so many objects, living beings and the space around them with what they have learnt. Therefore, as a technique in science education, metaphor-based teaching is used for the concretization of the abstract concepts (Arslan & Bayrakçı, 2006; Cameron, 2002; Saban, et al., 2006; Singh, 2010). Metaphor refers to the explanation of an abstract subject, concept or a term, which is difficult to understand, with a concrete concept, which is already known (Aydın, 2010). When-national-literature is reviewed, it is seen that there are researches conducted on metaphors in various fields. In the research conducted by Şenel and Aslan (2014), 54 valid metaphors were produced for the concept of science and 49 valid metaphors were produced for the concept of scientist regarding the prospective preschool teachers' concepts of science and scientist. In the research carried out by Deniş Çeliker and Akar (2015), secondary school students' perceptions towards the concept of "nature" were examined to identify the metaphoric perceptions of 238 secondary school students towards the concept of "nature", and it was concluded that they differed according to their education, socio-cultural

level and the environment they lived in. In the study conducted by Arık and Özdemir (2014) with 72 prospective science teachers, an attempt was made to determine their metaphoric perceptions of the science laboratory. In their study, mostly the "kitchen" metaphor was obtained, and the metaphors of the female students were rather included in the categories of putting forward a new product and exploration. In the study conducted by Soysal and Afacan (2012) with 137 primary school students, it was tried to reveal the students' metaphoric perceptions of the Science and Technology course and the concept of science-technology teacher. As a result of the research, it was exhibited how strong the primary school students' imagination and ability of drawing an analogy were. In their study, Uslu, Kocakülah and Gür (2016) examined the secondary school students' metaphors for the concepts of science, scientist and teacher. As a result of this research, 42 metaphors were produced by the students. As a result of the research, it was revealed that students generally had positive perceptions towards these concepts. Moreover, it is seen that various studies were conducted to determine the metaphors regarding preschool students (Güler & Akman, 2006; Kılıç, 2010), primary school students (Deniş et al., 2015; Gömleksiz et al., 2012; Mertol et al., 2013; Özgelen, 2012), secondary school students (Aydın, 2010; Bıyıklı et al., 2015; Doğan Bora et al., 2006; Yapıcı, 2015), and prospective teachers (Aktamış & Engin 2006; Aydın, 2011; Arık & Yılmaz, 2017; Çermik, 2013; Güven,2014; Güvenli et al., 2011; Kaya, 2014; Levine, 2005; Saban, 2009; Tortop, 2013; Ürey et al., 2017) in Turkey. Determination of prospective teachers' metaphoric perceptions of science education will contribute to the more effective and efficient organization of science education and the structure of its teaching. In this aspect, this research aimed at determining prospective teachers' metaphoric perceptions of science education in terms of various variables. For the purpose of the research, answers to the following research questions were sought:

1. What are the prospective teachers' metaphoric perceptions of science education as an “emotion”?
2. What are the prospective teachers' metaphoric perceptions of science education as a “color”?
3. What are the prospective teachers' metaphoric perceptions of science education as a “game”?
4. What are the prospective teachers' metaphoric perceptions of science education as a “transportation vehicle”?
5. What are the prospective teachers' metaphoric perceptions of science education as a “technological tool”?

Methodology

In this research, a phenomenological study, which is one of the qualitative research designs, was adopted. Phenomenology studies explain and define the meanings imposed on an experience (McMillan & Schumacher, 2010). In such studies, the focus is set on the cases, which are noticed but not understood in depth and detail (Büyüköztürk et al., 2008; Yıldırım & Şimşek, 2008). By putting all his prejudgments aside, the researcher collects data about the meanings attributed to a certain situation or experience by the individuals (McMillan & Schumacher, 2010). In this research, it was tried to determine the prospective teachers' perceptions of science education with creative comparisons. The researchers put their own prejudgments and opinions aside and tried to determine the meanings attributed to science education by the prospective teachers.

Research Group and Ethical Principles

This research was conducted on 301 prospective teachers enrolled in the Departments of Preschool Teaching, Classroom Teaching and Science Teaching at a public university in the Southeastern Anatolia Region during the spring semester of the 2016-2017 academic year. In the research, convenience sampling method, which is one of the non-random (Büyüköztürk et al., 2008) purposive (Yıldırım & Şimşek, 2008) or nonprobability (McMillan & Schumacher, 2010) sampling methods, was used to determine the research group. Convenience sampling method is widely used in qualitative researches, and it includes individuals and groups that are close, easy to reach and voluntarily participate in the research (Büyüköztürk et al., 2008). This sampling method enables to better understand the existing situations or relationships beyond generalizing in the studies (McMillan & Schumacher, 2010). It was primarily ensured in this research that the prospective teachers had taken the Science course. In the research, all the prospective teachers participated voluntarily, and sample selection was made from the immediate environment to make it easily accessible.

While conducting this research, the attention was paid to adhering to all the ethical principles. In this context, the volunteering was taken as a basis in the participation, all the data collected from the participants were used only within the scope of the research, it was made sure that the data would not be shared with third parties and the identities of the participants would remain confidential. In addition, the participants were assured that the research results would not be used against them.

The demographics of the research group are given in Table 1. Since some teacher candidates did not respond to some metaphors, results below 301 were given in the analysis as in Table 2, Table 4, and Table 6.

Table 1
Demographics of the Prospective Teachers

Prospective Teachers	Male	Female	f
Primary Classroom	28	30	58
Pre-school	16	118	134
Science	15	94	109
Total			301

Data Collection Tools and Process

Before the research, theoretical information was first given to the prospective teachers about creative comparison. Thus, it was aimed to inform the prospective teachers about creative comparison. Afterwards, implementation was carried out. The creative comparison form was distributed to the students. Prospective teachers were not requested to write their names on the form so that they could write down their opinions openly. To determine demographic characteristics, students were asked to write their departments, classes, genders and ages. In order to learn the creative comparisons made by prospective teachers about science education in terms of various variables, the following questions are directed:

1. If science education were an “emotion”, it would be…. because...
2. If science education were a “color”, it would be…. because...
3. If science education were a “game”, it would be…. because...
4. If science education were a “transportation vehicle”, it would be…. because...
5. If science education were a “technological tool”, it would be…. because...

A total of five questions were asked. Prospective teachers were asked to fill in the blanks. Here, the prospective teachers' creative comparisons were limited to be an emotion, color, game, transportation vehicle and technological tool to enable them make associations more easily. Prospective teachers were given about 20 minutes to write their creative comparisons for science education.

Data Analysis

The content analysis method, which is one of the qualitative data analysis methods, was used to analyze the collected data. The basic process in the content analysis is to gather similar data within certain concepts, themes and codes, and to organize and interpret them so that the reader can understand them (Yıldırım & Şimşek, 2008). In the content analysis, the existence of certain words or concepts within a set of text or texts is identified, and their existence, meanings and relationships are specified and analyzed to make inferences about the message in the texts (Büyüköztürk et al. 2008). In the data analysis, first, the categories (emotion, color, game, transportation vehicle, technological tool) were examined in detail.

Creative comparisons written by prospective teachers were listed one by one. Invalid and valid comparisons were determined, and invalid ones were excluded. Afterwards, the collected data were analyzed independently by both authors. In the comparisons, *the numbers of consensus* and *dissensus* were determined and the reliability of the research was calculated via Miles and Huberman's formula (*Reliability*= consensus / consensus + dissensus), and an value of 80% and above refers to an acceptable reliability (Miles & Huberman, 1994). In the content analysis conducted by the authors, a great deal of consensus was reached among them, and this rate was found to be well above 80 % and the differences, though few, were agreed upon, and the analysis was concluded. This has shown that the data obtained from the research are reliable. Besides, the reliability of the study was supported and tried to be increased with frequent quotations from the prospective teachers' statements on science education for creative comparison. The frequency (f) and percentage (%) of the data obtained at the end were calculated and presented in tables.

Result

In this research, prospective teachers' perceptions of science education were determined by making creative comparisons. The percentages and frequencies of the data were determined and presented in tables. While transferring the data into tables, the reasons that came into prominence in creative comparisons, that is, the explanations and expressions of the prospective teachers were also included. The data were organized in 5 tables.

Table 2
Prospective Teachers' Metaphoric Perceptions of Science Education as an "Emotion"

Positive Emotions	f	%	Explanations of the prospective teachers (Because...)
Curiocity	72	29.51	"We are constantly progressing curiously", "curiosity is in the center of all the researches", "research encourages examination"
Excitement	58	23.78	"it gives excitement because learning comes from experience", "new information is new excitement", "each stage of it is exciting"
Happiness	33	13.53	"Science education is a fun and enjoyable course", "exploring something makes people happy", "people are happy as much as they can research and examine"
Surprise	18	7.38	"we always learn new things", "exploring surprises people", "it is a surprising education in every aspect"
Joy	13	5.33	"it can make different contributions in every sense", "it is fun, and makes people happy"

Love	12	4.92	"you see what you want to see", "you are involved as you progress", "it wants to be chased as you run after it"
Affection	4	1.64	"overcoming the difficulties in life starts with loving yourself", "research cannot be conducted without loving science", "it gives people peace"
Perseverance	3	1.23	"the desired result is achieved with a little effort and patience"
Enthusiasm	2	0.82	"excitement never comes to an end", "it is an education that excites people"
Serenity	2	0.82	"new findings give peace"
Sub-Total	*217*	*88.93*	

Negative Emotions	**f**	**%**	**Explanations of the prospective teachers (Because...)**
Sadness	12	4.92	"I get bored when I see it", "science makes you unhappy, necessary but difficult", "boring and sad"
Anger	6	2.46	"it is a boring course, it makes you get bored", "it constantly renews itself"
Hate	6	2.46	"it is never loved", "I hate it"
Fear	2	0.82	"it scares people with its difficult aspects and unknown parts"
Worry	1	0.41	"it is a difficult education to comprehend"
Sub-Total	*27*	*11.07*	
Total	244	100	

Table 2 presents the creative comparisons of the prospective teachers for science education as an emotion. When Table 2 was examined, it was determined that prospective teachers had a positive emotion by 88.93%, and among these, they mostly emphasized "curiosity" by 29.51% (f=72), "excitement" by 23.78% (f=58) and "happiness" by 13.53% (f=53). The justifications were based on the fact that science education was a course requiring continuous research, inquiry and examination. In the concept of “excitement” which was the answer that was mostly given following “curiosity”, Science was observed to be a course learned by doing and experiencing and encountered several times in life. In the concept of "happiness", science education was emphasized as a fun and enjoyable course that made people happy. Furthermore, as can be seen from Table 1, it was determined that prospective teachers had negative emotion by 11.07%, and among these, emphasis was on "sadness" with 4.92% (f=12), which was followed by "anger" "anxiety", 2.46% (f=6), "fear", 0.82% (f=2), and "anxiety", 0.41% (f=1). In the answers given by the prospective teachers, it was found that they expressed negative or conflicting emotions, tough very few, such as sadness, anger, anxiety, fear and anxiety.

Table 3
Prospective Teachers' Metaphoric Perceptions of the Science Education as a “Color”

Color	**f**	**%**	**Explanations of the prospective teachers (Because...)**
Blue	103	34.22	"it is a color that gives people peace", "it has an area as wide as the sky", "it is endless like the blueness of the sky"
White	57	18.94	"it contains every color", "it includes all the situations like probability, certainty, excitement", " it is white, including all the other colors"
Green	46	15.28	"Science education allows us to look at events positively", "science means nature", "science means natural science, the color of the nature is green"
Red	29	9.64	"it is the most intense course", "it attracts attention"
Black	22	7.31	"It absorbs people like a depth without boundaries", "precise and general"
Grey	15	4.98	"it contains rights, wrongs and information that is not right and wrong", "not everything is clear", "it is uncertain"
Yellow	8	2.66	"it is the most charming color"
Purple	8	2.66	"it is mysterious like the purple ", "it is a rich field", "purple is a noble color, science education is also noble"

All colors	3	1.00	"There are different colors in nature", "t is a very wide area", "science contains everything"
Orange	3	1.00	"Is the color of energy", "it brightens us like the sun"
Navy blue	3	1.00	It is "formal", "it evokes an order and system"
Brown	2	0.67	"it is joyless and boring", "it is the earth that signifies the nature, the color of the earth is brown"
Magenta	1	0.33	"it is not as empty as light pink, and it is not as heavy and formal as dark blue"
Pink	1	0.33	"it makes our lives colorful"
Total	**301**	**100**	

Table 3 presents the creative comparisons of the prospective teachers for science education as a color, and frequencies and percentages together with their reasons. When Table 3 was examined, it was discovered that prospective teachers mostly perceived "blue" with 34.22% (f=103), which was followed by "white", 18.94% (f=57) and "green", 15.28% (f=46), respectively. It was noteworthy that the prospective teachers perceived “blue” as a peaceful color and associated it with the creative comparison of 'sky'. On the other hand, they associated the "white" color they saw in life in terms of forming all the other colors. When we look at the "green" color, they found a resemblance between Science and nature, and saw it as a color within the nature. Moreover, when we look at the creative comparison of all the colors in the answers given by the prospective teachers, it was expressed that Science was attributed to different colors, it is a huge area and Science includes everything.

Table 4
Prospective Teachers' Metaphoric Perceptions of the Science Education as a “Game”

Game	**f**	**%**	**Explanations of the prospective teachers (Because...)**
Hide and seek	173	59.25	"As we learn about science education, it is about new and successive subjects", "it is full of secrets", "it tries to find what is hidden", "there is a mysterious aspect", "it is necessary to find it where it is hidden"
Chess	16	5.48	"it is the course that best strengthens the development of intelligence ", "it is an area that requires intelligence", "unexpected processes may develop while playing"
Puzzle	13	4.45	"it becomes integrated as it unites the parts", "it can be formed like the connection of the spheres", "Nature is something that parts, when they unite, the jigsaw puzzle of the nature is formed", "we find the right by making mistakes", "every information brings forth another information"
Tag	10	3.43	"it is necessary to catch, to explore new things"
Crossword	9	3.08	"all the science lessons are interconnected", "they involve an effort on continuous discovery like puzzles"
Football	6	2.06	"it requires discipline and a lot of work", "it is both tiring and enjoyable"
HopScotch	5	1.71	"as progress is made step by step", "science education progresses with certain steps", "you jump from one branch to another"
Box box plier	4	1.34	"everything is in a circular interaction", "not all the students participate"
Burning ball	4	1.34	"it catches those around"
Car race	3	1.03	"it tires the eyes", "it is attention-grabbing, exciting and inspiring"
Knowledge game	3	1.03	"it has a lot of questions and answers for these questions", "it teaches new information"
Halay	3	1.03	"it is very colorful and fun", "everyone is somehow involved"
Boxing	3	1.03	"it is a scientific discipline containing conflicts", "it is a heavy sport"

Theater	2	0.68	"everyone is given a task", "we connect many topics with ourselves"
Spin the bottle	2	0.68	"play is never over", "existing truths can also be used"
7 towers	2	0.68	"the whole information that everyone accumulates and creates is reorganized when someone new puts forward new ideas"
Okay	2	0.68	"it is colorful"
Taboo	2	0.68	""it is not known what will come out", "the things are like a chain"
Basketball	2	0.68	"new methods are sought every time", "it requires intelligence"
Rubik's Cube	2	0.68	"science education requires intelligence"
Survivor	2	0.68	"it is very adventurous", "science education is exciting"
Jumping	2	0.68	"it is in a cycle", "it means to jump with eyes closed"
Volleyball	1	0.34	"the right move should be in the right place"
Pinball	1	0.34	"victory is achieved only with a specific combination"
Lego	1	0.34	"by combining a lot of little information in science education, we can reveal new projects, new and different information and ideas"
Computer game	1	0.34	"it is addictive"
Labyrinth	1	0.34	"science education is finding a way"
Pes 2013	1	0.34	"it requires talent"
Treasure hunter	1	0.34	"science is full of mysteries, different results come out of every experiment"
Corner grab	1	0.34	"there are many fields in science, and everyone is trying to grab an area"
Snowball	1	0.34	"it is very complex and connected"
Hangman	1	0.34	"it requires constant prediction"
Salsa	1	0.34	"integration is provided by going back and forth"
Silent cinema	1	0.34	"first you know, then you try to prove"
Monopolly	1	0.34	"in nature, everything has a stage of attempt "
Sudoku	1	0.34	"I never understand it"
Stall	1	0.34	"its has such continuity that its names are countless"
High above ground	1	0.34	"it always changes"
Passionflower	1	0.34	"science education has more than one subject"
Wolf dad	1	0.34	"it gives information about self-care skills"
I sell oil	1	0.34	"it is in a continuous cycle"
Turn around butterfly	1	0.34	"we live in our own cycle"
Jumping by	1	0.34	"it means jumping where you are"
Guess	1	0.34	"a judgment is made as a result of clues"
Total	**292**	**100**	

Table 4 presents the creative comparisons of prospective teachers for science education as a game, and frequencies and percentages together with their reasons. When Table 4 was examined, it was determined that in the first three ranks of prospective teachers' perceptions towards science education as a game, there were hide-and-seek/blindman's buff with a rate of 59.25% (f=173), chess with 5.48% (f=16) and puzzle with 4.45% (f=13). It was discovered that, as the prospective teachers received science education with "hide-and-seek/blindman's buff", they obtained information about the new and successive subjects, revealed hidden things, and there is a mysterious aspect of science education, people try to find things with eyes closed. Besides, they had a perception that science education was the course that best strengthened the development of the intelligence. When we reviewed other creative comparisons in the table, it was observed that the answers with low frequencies such as duck duck goose, turn turn butterfly and wolf dad belonged to prospective preschool teachers.

Table 5
Prospective Teachers' Metaphoric Perceptions of the Science Education as a "Transportation Vehicle"

Transportation Vehicle	**f**	**%**	**Explanations of the prospective teachers (Because...)**
Airplane	105	34.88	"it is like going further in the vast sky", "all parts of the world can be reached", "nice things come out due to high efforts"
Train	51	16.94	"it contains a very fast-progressing science", "if you come out of one of the tracks, you cannot go anywhere you want to reach", "science education is like the train wagons connected to each other."
Bus	31	10.30	"science education can be achieved with the society, not with a single person", "it contains a lot of things in it", "it has a huge content"
Bicycle	28	9.30	"it has peace", "it tries to reach the desired goal", "it is an instrument used by all the age groups"
Car	14	4.65	"science education makes our life easier like a car", "science education enables accessing information from information", "it is necessary to use it properly to reach it"
Steamboat	13	4.32	"Science is like navigating in an open sea", "it is found by trial and error", "it calmly moves forward and broadens the horizon"
Space shuttle	12	3.99	"it is useful for traveling to other horizons", "it always seeks the unknown and finds it", "it is about seeking and finding everything different"
Truck	9	2.99	"it takes a bit time, but firm steps are taken", "its background is full of information", "its load is heavy, it contains a lot of information"
Motorcycle	6	1.99	"whoever accelerates wins", "it helps us reach even the farthest points"
Metro	6	1.99	"I saw a resemblance between science and the underground as technology progresses very fast like the underground", "it advances very quickly, and it progresses fast"
Helicopter	3	1.00	"it can enter any area"
Cart	3	1.00	"it moves slowly, but constantly"
Aircraft	2	0.67	"science education explores the space"
Tumbrel	2	0.67	"it is cumulative, it progresses slowly", "everything settles down slowly"
Tram	2	0.67	"it is easy and fun in terms of transportation"
Human feet	2	0.67	"everything is revealed slowly with patience", "it is the people who will carry science to the future"
Jet	2	0.67	"it can be taken anywhere"
Ambulance	1	0.33	"one aspect of science education is about health", "science education is everything we have"
F 16	1	0.33	"it must be advanced and the best"
Vosvos	1	0.33	"it is both beautiful and attractive"
Caravan	1	0,33	"it is a personal course", "not everyone can take it by having fun and enjoying.
Wheelbarrow	1	0.33	"it is tiring and long"
Cable car	1	0.33	"it is not like any transportation vehicles"
Tractor	1	0.33	"too much talking is involved in it, sounds disturb you"
Navigation balloon	1	0.33	"it reaches infinite heights and explores science"
Ufo	1	0.33	"it is impressive, very beautiful"
Car tow truck	1	0.33	"it attracts everything it finds"
Toplam	**301**	**100**	

Table 5 presents the creative comparisons of the prospective teachers for science education as a transportation vehicle, and frequency and percentages together with their reasons.

When Table 5 was examined, it was found out that the first three ranks of the prospective teachers' perceptions towards science education as a transportation vehicle included airplane with a rate of 34.88% (f=105), train with 16.94% (f=51) and bus 10.30% (f=31). It was determined that prospective teachers considered science education as a science that continuously advanced and progressed when it comes to their comparison with "airplane". Their comparison to "train" showed that they had a perception such as "it contains a very fast-progressing science", "if you come out of one of the tracks, you cannot go anywhere you want to reach", "science education is like the train wagons connected to each other." Regarding their comparison to "bus", they had a perception that "science education can be achieved with the society, not with a single person", "it contains a lot of things in it", and "it has a huge content".

Table 6
Prospective Teachers' Metaphoric Perceptions towards the Science Education as a "Technological Tool"

Technological Tool	**f**	**%**	**Explanations of the prospective teachers (Because...)**
Computer	124	43.66	"it contains almost all kinds of information", "it makes our life easier", "it is completely informational"
Telephone	72	25.35	"everything you want will be in your pocket instantly", " it is always with us", "when you are deep in it, you cannot come out"
Microscope	16	5.63	"it is open to examination and investigation", "we can access everything down to the last detail"
Television	8	2.82	"it looks like how it desires", "it has benefits as well as harms", "each section of it is different and complex"
Spacecraft	6	2.11	"it is wide and comprehensive", "it wants to have new explorations"
Robot	5	1.76	"it makes people's lives easier with efforts", "robots have been invented over the field of science", "it is an order machine system"
Washing machine	4	1.41	"we collect and organize things and do them when we want", "you cleanse your spirit"
Mixer	4	1.41	"it unites all the sciences and reveals them with a logical reason"
Camera	3	1.06	"we can catch great things", "it is good for proving, documenting and keeping for a long time"
Tablet	3	1.06	"it shows us every experiment visually", "it is addictive"
Airplane	3	1.06	"as you accumulate knowledge, you feel like you are going to fly"
Speaker	2	0.71	"science sets forth the causes, and people who studied science give us the answers of the questions like 'why did this happen so?"
Telescope	2	0.71	"it is necessary to see distant points", "while the sky is examined, newer things are always found and learned, and science education is like this"
Engine	2	0.71	"it is complex", "it is indispensable for many technological tools"
Weapon	2	0.71	"if you fill it with your knowledge, you can shoot or you cannot shoot"
Fruit juicer	2	0.71	"it strains every information", "it investigates a case in pieces and then reaches a conclusion"
Hard disk	2	0.71	"it has thousands of hidden details", "it contains a lot of information"
Internet	2	0.71	"you can find everything"
X-ray machine	2	0.71	"it reflects everything as it is, realistically"
Telegram	1	0.35	"it is difficult"
Calculator	1	0.35	"it is the technological tool that I like the most in this field as it deals with a lot of operations"
Smart board	1	0.35	"it makes our lives easy"
Heater	1	0.35	"it is the favorite thing of many experiences"
Iron	1	0.35	"it fixes the wrinkles, and science education answers all the questions in our heads and fixes them"

Shock device	1	0.35	"it brings people to life"
Monitor	1	0.35	"when we look at the monitor, it shows us everything"
Missile	1	0.35	"it always progresses"
Lying machine	1	0.35	"it distinguishes the right and the wrong"
Bakery	1	0.35	"all kinds of ingredients are cooked in it"
Compass	1	0.35	"it is taken to the end of the activity"
Toy	1	0.35	"we perceive it as a toy"
Projection	1	0.35	"it reflects our life"
Dialysis machine	1	0.35	"it makes our life easier and allows us to live happily"
Wheel	1	0.35	"everything begins with science"
Centrifuge device	1	0.35	"it protects us from confusion and doubt"
Vacuum cleaner	1	0.35	"it gives us a headache"
Typewriter	1	0.35	"it does not come to an end by writing"
radio	1	0.35	"it sounds good"
Lamp	1	0.35	"every darkness needs a light"
Toplam	**284**	**100**	

Table 6 presents the creative comparisons of the prospective teachers for science education as a technological tool, and frequencies and percentages together with their reasons. When Table 6 was examined, it was found that the first three ranks of the creative comparisons of prospective teachers for science education as a technological tool included "computer" with a rate of 43.66% (f=124), "telephone" with 25.35% (f=72) and "microscope" with 5.63% (f=16). Considering the creative comparisons of the prospective teachers, it was revealed that they perceived science as a computer because it contains all kinds of information, as a phone because it is technological tool an accessible at any time, as a microscope since everything can be seen down to the last detail due to examination and investigation performed in the Science course. Moreover, via the creative comparisons with low frequencies such as irons, centrifugals, lamps and lie detectors, they were found to perceive Science as a course that facilitated life, made people happy and shed light on things.

Discussion, Conclusion and Suggestions

Creative comparisons, which facilitate the perception of abstract concepts, are the metaphors using the thoughts, analogies and figures of speech about an event or a subject. There are many benefits of using creative comparisons in the field of education. They are useful methods for learning and they increase motivation. They enable us to keep information in the mind permanently, develop intuitions, eliminates fear of class and unwillingness, and provides creative and investigative learning (Aktamış & Dönmez, 2016; Jeppsson et al., 2013).

Prospective teachers' perceptions, which develop with their education at the university towards events, situations or facts, form the basis of their professional perspectives. Selection of the right creative comparisons is very important in teaching a complex course such as science education. In this sense, the perceptions and attitudes of prospective teachers towards the concepts they are obliged to teach provide significant information about how to convey those concepts. It is apparent that it is not possible to explain a concept as a whole with a single creative comparison. In our study, the purpose of using different categories for creative comparisons is to put forward different and richer results. As a result of this study, the creative comparisons of prospective teachers for science education were gathered under 5 categories: emotion, color, game, transportation vehicle and technological tool.

In emotion-related creative comparisons, it was concluded that 10 out of 15 emotions evoked positive emotions (88.93%) and 5 evoked negative emotions (11.08%). It was concluded that prospective teachers had a positive emotion towards science education, and among these emotions, they mostly emphasized curiosity (29.51%). It was observed that, although rarely, prospective teachers also expressed sadness, which can be considered a negative emotion, (4.92%). This study is in parallel with the study conducted by Demirci-Güler (2012) on prospective classroom teachers, and it was seen that prospective teachers mostly had positive emotions towards the Science and Technology course whereas, less frequently they had negative emotions.

In the color-related creative comparisons, it was concluded that prospective teachers emphasized 14 different colors in total, and among these, the most common being the blue color (34.22%). It was concluded that science education was peaceful, as vast as the sky and infinite according to the views of the prospective teachers. In the game-related creative comparisons, it was concluded that prospective teachers emphasized 46 different games in total, and among these, the most common being the hide-and-seek/blindman's buff (59.25%). According to the opinions of the prospective teachers, science education is full of secrets, it is a science that enables the learning of new subjects, and the mysteries of life can be revealed with science education. The results obtained from this study are in parallel with the study conducted by Afacan (2011) on prospective science teachers and the study conducted by Demirci-Güler (2012) on prospective classroom teachers, and the creative comparisons, where a connection was built between life and science and life itself was considered science, were emphasized by the prospective teachers.

In the creative comparisons related to transportation vehicles, it was concluded that prospective teachers emphasized 29 different vehicles in total, and among these, most common was 'airplane' (34.88%). According to the opinions of the prospective teachers, it was concluded that science education was going further in the vast sky. It was a technological development through which everywhere can be reached. This reveals that science education has a structure that facilitates human life with technological advancements and developments. In the creative comparisons related to technological tools, it was concluded that prospective teachers emphasized 39 different tools in total, and among these, most common one being ‘computer’ (43.66%). According to the opinions of the prospective teachers, it was concluded that science education contained all the information that would facilitate human life. This study has similar results with the study conducted by Soysal and Afacan (2012) on primary school students and the study conducted by Demirci-Güler (2012) on prospective classroom teachers, and students and prospective teachers emphasized the creative comparisons such as 'computer' since the Science and Technology course embodies everything.

Furthermore, according to the results of this study, it was seen that the creative comparisons of prospective classroom teachers for science education were more historical and interesting. Prospective preschool teachers were found to perceive the creative comparisons for science education as creative, emotional and like a game. On the other hand, prospective science teachers were observed to perceive science education as an area, which constantly progresses, requires research and examination and contains hidden problems that need to be revealed. The selection of the prospective teachers from different departments increased the content validity of the research. Additionally, while the creative comparisons of female prospective teachers were more emotional (love, like, all colors, pink) than men, men were found to make more logical explanations (blue, microscope, white, black, gray, f-16). Besides, while prospective science teachers gave more traditional answers to games (hide-and-seek, blindman's buff, riddle, puzzle, PES 2013 etc.), prospective classroom and preschool teachers wrote more unfamiliar interesting answers (turn turn butterfly, wolf dad, duck duck goose, jumping, predicting etc.).

Consequently, it has been revealed through the findings that prospective teachers generally had positive perceptions towards the concept of science, however, there were still negative perceptions although very few. Together with the developing and changing world, the creative comparisons used by the prospective teachers for science education also differentiate.

Considering the results of the research, the following suggestions have been proposed for science education and for the studies to be conducted: A similar study can be conducted on students studying at primary and secondary school and different departments of the universities. The content of the study can be of a different type, and rich contents can be created about creative comparisons. Similarly, the creative comparisons of newly graduate or experienced teachers for science education can be studied. These findings can also be used to compare perceptions existing before starting to practice the profession to those existing during the practice of the profession. Different studies can be conducted in order to know the reasons of prospective teachers' negative perceptions towards science education. Moreover, while designing science education, it is recommended to consider prospective teachers' emotions, colors they have adopted, games they have suggested, transportation vehicles and technological tools. Thus, it is thought that this will result in more effective and efficient science education.

The convenience sampling method was used for this study, which is one of its limitations. This has an impact on the study's generalizability. However, because the study was conducted using phenomenology, one of the qualitative research designs, there are no generalizability concerns. Thus, because it was conducted using the phenomenological method, this study contributes significantly to the literature by revealing the current perceptions of science teachers toward the concept of science education.

References

Afacan, Ö. (2011). Fen bilgisi öğretmen adaylarının "Fen" ve "Fen ve Teknoloji Öğretmeni" kavramına yönelik metafor durumları [Metaphors used by elementary science teacher candidates to describe "scıence" and "elementary science and technology teacher]. *E-Journal of New World Sciences Academy (NWSA), 6*(1), 1242-1254.

Aktamış, H., & Ergin, Ö. (2006). Fen eğitimi ve yaratıcılık [Science education and creativity]. *Dokuz Eylül Univesity the Journal of Buca Faculty of Education, 20*, 77-83.

Aktamış, H., & Dönmez, G. (2016). Ortaokul öğrencilerinin fen bilimleri dersine, bilime, fen bilimleri öğretmenine ve bilim insanına yönelik metaforik algıları [Metaphoric perception of secondary school students towards science classes, science, science teacher and scientist]. *Ondokuz Mayıs University Journal of Education, 35*(1), 7-30.

Arık, S., & Özdemir E. (2014). Fen ve teknoloji öğretmen adaylarının fen laboratuvarına yönelik metaforik algıları [The metaphoric perceptions of prospective science and technology teacher to the concept of science laboratory]. *Kastamonu Education Journal, 24*(2), 673-688.

Arık, S., & Yılmaz, M. (2017). Fen bilimleri öğretmen adaylarının çevre sorunlarına yönelik tutumları ve çevre kirliliğine yönelik metaforik algıları [Prospective science teachers' attitude toward the environmental problems and their metaphorical perceptions about "environmental pollution]. *Kastamonu Education Journal, 25*(3), 1147-1164.

Arslan, M., & Bayrakçı, M. (2006). Metaforik düşünme ve öğrenme yaklaşımının eğitim öğretim açısından incelenmesi [An examination of metaphorical thinking and learning from educational view]. *Jornal of National Education, 171*, 100-108.

Aydın, F. (2010). Ortaöğretim öğrencilerinin coğrafya kavramına ilişkin sahip oldukları metaforlar [Secondary school students' metaphors about the geography concept]. *Educational Scıences: Theory & Practıce, 10*(3), 1293-1322.

Aydın, F. (2011). Üniversite öğrencilerinin "Çevre" kavramına ilişkin metaforik algıları [The metaphoric perceptions of university students towards "environment" concept]. *Doğu Coğrafya Dergisi [Eastern Geographical Review], 16*(26), 25-44.

Bıyıklı, Ç., Başbay, M., & Başbay, A. (2014). Ortaokul ve lise öğrencilerinin bilim kavramına ilişkin metaforları [Secondary and high school students' metaphors about the concept of science]. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi [Bolu Abant İzzet Baysal University Journal of Faculty of Education], 14*(1), 413-437.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2008). *Bilimsel araştırma yöntemleri* [*Sxientific research methods*] (2nd ed.). Pegem.

Cameron, L. (2002). Metaphors in the learning of science: A discourse focus. *British Educational Research Journal, 28*(5), 673-688.

Çepni, S., Ayas, A., Johnson, D., & Turgut, M. F. (1997). *Fizik öğretimi* [*Physics teaching*]. YÖK/Dünya Bankası Milli Eğitimi Geliştirme Projesi, Hizmet Öncesi Öğretmen Eğitimi.

Çepni, S., & Keleş, E. (2006). Turkish students' conceptions about the simple electric circuits. *International Journal of Science and Mathematics Education, 4*(2), 269-291.

Çermik, H. (2013). Öğretmen adaylarının zihinlerinde canlanan resimdeki bilim insanı [A scientist created in the picture that pre-service teachers have in their minds]. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 33*, 139-153.

Demirci-Güler, M. P. (2012). Sınıf öğretmeni adaylarının fen ve teknoloji dersine ilişkin metaforik tanımlamaları [Metaphorical definitions of classroom teacher candidates about science and technology courses]. *Electronic Journal of Social Sciences, 11*(41), 53-63.

Deniş-Çeliker, H. D., & Akar, A. (2015). Ortaokul öğrencilerinin doğaya ilişkin metaforik algıları [Metaphors regarding to nature of middle school students]. *Ahi Evran University Journal of Kırşehir Education Faculty, 16*(2), 101-119.

Doğan Bora. N., Arslan, O., & Çakıroğlu, J. (2006). Lise öğrencilerinin bilim ve bilim insanı hakkındaki görüşleri [What do high school students think about science and scientıst?]. *Hacettepe University Journal of Education, 31*, 32-44.

Dönmez, G. (2017). *Ortaokul Öğrencilerinin fen bilimleri dersine, bilime, fen bilimleri öğretmenine ve bilim insanına yönelik metaforik algıları ve imajları [Metaphorical perceptions and imaginations of secondary school students for science course, science, science teachers and scientist]*. (Unpublished master's thesis). Aydın: Adnan Menderes University.

Jaakkola, T., & Veermans, K. (2018). Exploring the effects of concreteness fading across grades in elementary school science education. *Instructional Science*, *46*(2), 185-207.

Jeppsson, F., Haglund, J., Amin, T. G., & Strömdahl, H. (2013). Exploring the use of conceptual metaphors in solving problems on entropy. *Journal of the Learning Sciences, 22*(1), 70-120.

Güler, T., & Akman, B. (2006). 6-yaş çocuklarının bilim ve bilim insanı hakkındaki görüşleri [6-year-old children's views on science and scientists]. *Hacettepe University Journal of Education, 31*, 55-66.

Gömleksiz, M. N., Kan, A. Ü., & Öner, Ü. (2012). İlköğretim öğrencilerinin sosyal bilgiler dersine ilişkin metaforik algıları [Metaphorical perceptions of elementary school students toward social studies course]. *Erzincan University Journal of Education Faculty, 14*(2), 419-436.

Güveli, E., İpek, A. S., Atasoy, E., & Güveli, H. (2011). Sınıf öğretmeni adaylarının matematik kavramına yönelik metafor algıları [Prospective primary teachers' metaphorical perceptions towards mathematics]. *Turkish Journal of Computer and Mathematics Education, 2*(2), 140-159.

Güven, E. (2014). Fen ve teknoloji öğretmen ve öğretmen adaylarının çevre eğitimine ilişkin metaforik algıları [Metaphoric perception of science and technology teachers and teacher candidates for environmental educatıon]. *Journal of Research in Education and Teaching, 3*(3), 26-37.

Hançer, A.H., Uludağ, N., & Yılmaz, A. (2007). Fen bilgisi öğretmen adaylarının kimya dersine yönelik tutumlarının çeşitli değişkenlere göre değerlendirilmesi **[**The evaluation of the attitudes of scıence teacher candidates towards chemistry lesson**].** *Hacettepe University Journal of Education, 32*, 100-109.

Kaya, M. F. (2014). Sosyal bilgiler öğretmen adaylarının çevre sorunlarına ilişkin metaforik algıları [Social studies teachers' perception related to environmental problems: A sample analysis of metaphors]. *Turkish Studies-International Periodical for the Languages, Literature, and History of Turkish or Turkic, 9*(2), 917-931.

Kılıç, Ş. (2010). Çocukların bilime ve bilim insanına yönelik tutumları ve kalıplaşmış yargıları [Children's attitudes and stereotypes towards science and scientists]. *The Journal of turkishs Educational Sciences, 8*(2), 439-455.

Levine, P. M. (2005). Metaphors and images of classroom. *Kappa Delta Pi Record, 41*(4), 172-175. https://files.eric.ed.gov/fulltext/EJ724893.pdf

McMillan, J. H., & Schumacher, S. (2010). *Research in education: Evidence-based inquiry* (7th ed.). Pearson Education.

Mertol, H., Doğdu, M., & Yılar, B. (2013). Üstün zekâlı ve yetenekli öğrencilerin sosyal bilgiler dersine ilişkin metaforik algıları [Metaphorical perceptions of the gifted and talented students with regard to the social studies lesson]. *Journal of Gifted Education Research, 1*(3), 176-183.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage Publications.

Minister of National Education [MNE] (2018). *Fen bilimleri dersi öğretim programı (İlkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar)* [Science course cirriculum (Primary and Secondary school 3, 4, 5, 6, 7 and 8 classes)]. Ankara: Talim ve Terbiye Kurulu Başkanlığı.

Özgelen, S. (2012). Turkish young children's views on science and scientists. *Educational Sciences: Theory & Practice, Special Issue*, 3211-3225.

Saban, A. (2009). Öğretmen adaylarının öğrenci kavramına ilişkin sahip olduğu zihinsel imgeler [Prospective teachers' mental images about the concept of student]. *Turkish Journal of Science, 7*(2), 281-326.

Saban, A., Koçbeker, B. N., & Saban, A. (2006).Öğretmen adaylarının öğretmen kavramına ilişkin algılarının metafor analizi yoluyla incelenmesi [An investigation of the concept of teacher among prospective teachers through metaphor analysis]. *Educational Sciences: Theory & Practice*, *6*(2), 509-522.

Singh, K. (2010). Metaphor as a tool in educational leadership classrooms. *Management in Education, 24*(3) 127– 131.

Sosyal, D., & Afacan, Ö. (2012). İlköğretim öğrencilerinin "Fen ve Teknoloji Dersi" ve "Fen ve Teknoloji Dersi Öğretmeni" kavramlarına yönelik metafor durumları. [Metaphors used by primary school students to describe "science and technology lesson" and "scıence and technology teacher"]. *Mustafa Kemal University Journal of Social Sciences Institute, 9*(19), 287-306.

Şenel, T., & Aslan O. (2014). Okul öncesi öğretmen adaylarının bilim ve bilim insanı kavramlarına yönelik metaforik algıları [The metaphoric perceptions of preservice early childhood teachers' conceptions on science and scientist]. *Mersin University Journal of the Faculty of Education, 10*(2), 76-95.

Tortop, H. S. (2013). Öğretmen adaylarının üniversite hocası hakkındaki metaforları ve bir değerlendirme aracı olarak metafor [Preservice teachers' metaphors about university teacher and metaphor as an evaluation tool]. *Journal of Higher Education and Scienci, 3*(2), 153-160.

Uslu, N., Kocakülah, A., & Gür, H. (2016). Ortaokul öğrencilerinin bilim, bilim insanı ve öğretmen kavramlarına ilişkin metafor algılarının incelenmesi [Secondary school students' science, scientıst, and teacher perceptıon on the concepts of metaphor study]. *Journal of Research in Education and Teaching, 5*(1), 354-364.

Ürey, M., Karaçöp, A., Göksu, V., & Çolak, K. (2017). Fen ve sosyal bilimler kökenli öğretmen adaylarının bilim insanı algıları [Perceptions of prospective science and social studies teachers toward scientists]. *YYU Journal of Education Faculty, 14*(1), 205-226.

Yapıcı, İ. Ü. (2015). Lise öğrencilerinin biyoloji kavramına ilişkin metaforik algıları [High school students' metaphorical perceptions towards biology]. *Electronic Journal of Social Sciences, 14*(55), 139-147.

Yıldırım, A. & Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri* (7th ed.) [*Qualitative research methods in the social sciences*]. Seçkin.

Yılmaz, Z. A., & Batdı, V. (2016). A meta-analytic and thematic comparative analysis of the integration of augmented reality applications into education. *Eğitim ve Bilim*, *41*(188), 273-289. http://dx.doi.org/10.15390/EB.2016.6707

Research Article
Received: 25.10.2022
Accepted: 23.12.2022
Published: 31.12.2022

Citation: Demir, S. (2022). Evaluation of the Turkish course curriculum (middle school 5, 6, 7 and 8th grades) in terms of basic language skills outcomes. *International Journal of Scholars in Education, 5*(2), 117-131. http://dx.doi.org/10.52134/ueader.1194512

Evaluation of the Turkish Course Curriculum (Middle School 5, 6, 7 and 8th Grades) in terms of Basic Language Skills Outcomes

Selvi DEMİR*

***Abstract*:** This research was created to evaluate the basic language skills of the 2019 Turkish curriculum in terms of listening, speaking, reading and writing outcomes. These outcomes were examined in numbers, qualifications, distributions by classes and differentiation aspects. In the study, which is a qualitative study, the data in the Turkish middle school program were discussed with document review. Content analysis of the obtained data was carried out, and percentage and frequency values were also calculated. As a result of the research, it was determined that there was a total of 289 outcomes in the curriculum, 52 of which were related to listening/watching, 28 of which related to speaking, 142 of which related to reading and 67 of which related to writing skills. However, it has been found that the majority of outcomes are repeated exactly without changing as the class level increases. Accordingly, it was determined that the 289 language skills outcomes in the program consisted of 109 outcomes. Based on the research findings, it has been suggested that all of the basic language skills outcomes should be given equal weight in the Turkish course curriculum, especially to increase the inclusiveness of the outcomes of speaking skills.
Keywords: Turkish course, language skills outcomes, curriculum, middle school.

* Asisst. Prof. Dr., Kilis 7 Aralık University, Turkey, slv.demir@gmail.com, ORCID: 0000-0002-7043-7414

Introduction

The teaching programs are the documents occurring within the framework of the country's education policy, in addition to demonstrate when and how to process relevant content during the course for each discipline regulates how to measure and evaluate the output received also (Demir, 2021a). According to Kalaycı and Yıldırım (2020, s. 240), teaching programs are the source of a framework for the content and boundaries of educational work and a variety of dimensions. Besides, as İşeri and Bastuğ (2016) said teaching programs that allow generations to grow, to ensure the future and continuity of countries has a significant impact on the transfer of cultural values, while maintaining universal values that guarantee the future of countries.

In the republican period, in eight cycles (1924, 1929, 1938, 1949, 1981, 2006, 2015, 2017 dated) course programs prepared, Turkish courses were renewed in the same cycles as other courses (Arı, 2021). In addition to this, in 2018 and 2019, the Turkish course teaching programs were updated so from the Republic to the present, it has seen that middle school Turkish teaching programs have been renewed 10 times. While in Turkish teaching programs before the 1981 program, it is observed that the individual course hours for the linguistic skills are not determined and have no integrity, as İşeri and Baştuğ (2016) stated, the language skills are based on an integrated understanding of these skills, the principle of integrity, along with the separation of language skills in Turkish teaching programs updated in 1981 and later. Indeed, the current 2019 Turkish teaching program is observed, "it is configured in information in such a way that students can learn about listening/watching, speaking, reading and writing skills and mental skills for life, develop themselves individually and socially using these skills, communicate effectively, with Turkish love, have the ability to read and write on demand, a integrity with skills and values" (Ministry of National Education-MNE, 2019, p. 8). As seen, the students are first emphasized on the outcome of listening, speaking, reading and writing outcomes with basic language skills. Given that using language skills competently is a prerequisite for being good in the main language and that success in the main language affects success in language courses as well as in other disciplines, the functional aspect of the current Turkish course-teaching program is revealed. Indeed, in various research in the field (Demir, 2021b; Demir & Yapıcı, 2007; Durmuşçelebi, 2007; Öztürk, 2007; Yaman, 2009) it is emphasized that success in the main language is an important factor in improving academic success in other disciplines. However, a detailed review of the language skills outcomes in the 2019 Turkish course curriculum and the questioning of the overlap of the outcomes with the expressions specified in the program is deemed necessary to reveal the strengths and weaknesses of the program.

Starting from the Turkish course teaching program published in 2017, the expression "learning areas" has been changed in the form of "skills fields" and the five learning areas (listening/watching, speaking, reading, writing, language) of 2006 have been reduced to three (verbal communication, reading and writing) in the 2015 Turkish teaching program. This means that the ability to listen/watch and talk is included in the single title under "verbal communication". However, this step was found to be incorrect and in 2017 program, the skills were deducted in four (listening/watching, speaking, reading and writing) under separate headings. Four skills have been preserved in the later published 2018 and updated 2019 programs. The 2019 Turkish courses' program is included in these four basic skills.

Scientific data have shown that "listening" is the first language skill developed in individuals. It is also known that the ability of human beings to speak with the influence of the environment, which is then born with the ability to speak, and finally, the ability to read and write, has developed. Man tends to wonder and pursue the unknown. Probably because of its effect, it is seen that the most valuable of the language skills are later acquired reading and

writing skills. This individual trend was also taken by program developers and those who directed programs and it is seen that the listening and speaking language skills acquired in the Turkish education system for years were ignored (Demir, 2021a; Emiroğlu & Pınar, 2013; Özbay & Melanlıoğlu, 2012; Yazar & Yazar, 2018). In scientific studies (Demir, 2020; Doğan, 2009; Gür, 2011; Maden, 2013; Kundakçı & Kapağan, 2015) and practical (Danişmend, 2017; Hepçilingirler, 2019; Hepçilingirler, 2020; Torun, 2015) including daily life and teaching process, it has been determined that the listening and speaking skills of individuals are not the desired quality. However, many research highlights that the main reason for language learning is the ability to communicate in the first place, and the basis for communication is listening and speaking skills with verbal communication skills (Akdemir, 2016; Tayşi Karakus, 2014; Takkaç & Akdemir, 2015; Yaman, 2014). In addition, seventy-five percent of the time spent communicating during the day should not be ignored that they are talking and listening (Erkuş, 2013). On the other hand, reading and writing outcomes included more comprehensively in comparison with other language skills in 2019 Turkish courses can be said to be better at meeting the need. The approach to creating an outcome for these two skills must apply to other skills as well. Whether it is natural or later, it is important that all language skills are not ignored by the ability to develop with education. Considering that language skills are part of the whole, it is inevitable that the holistic understanding of both teaching programs and educational applications will have an effect on capturing the success targeted in language courses and other disciplines indirectly.

When examined the outcomes of language skills in the Turkish language-teaching program, updated in 2019, the 2018 program has been preserved in a similar way, with the number of outcomes and expressions not changing. "It is also important to support scientific studies based on critical and multi-point evaluation of program changes or updates that are essential to comply with the needs of the age. If new steps are being taken in this way to support accuracy, it is possible to make the necessary changes by recognizing missing or incorrect conditions" (Demir, 2021a). As a matter of fact, there are many studies in the field where scientific examination of frequently updated Turkish teaching programs is conducted. In the most recent research (Çarkıt, 2021; Demir, 2021a; Direkçi et al., 2019; Esemen, 2020; Hamsi İmrol et al., 2021; Kılıç & Erkal, 2021; Susar Kırmızı & Yurdakul, 2019; Şahin, 2019; Ünveren Kapanadze, 2019), the Turkish teaching program is evaluated in various aspects of it. The aim of this study is to examine the 2019 Turkish courses at the currently used middle school level in terms of listening, speaking, reading and writing outcomes with basic language skills. These language skill outcomes are covered by the numbers, competencies, grades and whether they differ according to the classroom level.

Method

In this study, it has been used the document study in qualitative research methods. According to Corbin and Strauss, the document analysis is a method that requires the analysis and interpretation of the data in order to make sense, to create understanding of the relevant topic, to develop empirical information, such as other methods used in qualitative research (Cited Kıral, 2020). Document review covers "the analysis of written materials that contain information about the intended phenomenon or facts targeted for research. In a qualitative research, document review may be a single research method, and may be used as an additional source of information if other qualitative methods are used" (Yıldırım & Şimşek, 2016, p. 189). In this context, the 2019 Turkish course curriculum, which is one of the public/official records, has been examined in the context of language skill outcomes, while creating the document of this study alone.

Data Source and Data Analysis

In qualitative research, it is accepted that data is collected through observation, discussion and documentation (Berg & Lune, 2015; Merriam, 2009). The data of this research was obtained from the 2019 Turkish course-teaching programs on the website of the Ministry of National Education. The document was downloaded to the computer and transferred into Excel programme and performed the necessary analysis works on it. Content analysis was used to analyze the data reached. To this end, a framework has been created for the study of the field and accordingly, the data has been classified, defined, interpreted, presented in shapes and tables and reported. In this context, the 2019 Turkish teaching program has been examined in detail in the context of language skills outcomes, analyzed and frequency has been used to determine the density of the results reached as quantitatively, and percentage values to indicate the ratios.

After the completion of the analysis of the data, in order to ensure compliance with ethical principles and to reveal the reliability of coding, assistance was received from two faculty members who are experts in the field working in the Department of Turkish Education. The coding reliability formula of Miles and Huberman (1994) was used to ensure reliability. The coding of the researcher and other teaching staff were compared with each other and Miles and Huberman's (1994) coding reliability formula was used. The concordance of the analysis between the researcher and the experts was calculated according to the formula "Reliability=Number of Consensus/Number of Consensus+ Number of Non-Consensus". Since the average of the encoder reliability coefficient obtained as a result of document review turned out to be 0.90, the analysis of the data collection tool used in this study can be considered reliable.

Besides that, this research is thought to be valid and reliable by the rich scanning of the field, making coding based on the relevant studies and incorporating information and quotes into the research without modification based on the original of the document.

Findings

Data on the distribution of language skills outcomes achieved in the 2019 Turkish course curriculum according to middle school grade levels are presented in Table 1.

Table 1
Distribution of Language Skills Outcomes Achieved in the Turkish Course Curriculum According to Middle School Grade Levels

Skill area	5th grade		6th grade		7th grade		8th grade		Total	
	f	%	f	%	f	%	f	%	f	%
Listening	12	17.4	12	17.6	14	18.4	14	18.4	52	18
Speaking	7	10.1	7	10.3	7	9.2	7	9.2	28	9.7
Reading	34	49.3	35	51.5	38	50	35	46.1	142	49.1
Writing	16	23.2	14	20.6	17	22.4	20	26.3	67	23.2
Total	69	100	68	100	76	100	76	100	289	100

When examined Table 1, it has been examined that there are 289 outcomes in the curriculum for language skills in total; 52 of them are outcomes for listening/watching, 28 of them are speaking, 142 of them are reading and 67 of them are writing skills. In fact, it has been examined the greatest outcome is the reading skill and the lowest outcome is speaking skill at all class levels. In this context, almost half of the outcomes in all class levels are related to the reading skill (49.1%). The ratio of the outcomes related to speaking skill remained only 9.7%.

18% of the remaining outcomes are related to listening/watching and 23.2% are related to writing skills. When the distribution of language skills outcomes according to the classroom level was examined, it was determined that there were 69 outcomes at the fifth grade level, 68 outcomes at the sixth grade level, and 76 outcomes at the seven and eighth grade level. Therefore, it was concluded that seven and eight classes were the class level, where the highest outcome for language skills, and the class level with the lowest outcome was sixth grade.

Findings Related to Listening/Watching Skills

It has been determined that there are 52 outcomes for listening/watching skills in the 2019 middle school Turkish teaching program. 12 of these outcomes are fifth grade, 12 of them are sixth grade, 14 of them are seventh grade and 14 of them are eighth grade (Table 2). As seen, the outcomes for listening/watching skills have been uniformly distributed according to classroom levels.

The distribution of listening/watching outcomes in the Turkish curriculum according to grade levels was examined and the following findings were reached: it is observed that ten outcomes take part at all grade level including *"enacts the narrative texts he/she listens to/watches", "answers/answers the questions/questions about what he/she listens/watches", "makes predictions about the development and outcome of events when they listen/watch", "recommends different titles for what they listen/watch", "summarize what they listen/watch", "identifies/detects the main idea/main sense of what they listen/watch", "identifies/detects the subject of what they listen/watch", "states their opinions about what they listen/watch", "applies listening strategies", "comprehends the speaker's non-verbal messages";* the two learning outcomes in the form of five, six and seventh grades take part at the level of three grades including ; *"predicts the meaning of unfamiliar words when they listen/watch", "evaluates the content of what they listen/watch"*; two learning outcomes in the form of seventh and eighth grades take part at two grade levels including *"identifies the ways of developing the thought when they listen/watch", "questions the consistency when they listen/watch"*; the two learning outcomes in the form of are only at the eighth grade level take part including *"evaluates the media texts they listen/watch", "guesses the meaning of unfamiliar words when they listen/watch"*. Therefore, at the middle school level, it is seen that listening/watching skills are tried to be given to the students by giving place to 16 different outcomes in the field of listening/watching skills. In other words, it should be noted that although there are 52 outcomes in total for listening/watching in the program, there are actually 16 different outcomes (Table 2).

Table 2
Listening/Watching Outcomes by Grade Level

Outcomes	5th grade	6th grade	7th grade	8th grade
"It animates the narrative texts it listens to/watches."	+	+	+	+
"Answers/answers questions/questions about what they have listened/watched."	+	+	+	+
"When they listen/watch, they make predictions about the development and outcome of the events."	+	+	+	+
"Suggests different titles for what they are listening/watching."	+	+	+	+
"Summarizes what you have listened/watched."	+	+	+	+
"Identifies/tests the main idea/main emotion of what they listen/watch."	+	+	+	+
"Identifies/detects the subject of what they listen/watch."	+	+	+	+
"He/she expresses his/her opinions about what he/she listens to/watches."	+	+	+	+
"Applies listening strategies."	+	+	+	+
"Comprehends the speaker's non-verbal messages."	+	+	+	+

"When they listen/watch, they guess the meaning of the unfamiliar words."	+	+	+	
"Evaluates the content of what they listen/watch."	+	+	+	
"Identifies the ways of developing the thought applied when they listen/watch."			+	+
"When they listen/watch, they question consistency."			+	+
"Evaluates the media texts they listen/watch."				+
"When they listen/watch, they guess the meaning of the words they don't know."				+
Total	12	12	14	14

Findings Related to Speaking Skills

It has been determined that there are 28 outcomes for speaking skills in the 2019 middle school Turkish curriculum. Seven of these outcomes are at the fifth grade, seven at the sixth grade, seven at the seventh grade, and seven at the eighth grade level. Therefore, it has been determined that the outcomes for speaking skills at the middle school level are equally distributed in all grade levels (Table 3).

The distribution of speaking outcomes in the Turkish curriculum according to grade levels was examined and the following findings were reached: The seven outcomes related to the speaking skill in the form of a speech are given exactly the same place at all grade levels: *"makes a prepared speech", "makes an impromptu speech", "uses words in accordance with their meanings", "applies speaking strategies", "uses body language effectively in his speeches", "uses appropriate transition and connection expressions in his/her speech", "in his/her speeches, s/he uses the Turkish words of words taken from foreign languages and not yet settled in our language".* Therefore, only seven different outcomes regarding speaking skill at middle school level are included. In other words, although a total of 28 outcomes for speaking skills were included in the 2019 Turkish curriculum at middle school level, it should be noted that during the four-year middle school education, students' speaking skills were tried to be improved with seven different outcomes (Table 3).

Table 3
Speaking Outcomes by Grade Level

Outcomes	5th grade	6th grade	7th grade	8th grade
"S/he makes a prepared speech."	+	+	+	+
"S/he makes impromptu speeches."	+	+	+	+
"Uses words according to their meanings."	+	+	+	+
"Applies speaking strategies."	+	+	+	+
"S/he uses body language effectively in her speeches."	+	+	+	+
"Uses appropriate transitional and linking expressions in his/her speech."	+	+	+	+
"In his/her speeches, s/he uses the Turkish words of words taken from foreign languages and not yet settled in our language."	+	+	+	+
Total	7	7	7	7

Findings Related to Reading Skills

It has been determined that there are 142 reading skills outcomes in the 2019 middle school Turkish curriculum. Of these outcomes, 34 are at the fifth grade, 35 at the sixth grade, 38 at the seventh grade, and 35 at the eighth grade level. Therefore, it has been determined that the highest level of outcome for reading skills at the middle school level is at the seventh grade, and the least attainment is at the fifth grade (Table 4).

The distribution of reading outcomes in the Turkish curriculum according to grade levels was examined and the following findings were reached: it is determined that 22 outcomes in the form of including *"predicts the meaning of unfamiliar words and phrases based on/using the context", "uses information sources effectively", "questions the reliability of information sources", "reads texts written in different fonts", "guesses the subject of the text to be read from the visuals and the title". "Answers questions about visuals", "evaluates/analyzes media texts", "distinguishable text types", "generates different solutions to the problems discussed in the text", "understands the ways of emphasizing important points in the text", "real and fictional texts in the text". distinguishes elements of the text", "identifies the figures of speech in the text", "asks questions about the text", "answers questions about the text (answers questions)", "makes comparisons between texts", "reads the text in accordance with the characteristics of the genre", determines the main idea/feeling of the text", "identifies the subject of the text", "reads aloud and silently by paying attention to punctuation marks", "makes inferences about what they read". found", "summarizes what they have read", "uses reading strategies"; three outcomes in the form of five, six and seventh grade levels including "determines the contribution of idioms and proverbs to the text", "identifies the story elements in the text", "evaluates the contribution of the transition and connection expressions between the elements that make up the text";* three outcomes in the form of six, seven and eighth grade including *"interprets the information presented with graphics, tables and charts", "determines the appropriate title/headings for the content of the text", "interprets the content of the text"* three outcomes in the form of seventh and eighth grade level including *"identifies the forms of expression in the text", "understands the work and process steps in the text", "identifies the auxiliary ideas in the text"; outcome at the sixth and seventh grade level including "distinguish the functions of inflectional affixes"*; the nine outcomes in the appendix are at the fifth grade level including *"distinguish the meanings of homonyms", "answer questions about information presented in graphs, tables and charts", "find synonyms for words", "find antonyms of words", "distinguish roots and affixes", "interpret text", " distinguishes the real, figurative and terminological words in the text he reads", "determines the title(s) suitable for the content of the text he reads", "explains the functions of the suffix"*; six outcomes in the form of sixth grade level including *"explains the morphological features of poetry", "distinguish between simple, derivative and compound words", "explains the contribution of prepositions, conjunctions and exclamations to the meaning of the text", "explains the contribution of noun and adjective phrases to the meaning of the text", "explains the contribution of nouns and adjectives to the meaning of the text", "explains the contribution of the pronouns to the meaning of the text", "explains the contribution of the pronouns to the meaning of the text"*; six outcomes in the form of seventh grade level including *"distinguish simple, derived and compound verbs", "detects speech disorders", "recognizes the semantic features of verbs", "identifies ways of developing the thought used in the text", "compares the written version of the texts with the media presentations", "detects the differences between the adverbs and the meaning of the text", "explains its contribution"* and that seven outcomes in the form of including *"identifies the contribution of idioms, proverbs and aphorisms to the text", "compares the written text of the literary work with the media presentation", "understands the functions of the verbs in the sentence", "evaluates the contribution of the transitional and connection expressions to the text", "identifies the expression disorders in the text", determines the story elements in the texts", "identifies the ways of developing the thinking used in what they read"*. Therefore, it is seen that students in middle school are trying to gain reading skills with 60 different outcomes. In other words, although there are 142 outcomes for reading skills in the curriculum, there are actually 60 different outcomes (Table 4).

Table 4
Reading Outcomes by Grade Level

Outcomes	5th Sınıf	6th Sınıf	7th Sınıf	8th Sınıf
"Guess the meaning of unfamiliar words and phrases based on/using the context."	+	+	+	+
"Uses information resources effectively."	+	+	+	+
"It questions the credibility of information sources."	+	+	+	+
"Reads texts written in different fonts."	+	+	+	+
"Predicts the subject of the text to read from the images and the title."	+	+	+	+
"Answers questions about images."	+	+	+	+
"Evaluates/analyzes media texts."	+	+	+	+
"Distinguishes text types."	+	+	+	+
"Produces different solutions to the problems addressed in the text."	+	+	+	+
"Comprehends the ways of emphasizing important points in the text."	+	+	+	+
"Distinguishes real and fictional elements in the text."	+	+	+	+
"Identifies the figures of speech in the text."	+	+	+	+
"Ask questions about the text."	+	+	+	+
"Answers (answers) questions about the text."	+	+	+	+
"Makes comparisons between texts."	+	+	+	+
"Reads the text in accordance with the characteristics of the genre."	+	+	+	+
"Determines the main idea/main sense of the text."	+	+	+	+
"Determines the subject of the text."	+	+	+	+
"Reads aloud and silently, paying attention to punctuation."	+	+	+	+
"He makes inferences about what he reads."	+	+	+	+
"Summarizes what you have read."	+	+	+	+
"Uses reading strategies."	+	+	+	+
"Determines the contribution of idioms and proverbs to the text."	+	+	+	
"Identifies the story elements in the text."	+	+	+	
"Evaluates the contribution of transition and connection expressions between the elements that make up the text to the meaning."	+	+	+	
"Interprets information presented in graphs, tables, and charts."		+	+	+
"Determines the appropriate title/headings for the content of the text."		+	+	+
"Interprets the content of the text."		+	+	+
"Identifies the forms of expression in the text."			+	+
"Comprehends the work and process steps in the text."			+	+
"Identifies supporting ideas in the text."			+	+
"Distinguish the functions of inflectional suffixes."		+	+	
"Distinguish the meanings of homophones."	+			
"Answers questions about information presented in graphs, tables, and charts."	+			
"Finds synonyms for words."	+			
"Finds the antonyms of words."	+			
"Distinguishes roots and suffixes."	+			
"Interprets the text."	+			
"Distinguishes real, figurative and literal words in the text he reads."	+			
"Determines the title(s) appropriate to the content of the text he reads."	+			
"Explains the functions of the suffix."	+			
"Explains the morphological features of the poem."		+		
"Distinguish between simple, derived and compound words."		+		
"Explains the contribution of prepositions, conjunctions and exclamations to the meaning of the text."		+		
"Explains the contribution of noun and adjective phrases to the meaning of the text."		+		
"Explains the contribution of nouns and adjectives to the meaning of the text."		+		
"Explains the contribution of pronouns to the meaning of the text."		+		
"Distinguish between simple, derived and compound verbs."			+	

"Detects speech disorders."			+	
"Recognizes the semantic features of verbs."			+	
"Identifies ways of developing thinking used in the text."			+	
"Compares the written version of the texts with the media presentations."			+	
"Explains the contribution of adverbs to the meaning of the text."			+	
"Idioms determine the contribution of proverbs and aphorisms to the text."				+
"Compares the written text of the literary work with the media presentation."				+
"Comprehends the functions of the verbs in the sentence."				+
"Assesses the contribution of transitional and linking expressions to the meaning of the text."				+
"Identifies the grammatical errors in the text."				+
"Identifies the story elements in the texts read."				+
"Identifies ways of developing thinking used in what they read."				+
Total	34	35	38	35

Findings Related to Writing Skills

It has been determined that there are 66 outcomes for writing skills in the 2019 middle school Turkish curriculum. Of these outcomes, 16 are in the fifth grade, 14 in the sixth grade, 17 in the seventh grade, and 20 in the eighth grade level. Therefore, it was determined that the highest attainment of writing skills at the middle school level was at the eighth grade, and the least attainment was at the sixth grade (Table 5).

The distribution of writing outcomes in the Turkish curriculum according to grade levels was examined and the following findings were reached: it is determined that 12 outcomes in the form of at all grade levels including *"writes informative texts", "fills in forms in accordance with instructions", "writes narrative texts", "writes short texts", "writes poetry", "uses Turkish words from foreign languages that have not yet settled in our language", "organizes what they write", "shares what he writes", "determines a suitable title for the content of his writings", "uses appropriate transition and connection expressions in his writings", "uses proverbs, idioms and aphorisms to enrich his writings", "applies writing strategies"*; three outcomes in the form of seventh and eighth grade level including *"writes a work according to the process steps" at the six, seventh and eighth grade levels including "uses graphs and tables to support the narrative", "presents the results of their research in written form", "uses narrative forms in their writings"*; four outcomes in the form of fifth grade including "writes numbers correctly", *"uses sound words correctly", "writes the steps of a job", "uses capital letters and punctuation marks in appropriate places"; outcome in the form of sixth grade including "uses graphs and tables when necessary to support what s/he writes"; outcome in the form of seventh grade including "uses in accordance with additional actual functions"* and four outcomes in the form of eighth grade including *"recognizes the types of sentences", "distinguish the elements of the sentence", "understands the contribution of the verbal features of the verbs to the meaning", "uses humorous elements in their writings"*. Therefore, it is seen that middle school students are trying to gain this skill with 26 different outcomes for writing skills. In other words, although a total of 66 outcomes for writing skills are included in the program, it is observed that there are actually 26 different outcomes (Table 5).

Table 5
Writing Outcomes by Grade Level

Outcomes	5th grade	6th grade	7th grade	8th grade
"They write informative text."	+	+	+	+
"They fill the forms in accordance with the instructions."	+	+	+	+
"They write narrative text."	+	+	+	+
"They write short texts."	+	+	+	+
"They write poetry."	+	+	+	+
"When they write, they use the Turkish words of words taken from foreign languages and not yet settled in our language."	+	+	+	+
"They organize what they write."	+	+	+	+
"They share what they write."	+	+	+	+
"They determine a suitable title for the content of what they write."	+	+	+	+
"They use appropriate transitional and linking expressions in their writings."	+	+	+	+
"They use proverbs, idioms and aphorisms to enrich their writings."	+	+	+	+
"They apply writing strategies."	+	+	+	+
"They write a job according to the processing steps."		+	+	+
"They uses graphs and tables to support the narrative."			+	+
"They present the results of her research in writing."			+	+
"They use narrative forms in their writings."			+	+
"They write numbers correctly."	+			
"They use the words that are phonetic correctly in their writings."	+			
"They write down the steps of a work."	+			
"They use the capital letters and punctuation in appropriate place."	+			
"They use graphs and tables when they need to support what they write."		+		
"Additional uses in accordance with its actual functions."			+	
"They recognize sentence types."				+
"They distinguish the elements of the sentence."				+
"They comprehend the contribution of the verb's properties to the meaning."				+
"They use humorous elements in their writings."				+
Total	16	14	17	20

Discussion and Conclusion

It has been determined that 52 of the outcomes in the 2019 middle school Turkish curriculum, which includes 289 outcomes related to the basic language skills of listening/watching, speaking, reading and writing, are related to listening/watching, 28 speaking, 142 reading and 67 writing skills. Almost half (49.1%) of the outcomes in the curriculum consist of outcomes related to reading skills. It is noteworthy that while the outcomes related to reading skills are mostly included in the curriculum at all grade levels, the outcomes related to speaking skills are the least (9.7%). This finding is valid not only for the 2019 middle school curriculum, but also for the 2019 primary school Turkish curriculum. As a matter of fact, in Demir's (2021a) study, it is stated that the current Turkish curriculum includes the outcomes for reading skills at most and speaking skills the least. Again, in the studies of Hamsi İmrol et al. (2021), it is stated that the Turkish course curriculum focuses on reading and writing skills, and the rate of speaking skills is very low. Similarly, Kıymaz (2019) states that the Turkish course curriculum is a program that is shaped within the framework of reading outcomes; with the effect of the high number of reading outcomes, it is divided into "Reading for Reading" and "Comprehension" sub-skills in the 1st grade, and sub-skills as "Fluent Reading", "Vocabulary" and "Comprehension" from the 2nd grade; draws attention to the fact that such a distinction is not found in other skills. Kıbrıs's (2019) 5-8. there is consistency

between the findings of this study with the finding that less number of activities and questions regarding listening/watching and speaking learning areas were included in his study in which he examined the 4th grade Turkish course curriculum and textbooks. In the 2009 Turkish course curriculum, which is one of the previous programs, it is seen that the reading skill outcomes include those of listening but are even higher (Baş, 2012). On the other hand, in the studies of Kılıç and Erkal (2021), the outcomes in the 2019 Turkish course curriculum are evaluated as both adequate and functional.

As can be seen, reading has been given an advantage over other language skills in Turkish course curriculum for years. Despite this, the fact that our society is far from the expected level in terms of reading is a situation that should be questioned. As a matter of fact, the aim of the "No School Without a Library" project, which is a current study and was introduced by the Ministry of National Education and the Ministry of Culture and Tourism on October 26, is "to help students grow up as individuals who question, research, think analytically and produce knowledge, by providing them with the culture of reading, and to help them develop life and education preparing for the future" (MNE, 2021). Unfortunately, despite all this, it is observed that the reading level of our society is low. According to the Turkey Reading Culture Research (2019), report prepared by the Association of Turkish Publishers and Distributors Association, the rate of reading books is 42 percent. According to the Turkey Trends Research (2020) report prepared by Aydın et al. (2021) within Kadir Has University, which also draws attention to the fact that reading habits are gradually decreasing, the rate of those who do not read books in our country was 50.9 percent in 2019, while this rate reached 59.1 percent in 2020. International sources reveal that the situation is more dire. According to the PISA 2018 Turkey Preliminary Report (2019, p. 37), Turkey (466 points) is below the average of OECD countries (487 points) in reading comprehension.

The results of the research show that in the 2019 Turkish course curriculum, the least outcomes is reserved for speaking skills. While listening (Özbay & Melanlıoğlu, 2012; Yazar & Yazar, 2018) was the language skill that was ignored both in the program and in practice in our country until recent years, it is seen that speaking has taken its place. Combining listening/watching and speaking outcomes under the umbrella of "oral communication" rather than as different learning areas in the 2015 Turkish course (1-8th grades). Curriculum is the most obvious indicator that these two skills are ignored together. Considering that speaking is the essential element of language and its share in communication, psychology and success, in short, in human life, it is remarkable that the necessary importance is not given to speaking skills in the current program. Baş (2012, p. 278), who critically evaluated the 2006 Turkish curriculum and stated that the pre-service teachers who came to education faculties had a very good reading comprehension level but had difficulties in expressing themselves, said, "The way to develop writing skills is to develop speaking skills in writing logic does not go through the evaluation process. Such acceptances have led to the sacrifice of listening to reading and speaking to writing". In this context, it should be reminded that education administrators should give importance to all skills. As a matter of fact, the outcome of basic language skills is based on the idea of adequately developing all linguistic skills in students. It should be underlined that success or failure in language lessons based on comprehension and expression is reflected in other lessons in parallel. In this context, it can easily be said that if a holistic development process cannot be achieved, it will not be possible to achieve the targeted holistic success.

One of the research results is that most of the language skills outcomes are repeated without changing as the grade level increases. According to this, although there are 52 outcomes in total for listening/watching in the 2019 Turkish course curriculum, there are actually 16 different outcomes, a total of 28 outcomes for speaking skills are included, but there are actually seven different outcomes, a total of 142 outcomes for reading skills, but actually 60 different outcomes and finally, although a total of 66 outcomes for writing skills are included, it is seen

that there are actually 26 different outcomes. In other words, although there are 289 outcomes in total for language skills in the 2019 Program, there are only 109 different outcomes. It should be said that it is very difficult to gain speaking skill with only seven outcomes during middle school education. The absence of any outcome that stress and intonation change meaning in Turkish; the most obvious shortcomings are the lack of any outcome that the vocabulary is not limited to the written language, that is, standard Turkish, but also includes local language features. The existence of these deficiencies can be considered as an indication that the scope of knowledge/subject included in the field of speaking skill is kept very narrow; therefore, the scope of knowledge/subject is ignored while determining the number of outcomes. This results in the conclusion that the necessary importance is not given to the field of speaking skills. In addition, what is wanted to be brought to attention; some of the outcomes are found at one or two grade levels, and the preservation of some at all grade levels cannot be put into a logical framework. In other words, it is considered as a situation that should be questioned whether the outcomes of language skills should be in a spiral structure as in the current program or in a gradual manner according to grade levels. In the light of the findings of this study, it can be said that the following evaluations made by Arı (2016) for listening/watching and speaking outcomes in the 2015 Turkish curriculum, which is one of the previous programs, are still valid. "Some outcomes are eternal at intermediate class levels, some are eternal, some are interrupted, and some are not permanent, which can be seen as a factor that disrupts the balance of succession."

Based on the information obtained as a result of the research, it can be said that all language skills should be given sufficient importance in the Turkish secondary school curriculum. The inclusiveness of the acquisitions of listening skills, especially speaking skills, should be increased. As a matter of fact, it should not be ignored that language skills are parts of a whole. It should be noted that the disruption that will occur in one of them will affect the others as well. As a matter of fact, some findings about this reality have been discussed and emphasized in this study.

References

Akdemir, A. S. (2016). Willingness to communicate (WTC) in L2: An affective construct of language learning process. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 20*(3), 839-854. https://dergipark.org.tr/tr/pub/ataunisosbil/issue/26967/283429

Arı, G. (2016). A critical view of outcomes in oral communication learning areas of Turkish curriculum (1-8th grades). *Sakarya University Journal of Education, 6*(2), 235-253. https://doi.org/10.19126/suje.40827

Arı, G. (2021). Türkçe öğretiminin tarihçesi ve Türkçe öğretim programları [History of Turkish teaching and Turkish teaching programs]. In F. Topçuoğlu Ünal. *Türkçe öğrenme ve öğretim yaklaşımları [Turkish learning and teaching approaches]* (pp. 47-74). Nobel Akademik.

Aydın, M., Çelikpala, M., Yeldan, E., Güvenç, M., Zaim, O. Z., Hawks, B. B., Sokullu, E. C., Şenyuva, Ö., Yılmaz, O., & Tığlı, S. D. (2021). *Kantitatif araştırma raporu: Türkiye siyasal sosyal eğilimler araştırması 2020.* Kadir Has Üniversitesi Türkiye Çalışmaları Grubu, Akademetre ve Global Akademi.

Baş, B. (2012). A review to Turkish program in primary education as part of oral and written culture. *Kastamonu Eğitim Dergisi, 20*(1), 271-290. https://dergipark.org.tr/tr/pub/kefdergi/issue/48696/619524

Berg, B. L., & Lune, H. (2015). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences]*. (Trans. Ed. H. Aydın). Eğitim Kitabevi.

Çarkıt, C. (2021). Comparison of 1981 and 2019 Turkish course curriculums in terms of listening education. *Türkiye Sosyal Araştırmalar Dergisi, 25*(3), 827-838. https://dergipark.org.tr/tr/pub/tsadergisi/issue/66172/804083

Danişmend, M. (2017). *Türkçeyi yanlış kullanan kişiyi düzeltme deneyi [An experiment to correct the person who uses Turkish incorrectly]*. https://www.cnnturk.com/yazarlar/guncel/melis-danismend/turkceyi-yanlis-kullanan-kisiyi-duzeltme-deneyi

Demir, C., & Yapıcı, M. (2007). Turkish teaching as a special teaching field and its problems. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi, 9*(2), 177-192. http://hdl.handle.net/11630/3697

Demir, S. (2020). *The analysis of middle school eighth grade students' verbal lecture self-efficacy perceptions and the evaluation of their discourses*. (Unpublished doctoral dissertation). Erzurum: Atatürk University.

Demir, S. (2021a). Türkçe dersi öğretim programının dil becerileri açısından değerlendirilmesi (ilkokul 1, 2, 3 ve 4. sınıflar) [Evaluation of the Turkish lesson curriculum in terms of language skills (primary school 1st, 2nd, 3rd and 4th grades]. *3rd International Ankara Multidisciplinary Studies Congress*, 5-7 December (pp. 19-31), Ankara, Turkiya.

Demir, S. (2021b). Ortaokul öğrencilerinin Türkçe akademik başarılarının diğer disiplinlerle ilişkisinin incelenmesi [Examination of the relationship between the Turkish academic achievement of secondary school students and other disciplines]. *Ahi Evran International Conference on Scientific Research*, 30 November – 1-2 December, (pp. 898-906), Kırşehir, Turkiya.

Direkçi, B., Akbulut, S., & Şimşek, B. (2019). The analysis of Turkish course curriculum (2018) and middle school Turkish textbooks in terms of digital literacy skills. *Avrasya Uluslararası Araştırmalar Dergisi, 7*(16), 797-813. https://doi.org/10.33692/avrasyad.543868

Doğan, Y. (2009). Suggested activities to improve speaking skill. *Türk Eğitim Bilimleri Dergisi, 7*(1), 185-204. https://dergipark.org.tr/tr/pub/tebd/issue/26140/275307

Durmuşçelebi, M. (2007). *The mother language teaching in primary education in Turkey and Germany*. (Unpublished doctoral dissertation). Ankara: Ankara University.

Emiroğlu, S., & Pınar, F. N. (2013). Relationship between listening and other skill types. *Turkish Studies- International Periodical for the Languages, Literature and History of Turkish or Turkic, 8*(4), 769-782.

Erkuş, E. (2013). Konuşma eğitimi ve Türkçe öğretim programında yer alan yöntem ve teknikleri [Methods and techniques in speaking education and Turkish teaching program]. In C. Demir & H. Parlakyıldız. *Prof. Dr. Abdurrahman Güzel armağanı Türkçenin eğitimi ve öğretimi* (pp. 523-531). Ankara.

Esemen, A. (2020). *Analysis of 2019 primary school Turkish curriculum and Turkish textbooks in terms of critical reading skills*. (Unpublished master's thesis). Bursa: Uludağ University.

Gür, T. (2011). *Describing language usage and language attitudes of preservice turkish teachers with discourse analysis method*. (Unpublished doctoral dissertation). Erzurum: Atatürk University.

Hamsi İmrol, M., Dinçer, A., Doğan Güldenoğlu, B. N., & Babadoğan, M. C. (2021). Evaluation of the 2018 Turkish curriculum. *Eğitim ve Bilim, 46*(207), 403-437. http://dx.doi.org/10.15390/EB.2021.9625

Hepçilingirler, F. (2019). *Dedim: "ahh"*. Sia Kitap.

Hepçilingirler, F. (2020). *Türkçe "off"*. Kırmızı Kedi Yayınevi.

İşeri, K., & Baştuğ, M. (2016). An evaluation of new Turkish course curriculum. *International Journal of Language Academy, 4*(4), 17-35. http://dx.doi.org/10.18033/ijla.428

Kalaycı, N., & Yıldırım, N. (2020). Comparative analysis and evaluation of Turkish course curricula (2009-2017-2019). *Trakya Eğitim Dergisi, 10(*1), 238-262. https://doi.org/10.24315/tred.580427

Kıbrıs, S. (2019). *Text genre awareness' in Turkish lesson program and textbooks in secondary school*. (Unpublished master's thesis). Ankara: Başkent University.

Kılıç, F., & Erkal, M. (2021). Middle school (5-6-7-8) Turkish language curriculum listening/watching outcomes and examining the relationship between text and strategy *Ağrı İbrahim Çeçen Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 7*(2), 1-25. https://doi.org/10.31463/aicusbed.876747

Kıral B. (2020). Document analysis as a qualitative data analysis method. *Siirt Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 8*(15), 170-189. https://dergipark.org.tr/tr/pub/susbid/issue/54983/727462

Kıymaz, M. S. (2019). 2019 Türkçe dersi öğretim programı -2- öğrenme alanları, kazanımlar, diğer derslerle ilişkisi [2019 Turkish course curriculum -2- learning areas, outcomes, relationship with other courses]. In A. Akçay & M. N. Kardaş. *Türkçe dersi öğretim programları [Curriculum of Turkish course]* (pp. 167-183). Pegem Akademi. https://doi.org/10.14527/9786058008915.09

Kundakçı, M., & Kapağan, E. (2015). Oral and written text formation problem in teaching Turkish as mother language at the middle education level. *Tarih Kültür ve Sanat Araştırmaları Dergisi, 4*(1), 1-18. http://kutaksam.karabuk.edu.tr/index.php/ilk/article/view/379

Maden, S. (2013). Why do we not listen? A sociocultural analysis of the inability to listen. *Uluslararası Türkçe Edebiyat Kültür Eğitim Dergisi, 2*(1), 49-83. https://dergipark.org.tr/tr/pub/teke/issue/12845/155636

Merriam, S. B. (2009). *Case study research in education: A qualitative approach*. Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook qualitative data analysis*. Sage Publications.

Ministry of National Education-MNE (2019). *Türkçe dersi öğretim programı (ilkokul ve ortaokul 1, 2, 3, 4, 5, 6, 7 ve 8. sınıflar) [Turkish lesson curriculum (primary and secondary school grades 1, 2, 3, 4, 5, 6, 7 and 8]*. Millî Eğitim Bakanlığı.

Ministry of National Education-MNE (2021). *Kütüphanesiz okul kalmayacak [There will be no school without a library]*. https://www.meb.gov.tr/kutuphanesiz-okul-kalmayacak/haber/24405/tr

Association of Turkish Publishers and Distributors Association (2019). *Turkey reading culture research 2019.* Acar Basım.

Özbay, M., & Melanlıoğlu, D. (2012). An evaluation of Turkish education programs in terms of listening skills. *Turkish Studies, 7*(1), 87-97. http://dx.doi.org/10.7827/TurkishStudies.2941

Öztürk, N. (2007). *Türkçe öğretimi [Teaching of Turkish]*. Arı Matbaacılık.

PISA 2018 Turkey Preliminary Report (2019). Millî Eğitim Bakanlığı: Eğitim Analiz ve Değerlendirme Raporları Serisi. http://www.meb.gov.tr/meb_iys_dosyalar/2019_12/03105347_PISA_2018_Turkiye_On_Raporu.pdf

Susar Kırmızı, F., & Yurdakul, İ. H. (2019). Primary school teachers' opinions regarding the revised 2018 Turkish Teaching Program. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi, 5*(1), 64-76.

Şahin, E. (2019). *Classroom teachers views on 2017 primary education Turkish curriculum: Erzurum province.* (Unpublished master's thesis). Bayburt: Bayburt University.

Takkaç, M., & Akdemir, A. S. (2015). Defining listeners in second language (L2) listening: investigating the Characteristics of language learners as listeners. *International Journal on New Trends in Education and Their Implications, 6*(2), 116- 141.

Tayşi Karakuş, E. (2014). *The effect of learning styles-based instruction on secondary school students' listening comprehension skills and their attitudes to listening.* (Unpublished doctoral dissertation). Ankara: Gazi University.

Torun, S. (2015). *Türkiye'de Türkçeyi doğru kullanıyor muyuz [Do we use Turkish correctly in Turkey?]*. https://www.milliyet.com.tr/pembenar/serap-torun/turkiye-de-turkceyi-dogru-kullaniyor-muyuz-2161068

Ünveren Kapanadze, D. (2019). Analyzing learning outcomes of new Turkish teaching curriculum in terms of higher-order thinking skills. *Milli Eğitim Dergisi, 48*(223), 83-112. https://dergipark.org.tr/tr/pub/milliegitim/issue/48112/609021

Yaman, E. (2014). *Konuşma sanatı [Eloquence]*. Akçağ.

Yaman, H. (2009). Teachers' views on the applicability of the Turkish course curriculum in crowded primary classrooms. *Educational Sciences: Theory and Practice, 9*(1), 349-359.

Yazar, S., & Yazar, İ. (2018). Dinleme öğretimi [Listening teaching]. In S. M. Taşkaya & R. Karadağ. *Türkçe öğretimi* [*Turkish teaching*] (pp. 79-102). Lisans Publishing.

Yıldırım, A., & Şimşek, H. (2016). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences]* (10th ed.). Seçkin.

Research Article
Received: 06.09.2022
Accepted: 31.12.2022
Published: 31.12.2022

Citation*:* Tiryaki, A., Yaman, M., & Tunç, B. (2022). A mixed-meta method study on the effect of constructivist approach on retention scores and evaluation of learner views. *International Journal of Scholars in Education, 5*(2), 132-144.

A Mixed-Meta Method Study on the Effect of Constructivist Approach on Retention Scores and Evaluation of Learner Views

Ahmet TİRYAKİ*, Mehmet YAMAN**, Bestami TUNÇ***

***Abstract*:** The aim of this research is to determine the effect of the constructivist approach on retention scores and to reveal its effectiveness in the learning environment within the framework of participant views. In this context, a mixed-meta method including both a quantitative and qualitative research was conducted. The mixed-meta method can be explained as the use of meta-analysis and meta-thematic analysis together based on document analysis. Within the scope of meta-analysis, studies examining the effect of constructivism on retention scores were evaluated by scanning different databases between the years 2005 and 2021. The data attained from the studies were analysed through the use of CMA program and the effect size value as calculated to be as g = 1.02. On the other hand, in the meta-thematic analysis process, studies containing participant views regarding the use of the constructivist approach in the learning environment were examined according to content analysis and some themes and codes were created. Requirements for a constructivist learning environment, the cognitive and affective effectiveness of the relevant approach, and the problems encountered in practice have emerged. As a result of the meta-analysis, it was appeared that the effect of the constructivist approach on the retention scores of the learners was high and positive. Accordingly, it can be inferred that the constructivist approach is quite effective on the retention scores of learners. As a result of the meta-thematic analysis, it was come out that the related approach facilitated the learning by supporting the learners in the cognitive and affective dimensions in the learning process. In addition, it has been determined that many aspects such as materials, technological support, physical condition of the learning environment, class size are required in the learning process. Considering the participant views, it was stated that in some instances, problems such as time, material, teacher training, and learner motivation could be encountered. When all the results are evaluated in general, it is appeared that if appropriate environment and conditions are provided, the constructivist approach is effective on the retention of learning and in creating positive learning environments.
Keywords: retention, mixed-meta method, learning environment, constructivist approach.

Introduction

* Ministry of Education, ORCID: 0000-0003-0335-5432, ahmettiryaki@gmail.com
** Ministry of Education, ORCID: 0000-0001- 7090-3633, mehmetyamanakademik@gmail.com
*** Ministry of Education, ORCID: 0000-0002-2610-4399, bestamitunc@gmail.com

Knowledge has gradually increased from the very beginning of human existence to the present day. People has absorbed the information almost like a rolling magnet collects iron dust, and eventually brought the information universe into existence today. The inconceivable multiplicity and diversity in the knowledge universe necessitated selectivity in learning. The questions of what, when, why and how much I will learn have caused people to need new ideas on this subject. These ideas were needed not only to learn but also to teach knowledge, and thus many new approaches were put forward for education in every period. Constructivist approach is one of these views and it has been one of the guides that lead current people in the information traffic that changes every minute.

An approach in which the teacher is only the instructor and the student is the learner, which has been put forward to ensure learning, cannot meet the needs of today's world. Now both the student and the teacher are learners. This situation necessitated the redefinition of teacher-centred education models and the roles of students in the classroom. As a result of these developments, the philosophies on which education is fed have also been updated and have taken an approach in which the individual takes action to learn. There are those who evaluated the philosophy of constructivism from its own perspective over time, in accordance with its nature, and there were also those who stated that it opened new avenues in terms of education. According to Demirel (2004) constructivism, which first developed in the form of understanding how people learn knowledge, started to focus on how the learner constructs what they learn over time. This has changed the role of related approach from being a theory of teaching to a theory of learning and knowledge, because knowledge has now turned into being grounded and constructed. Hanley stated that the thing learned at school should be used by students in business life and in crisis situations. A teacher who gives only knowledge and a teaching based only the textbook has not been able to raise an individual who criticizes, thinks, interprets, and gives meaning to what is learned. In that case, he says, it is necessary to take a classroom from the teacher centre and place it in the student centre (cited in Arslan, 2007). In a constructivist classroom, with metacognitive activities, the student advances his knowledge by adding new information on top of his own knowledge, produces new solutions to problems with his own perspective that is, the student educates himself.

In this new contemporary education model, the student will actively research, associate his old knowledge with his new learning, and construct what he has learned on top of what he knows. This synthesis will also reveal new information with the knowledge he has obtained. What does the teacher think about this educational approach of the new world? According to ÖYGM, teacher should know how to take into account the stages of learning, the effect of the level of development of the student on learning, and the different developmental qualities in his teaching. It should use processes related to different types of learning and teaching ways that will enable students to learn. It should determine the ways to be run in order to improve the work and learning skills of the student and to motivate him. They should know how to use services and resources to meet different and student-specific learning needs. They should be able to use the social or cultural experiences of the student to make teaching effective. Teacher should know that personal differences, internal and external motivation, learning by working routines are important in permanent and meaningful learning and should strive to create learning that fits students (Özdemir & Köksal, 2015). Constructivism in learning is a learner-centred approach. Each individual re-interprets the information he/she encounters through previous skills, knowledge and experience, and creates the information in his/her own mind. Constructivism is the reinterpretation and structuring of previous knowledge in the light of new experiences (Özel & Bayındır, 2008). The teacher gives the students complex tasks and problems and directs them to a mental interaction. The teacher also enables students to question, ask themselves questions, reflect on what they have done and evaluate their knowledge. As a result, the process is better understood by the students and new skills are acquired and students become decision-makers (Güneş 2007). In this context, the task of the teachers is to guide the students to find the resources to use in their activities while

structuring the knowledge. In this context, since the teacher simplifies the learning process, it also enables students to take part in the preparation of these resources (Fer & Cırık, 2007). In short, the duty of the teacher in a constructivist classroom is to guide the formation of learning environments where students can access new information.

Purpose and Importance of Research

In this study, it is aimed to examine the findings in the context of the effectiveness of the constructivist approach in the classroom environment from the perspective of classroom and branch teachers and to reveal the pros and cons of constructivism in the classroom based on these findings. In this study, teachers' opinions based on the experiences and observations of them who work in schools affiliated to the Ministry of National Education are especially included. The study is carried out in order to help teacher training institutions make arrangements in the direction of the result in the training they will give to teacher candidates and to bring new perspectives to the academicians working on education programs in the literature. Conducting the research with the mixed-meta method can contributes to obtaining more comprehensive findings by providing access to both quantitative and qualitative data. At this point, the following sub-objectives were determined in line with the main purpose of the research carried out within the mixed-meta method. In the context of;

- Meta-analysis, the effect of the constructivist approach on retention scores in the learning environment,
- Meta-thematic analysis, by examining the researches including the participant's views based on document analysis;
  - The effect of the constructivist approach applied in the learning environment on cognitive and affective aspects,
  - Requirements for the learning environment and
  - The problems encountered in implementation are aimed to examine.

Method

The present study is presented in the form of meta-analysis and meta-thematic analysis. The related method, which is defined as the mixed-meta method, can be defined as meta-analysis+meta-thematic analysis based on document analysis. In other words, in mixed-meta metod, studies included in the analysis are required to include both qualitative (meta-thematic analysis) and quantitative (meta-analysis) data which have scientific features that have been published or accepted for publication (Batdı, 2021). Mixed-method research, which is created by using qualitative and quantitative techniques together, can strengthen the beneficial aspects of these two techniques (Baki & Gökçek, 2012).

Meta-Analysis Process

Meta-analysis process is a quantitative research process unlike other literature review techniques because it is based on census techniques and numerical data (Kaşarcı, 2013, p.31). This technique deals with the results of previous experimental studies, presents quantitative data for researchers, and provides generalization by combining the results of all the studies (Dinçer, 2015, p.101). In this study, meta-analysis technique was used to compare the effectiveness of constructivism on teachers and students with the traditional method. In order to access and examine the studies on the effectiveness of this approach, a search was made in Turkish with the keywords of "constructivist approach/applications, the effect of constructivist approach on academic success/retention, constructivism" from the databases of Google Scholar, Dergipark and YÖK Thesis Center. In order to reach related studies, certain included criteria were

considered in our study. Therefore, studies carried out on the effect of constructivism on academic achievement, including experimental/semi-experimental pretest-posttest data, and containing statistical data required for analysis were preferred. Moreover, while searching the literature, the studies conducted between the years of 2005 and 2021 was taken into consideration. Thus, inclusion and exclusion criteria were determined. In addition, master's theses and doctoral dissertations written both in Turkish and/or English, were selected. As a result of the search, it was decided to benefit from data of 11 national studies in the meta-analysis.

Meta-Thematic Analysis Process

Meta-thematic analysis can be explained as re-interpreting the findings by examining the qualitative studies based on participant views in the context of a specific subject, re-discovering the codes and themes by arranging them, and accessing general and holistic information by synthesizing all the data in an inductive way (Batdı, 2019). Since the meta-thematic analysis is directly supported by the views of the participants, it can be stated that it is based on secure bases in terms of reliability (Batdı & Anıl, 2021). In the meta-thematic analysis process of this study, it was tried to reach the studies including the participants' views, and as a result of the literature reviews, a total of 4 studies, 2 theses and 2 articles, were reached. These studies were coded as Article 1 (M1), thesis 1 (T1), article 2 (M2) and thesis 2 (T2), and the quotations were taken directly from these studies. By this way, it is aimed to make transparency in the research. In order to ensure reliability in the qualitative study, the codes indicating the participants in the document review were transferred from the aforementioned studies in the same way without changing them. The direct quotations were the expressions which made the qualitative results more reliable. In this study, two-person coding was also used to increase reliability. In order to make the definitions and expressions more understandable, it is thought that two coders can make the coding process by using the same data. By dividing the number of codes that the coders agreed with and the number of codes that they could not agree with, the number of safety among the coders can be revealed. It is recommended that the result be 80% and above (Batdı, 2019). In this qualitative study, Miles & Huberman's (1994) reliability formula was used and the agreement between researchers was found to be 80% for this study.

Results

Meta-Analysis Results

In this part of the research, the results regarding the effect of the use of constructivist approach-based applications on students' retention scores were presented comparing with the traditional teaching method. The effect size value was reached by analyzing the descriptive information of the meta-analysis. In the meta-analysis process, a total of 11 theses in the national field were reached, which gave the arithmetic averages and standard deviations of the relevant application. Considering the total of the studies analyzed, it can be said that the experimental group consisted of 296 participants and the control group consisted of 312 participants.

In the current study, the meta-analysis findings regarding the permanence scores within the scope of the analysis are presented in Table 1. According to FEM, the results showed that the effect size was calculated as g =.93, with a standard error of 0.09 and a 95% confidence interval, with an upper limit of 1.1 and a lower limit of .76. It can be said that the effect of the constructivist approach-based applications on the retention scores is positive with an effect size value of .93 in the FEM.

Table 1
Meta-analysis Results

Test Type	Models			95% Confidence interval		Heterogeneity		
		n	g	Lower	Upper	Q	p	I^2
Retention	FEM	11	.93	.76	1.1	42.30	.00	76.36
	REM	11	1.02	.67	1.37			

Since it was seen that the distribution in the study has a heterogeneous structure in Table 1, analyzes were made in accordance with the random effects model. In other words, the use of related applications and teaching without the use of constructivist approach were compared according to the REM. As a result of the calculations, the data of 11 studies in the research were analysed and the effect size was calculated as g =1.02, with a standard error of .18 and a 95% confidence interval, with an upper limit of 1.37 and a lower limit of .67. Accordingly, it was observed that the effect size value was at large size according to the Thalheimer and Cook (2002) classification. This result can be said to have a positive effect on the retention scores of learners.

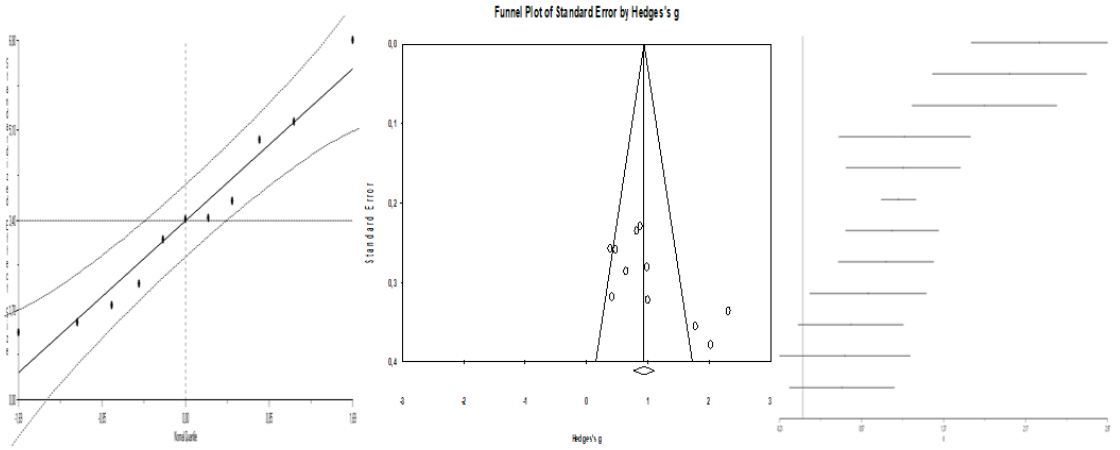

Figure 1. Normal quantile plot, funnel plot and effect size CI plot

In Figure 1, a graphic of the meta-analysis data set related to retention scores are presented. Normal Quantile Plot, Funnel Plot, and Effect Size CI Plot obtained as a result of the meta-analysis show the probability of publication bias. Analysis results indicate that if 502 studies regarding the effect of the constructivist approach on the retention scores are included in the analysis, the significant effect can decrease to zero. However, it has been understood that this attained value (n=502) is a high number in the context of the research considering the number of included studies. Therefore, when the relevant value is examined, it is concluded that there is no effect of publication bias, considering that too many studies are needed. In this case, it can be said that the process of the analysis is reliable. Similarly, when the Normal quantile plot chart is examined, it is seen that the studies included in the analysis are between two lines. This result means that the effect size level distribution of the studies shows reliable intervals (Rosenberg et al., 2000). At the same time, it is seen that the effect size CI plot values are in harmony with the thought. Thus, it can be said that the studies included in the analysis based on constructivism are in the reliable range.

Results of Meta-thematic Analysis

The participant opinions compiled from the included studies in the literature were coded by two researchers, and the extracted codes were combined under the relevant themes. These themes were arranged as "requirements for a constructivist learning, cognitive effectiveness, efficiency regarding the affective variables, and problems of the constructivist approach".

Figure 2. Requirements for constructive learning environment

The requirements of a constructivist learning environment in Figure 2 is listed as "facilitating activities, facilitating learning, serving the purpose, supporting the achievements, increasing interest, providing continuity in the course, exhibiting student products, having smart boards, manageable availability, having relevant materials, and a wide size of area". Some expressions referenced in the creation of these codes are as follows: "I attach importance to the classroom organization as purpose of the new student-centred curriculum can be achieved with a classroom organization that facilitates student activities and facilitates learning (T.2-p.108). In the study with the code of M.1-p.8, there is an expression as "Today, the materials (published books, programs supporting the curriculum over the internet) have increased so much that they have made the curriculum successful." As it can be understood from the codes and these statements, a constructivist classroom provides continuity in the course and provides a wide range of movement for education.

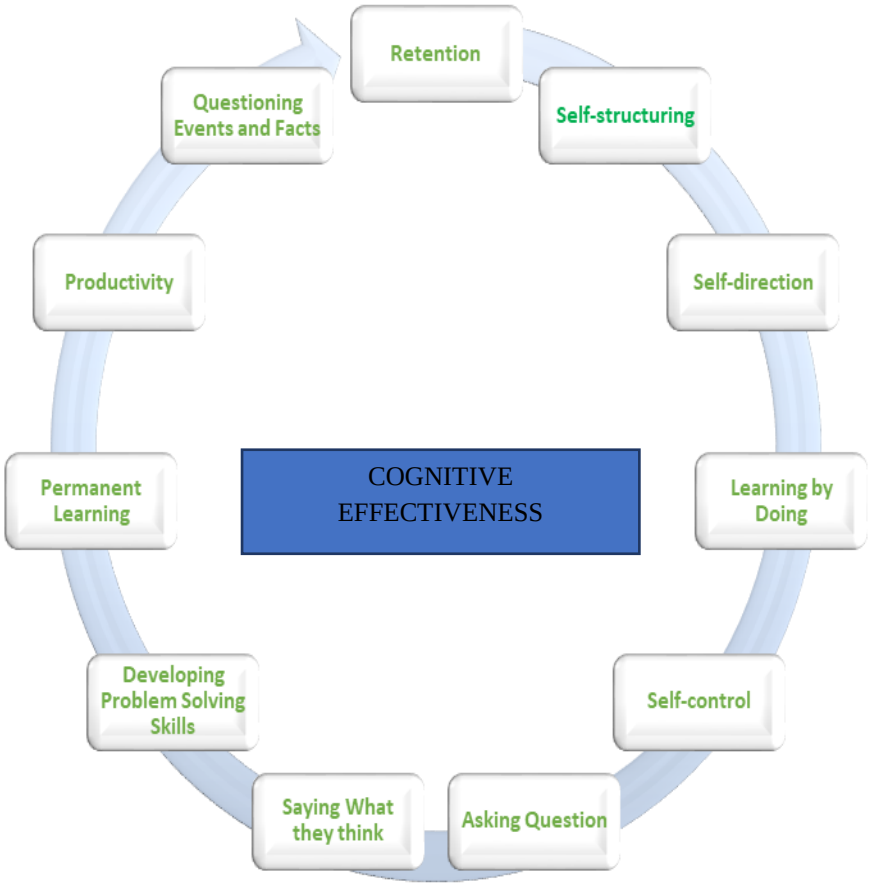

Figure 3. Cognitive effectiveness

When the effect of constructivism in Figure 3 on the cognitive dimension is examined, it has been seen that it contributes to "retention, self-structuring, self-direction, learning by doing, self-control, asking questions, saying what they think, improving problem-solving skills, permanent learning, productivity, questioning events and facts". While making the relevant identification codes, the following expression was referenced from the study coded as M.2-p.229 "…the student constructs his own work, directs it himself. For example, I give him a question, according to that question the child directs his studies. (…) The child is doing a work on his own, based on his own imagination or thoughts. (…) He thinks like today's scientists. He is like little scientists... While I'm constructing it there, I only ask questions to the student, he directs his own work with the questions…" Another expression quoted from the study coded as T.2-p.115 is like that "With this approach, the students desire to ask questions increased. Students can think and say what they think. They ask questions to themselves and find the answers by themselves." As it is understood from these expressions and codes, constructivism has positive effect on students' cognitive development, directs them to question and improves problem-solving skills, creating metacognitive awareness and establishing the retention of information.

Figure 4. Efficiency regarding the affective variables

Considering the affective effectiveness of constructivism in Figure 4, it is seen that they have contributions such as "motivation, curiosity, a democratic environment, respect, freedom, attractiveness, internalization, entertaining, dreaming". Some expressions can be presented as reference expressions which are used while creating the codes. A sample of them can be expressed as "*Exhibiting student products greatly increases the motivation of students*." , "*In order to encourage students to read, I occasionally read interesting passages from books and try to arouse their curiosity*." (T1-p.111 coded study). In addition, in another study encoded as M.2-p. 227, the following expression as *"...I realized that when the student is given responsibility, good things can come out. If applied well, children can both have fun and learn well. What they learn is permanent. I think it is an appropriate way of teaching students (...) this situation also helps the students to be motivated..."* can be presented. With these expressions, it is true to say that constructivism provides a learning that benefits the student in terms of affective development, creates a sense of curiosity in order to construct new information, makes his/her to dream, to express his/her views freely while having these dreams, and to have them fun.

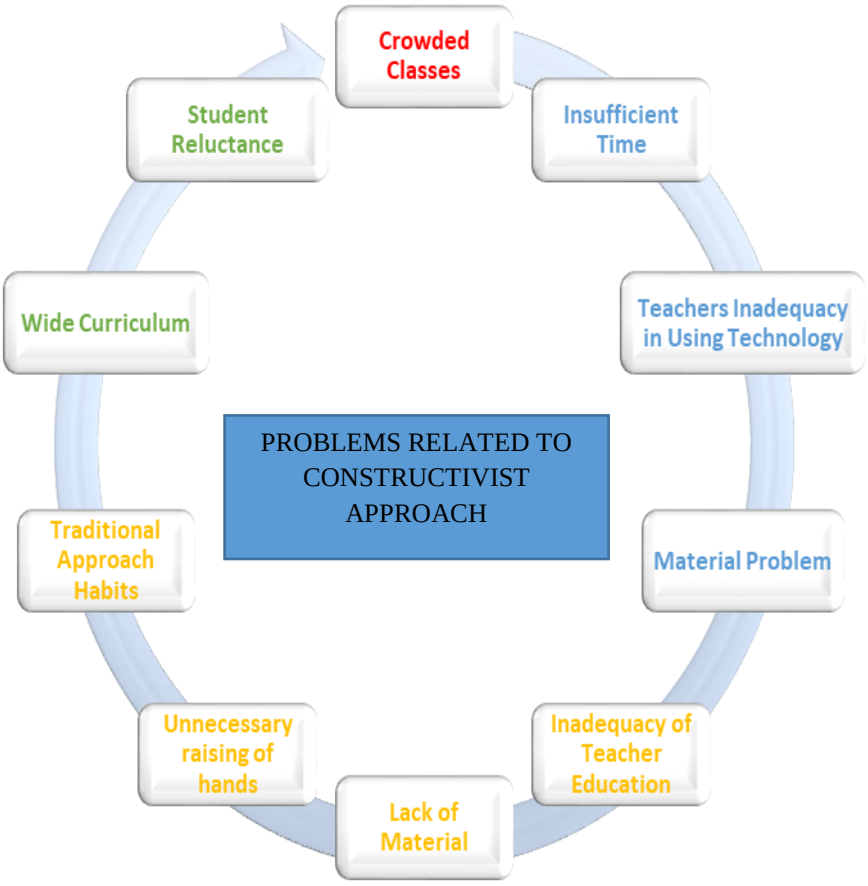

Figure 5. Problems related to constructivist approach

In Figure 5, under the theme of "Problems related to the constructivist approach" certain codes such as "crowded classes, insufficient time, teachers' inadequacy in using technology, material problem, inadequacy of teacher training, lack of material, unnecessary raising of hands, traditional approach habits, wide curriculum, reluctance of students" were created. Some of the participants' opinions, which constitute a reference while creating these codes can be presented as "Crowded classrooms negatively affect in-class activities." (Study coded as T2- p.113). In the M2-p.230 coded study, on the other hand, "...Not. Will I be teaching the curriculum in the three-hour lesson…" and in the study coded as T2- p.116, "One of the biggest problems is the unnecessary raising of hands during the lesson. The constructivist curriculum says to let the students speak; I always try to give a voice. The student can say things that are not relevant. If you don't give a voice, they always raise their hand. If you do the opposite, the important part of the lesson is gone. We also have a noise problem during events. There is unnecessary noise. Distraction of the subject causes the student to be distracted. " the related expressions were taken as references. There is also another reference sample expression from a study coded as M2- p.233 including that "…the readiness level of the students should be good. For example, if the student does not know the basics, you have to explain. (…) Also, students should be psychologically corrected as soon as possible, and if the student comes to school without a book or a pen on the way to school, it won't make any difference what approach you use…" According to the inferences made from the quotations and the extracted codes, it is considered that problems such as crowded classrooms, not being able to promise everyone due to lack of time, and unwillingness of students in the large curriculum disrupt education in a constructivist classroom. It is considered that teachers' inability to break away from traditional education and keep up with innovations is one of the important problems that need to be solved.

Discussion and Conclusion

In this study, it is aimed to determine the effectiveness of the constructivist approach in the classroom. Within this aim, the relevant databases were scanned, the results of meta-analysis and meta-thematic analysis were presented and inferences were made. The inferences were discussed in the results section. When the meta-analysis data regarding the retention in the current study is considered, the effects of constructivist-based applications on different disciplines were investigated in the context of meta-analysis and the results were presented. The effectiveness levels of the related applications showed that the retention scores of the participants have a positive effect (g=1.02). This result indicates that the constructivist theory-based applications applied in the experimental group are more effective than the traditional ones applied in the control group. The related effect size value has a large effect in terms of retention according to Thalheimer and Cook's (2002) level classification. The study entitled as "The effect of a constructivist learning-based curriculum on the reflective thinking and democratic attitudes of teacher candidates" (Kerimgil, 2008), which was not included in the analysis, showed that the relevant applications were found to contribute to continuous and purposeful thinking, open-mindedness, questioning and effective teaching, foresight and sincerity, and the profession. However, similar results were encountered in the results of a thesis by Yenice (2014). He investigated the effect of constructivist approach on academic success and retention scores of the subject of mitosis and meiosis, which was applied in the 8th grade science and technology lesson. As a result, it can be said that the practices based on the constructivist approach have a positive effect on the retention scores of the students, according to most of the studies both included in the analysis and not included.

In the meta-thematic analysis section, the codes were extracted and the themes that combine these codes were created. These themes can be stated as "requirements for a constructivist learning, cognitive effectiveness, efficiency regarding the affective variables, and problems of the constructivist approach". Many codes related to these themes have been reached. When all the findings are examined, it is evaluated that the effectiveness of the constructivist approach has positive results on students in many different ways and the teacher has an important role here. In structured learning, the teacher does not follow the same progression as traditional learning, which gradually increases the complexity of the information to be learned. A teacher who practices constructivism does the opposite. In other words, it activates students and transforms them into individuals who can solve complex learning situations (Selçuklu, 2019). In the study of Ekşi et al. (2018), it is stated that the active role of the student along with all stakeholders in the learning process will increase the effectiveness of learning. It has been concluded that a learning environment is effective if there are plenty of materials to increase the student's interest, the noise level is not disturbing, the activities can be created comfortably with a wide range of motion and if it is equipped with technological opportunities. It can be said that learning environments arranged with rich materials allow teachers and students to practice activity-based practices and provide opportunities for them (Aykan & Tatar, 2017).

In the cognitive development of constructivism, as a result of metacognitive activities such as problem solving and questioning, learning by doing-experience, it is seen that the permanence of knowledge in the student is ensured. It is also evaluated that cognitive awareness such as self-structuring and self-direction increase in students. With constructivist learning, the quality of teaching methods also changes and the student becomes active in the learning activity (Arslan, 2009). It is considered that most of the new teaching models aim at raising active students. When the affective effectiveness of constructivism is evaluated, it is concluded that in a democratic environment, it also supports the student's imagination by arousing curiosity and entertaining. As can be seen, constructivism is interactive and dynamic. This approach contributes

greatly to the student's learning and development in terms of mental skills. With this approach, classroom management is also changing. While each student is learning and developing their skills in the classroom, it is also important to organize the classroom in a way that will enable them to participate in collaborative work. Since constructivism affects all stakeholders, the principles of constructivist education should also be applied to all teachers. In addition, these principles are necessary for the professional development of teachers (Güneş, 2007). In other words, although constructivism seems like a student-centred approach, behind the curtain, the existence of a teacher who knows students' readiness, emotions, outlook on life and many similar academic and personality traits is extremely important in terms of education and the resulting product. In this context, it is thought that it is a good idea to raise the class level together with the students' levels. Because the constant presence of the teacher is very valuable, it allows the student to be closely monitored. In this way, the personality traits of the student can be constantly monitored, the performance status of the branch he/she is studying can be observed meaningfully, and the teacher will be able to shape the teaching in terms of his/her strengths and weaknesses. In this way, apart from the emphasis on individuality in the education model mentioned, it will also be possible to take into account this aspect (Bayraktaroğlu, 2011). Considering the problems of the constructivist approach, it has been seen that the applied approach is not very important for the reluctant student. Another problem is the desire of all students to attend the lesson at the same time and the lack of time for this. The crowdedness of the classroom is one of the problems emphasized in other studies. It has been observed that the number of students in the classroom is one of the most important problems (Ocak & Çimenci Ateş, 2015). Bal (2008) obtained similar data in his study; He stated that the overcrowding of the class size creates a negative effect in the process, however, the inadequacy of the applied course times causes problems in the preparation and implementation of the activities. The findings of Özbay's (2009) study also support the findings of the teacher's inability to break away from tradition in this study. In addition, teachers' inadequacy in using technology and teachers' lack of education are among the main problems. The fact that teachers feel inadequate as a result of not following innovations is also included in the study of Bada and Kırpık (2021), which supports these findings.

Considering all these results, it can be evaluated that in order to make constructivism more widespread in the field of education in today's world and to ensure that the student can comfortably reconstruct the old-new structure in a process, it is necessary to be in a situation that supports the infrastructure in educational institutions. In this context, it is important to establish the physical conditions of the classrooms and the technological materials to be used in order to support constructive education and training for this purpose. In addition, it is considered that providing training on the constructivist approach as a process and in practice for prospective and on-the-job teachers in teacher training institutions and educational institutions can reduce the problems in this regard. It is evaluated that new data can be brought to the literature with this study, which is carried out with the mixed-meta method in terms of the evaluation of learner views on this subject, with the effect of the constructivist approach on the retention scores in learning. In addition, it is thought that new perspectives can be provided for researchers.

References

(Studies included into the meta-thematic analysis)*
*(** Studies included into the meta-analysis)*

**Akın, M. F. (2007). *The effects of a constructive learning approach on learning success in the teaching of identities*. (Unpublished master's thesis). Diyarbakır: Dicle University.

**Andaç, K. (2007). *The effects of constructivist learning approach supported by reviewing strategy on students' attainment and retention of their knowledge about pressure*. (Unpublished master thesis). Diyarbakır: Dicle University.

Arslan, A. (2009). Constructivist learning approach and Turkish language teaching. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 13*(1), 143-154.

Arslan, M. (2007). Constructivist approaches in education. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi 40*(1), 41-61.

Aykan, A., & Tatar, M. (2017). Competency level of secondary school teachers about the constructivist approach. *Journal of Social Sciences of Muş Alparslan University 5*(2), 381-395. https://doi.org/10.18506/anemon.287791

Bada, M., & Kırpık, C. (2021). Self-efficacy perception of social studies teachers about constructivism and their opinion about the factors affecting it. *IBAD Journal of Social Sciences 9*, 462-480.

Baki, A., & Gökçek, T. (2012). A general overview of mixed method researches. *Electronic Journal of Social Sciences 11*(42), 1-21.

Bal, P. (2008). The evaluation of new mathematic curriculum in term of teachers' perspectives. *Ç.Ü. Journal of the Social Sciences Institute 17*(1), 53-68.

Batdı, V. (2019). Meta-thematic analysis. In V. Batdı (Ed.), *Meta-thematic analysis: Sample applications* (pp. 10–76). Anı Publication.

Batdı, V. (2021). The use of technology in language teaching to foreigners: a mixed-meta method. *Milli Eğitim Dergis, 50*(1), 1213-1244. http://dx.doi.org/10.37669/milliegitim.942631

Batdı, V., & Anıl, Ö. (2021). Learning by computer-based education: A meta-thematic analysis. *J. BAUN Inst. Sci. Technol. 23*(1), 111-127.

**Bayrak, N. (2008). *Examining of the effect on students' success, the lasting of data and attitudes science of course software and worksheets developed according to five gradual model of constructivist learning approach.* (Unpublished master thesis). Erzurum: Atatürk University.

Bayraktaroğlu, C. E. (2011). *Constructivist approach in education and a critical view*. (Unpublished master thesis). İstanbul: Maltepe University.

*Çandar, H., & Şahin, A. E. (2013). Teachers' views about effects of constructivist approach on classroom management. *Hacettepe University Journal of Education 44*, 109-119.

**Çiftçi, E. (2010). *The effect of teaching based on constructivist learning approach to student success and attitude in the field of learning geometry in primary education grade 6.* (Unpublished master thesis). Ankara: Gazi University.

Demirel, Ö. (2004). *Curriculum development in education from theory to practice*. Pegem Publication.

Dinçer, S. (2015). Effects of computer-assisted learning on students' achievements in Turkey: A meta-analysis. *Journal of Turkish Science Education 12*(1), 99-118.

Ekşi, H., Ulusoy, M. A., & Toprak, M. (2018). Village stakeholders participation values education: an action research. *The Journal of Humanity and Society, 8*(4), 125-154. http://dx.doi.org/10.12658/M0260

Erdem, E. & Demirel, Ö. (2002). Constructivism in curriculum development. *Journal of Hacettepe University Faculty of Education 23*, 81-87. https://dergipark.org.tr/tr/pub/hunefd/issue/7815/102628

Fer, S. & Cırık İ. (2007). *Constructivist learning, from theory to practice*. Morpa Publication.

Genç Ersoy, B. (2021). The use of educational games in teaching Turkish: A meta-thematic analysis. *Journal of Mother Tongue Education 9*(2), 510-530. https://doi.org/10.16916/aded.887902

Güneş, F. (2007). *Classroom management with a constructivist approach*. Nobel Publication.

**Hançer, A. H. (2005). *An investigation of the effects of computer aided instruction in a constructivist learning environment on learning outcomes in science education.* (Unpublished doctoral dissertation). Ankara: Gazi University.

Kaşarcı, İ. (2013). *The effectiveness of project based learning on students' academic achievements and attitude: A meta-analysis*. (Unpublished master thesis). Eskişehir: Eskişehir Osmangazi University.

*Kaya A. (2008). *A comparison of the classroom management approaches of the class teachers implementing constructivist learning approach and those of the branch teachers not implementing this approach (A case study in Gaziantep)*. (Unpublished doctoral dissertation). Malatya: Inönü University.

**Kerimgil, S. (2008). *The effect of curriculum based upon constructivist learning on pre-service teachers' reflective thinking and democratic attitudes.* (Unpublished master thesis). Elazığ: Fırat University.

**Kızıl Abdullah, Y. (2008). *The effect of constructivist approach on realization of aims of culture of religion and ethics course for primary schools*. (Unpublished doctoral dissertation). Ankara: Ankara University.

**Kirişçioğlu, S. (2007). *The effect of constructivist learning approach based instruction in elementary school seventh (7th) class science lesson "pressure" subject on academic achievement*. (Unpublished master thesis). Denizli: Pamukkale University.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook.* Thousand Oaks, California: Sage.

Ocak, G. (2010). Teacher attitudes towards constructivist learning practices. *Journal of Gazi Education Faculty 30*(3), 835-857.

*Ocak, G., & Çimenci A. F. (2015). Evaluating the applicability of constructivist approach in mathematics classes based on the views of secondary school math's teacher. *International Journal of Field Education 1*(2), 1-23.

Özbay, A. F. (2009). *English teachers' opinions on teaching English upon constructivist approach in English lessons*. (Unpublished master thesis). Afyon: Afyon Kocatepe University.

*Özdemir, İ., & Köksal, N. (2015). Attitudes of elementary school teachers towards constructivism. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi 19*(2), 221-244.

Özel, A., & Bayındır, N. (2008). *Classroom management according to constructivist approach* (1st ed.). Pegem Publication.

**Sakallı, A. F. (2011). *The influence of constructive 5E model about teaching complex numbers subject on students' academic achievement and attitudes.* (Unpublished master thesis). Kahramanmaraş: Kahramanmaraş Sütçü İmam University.

Selçuklu, O. (2019). *Analysis of teachers' constructive learning approaches*. (Unpublished master thesis). Konya: Necmettin Erbakan University.

Thalheimer, W., & Cook, S. (2002). *How to calculate effect sizes from published research articles: A simplified methodology.* Work-Learning Research Publication.

Yenice, E. (2014). *Researching the effect of 7E learning model of consructivist approach on students' academic success on the topic of "Mitosis and Meiosis Division" at 8th grade science and technology class*. (Unpublished master thesis). Kars: Kafkas University.

**Yıldız, M. (2012). *Determining effectiveness of the materials based on consructivist learning in geometrical optic teaching*. (Unpublished master thesis). Trabzon: Karadeniz Technical University.

**Yılmaz Kaya, S. (2008). *The effect of consructivist approach on the success of primary school second level students in science teaching*. (Unpublished master thesis). Konya: Selçuk University.

Research Article
Received: 24.11.2021
Accepted: 04.07.2022
Published: 31.12.2022

Yalçın, N., Tatlı, D., Çakar, B. B., & Kaya, Z. (2022). Meta-thematic analysis of constructivist approach in the second level of primary Education. *International Journal of Scholars in Education*, *5*(2), 145-157. http://dx.doi.org/10.52134/ueader.1027958

Meta-Thematic Analysis of Constructivist Approach in the Second Level of Primary Education

Nazan YALÇIN*, Derya TATLI**, Büşra Burçak ÇAKAR***, Zehra KAYA****

***Abstract*:** Today, the primary purpose of education is to raise individuals suitable for the age, as well as the personal development of the individual. Countries are trying to reflect the human qualities required by the age to social development by renewing their education programs in line with these purposes. It is seen that many different approaches have been adopted in the historical process. The aim of this study is to determine the effectiveness of the constructivist approach adopted today at the second level of primary education. In the study, a meta-thematic analysis study was carried out on the subject by scanning the literature. In the study, in order to determine the effectiveness of the constructivist approach in the second level of primary education, 680 studies were reached in the search made with the keywords "constructivist approach, primary education second level constructivism" in the National Thesis Center and Google Scholar database. As a result of the research, many cognitive-affective domain codes related to the constructivist approach have emerged. Outputs obtained in the cognitive domain; It has various contributions such as encouraging students to come up with new products, learning by doing, enabling the application of theoretical knowledge, providing permanent learning, and transferring the acquired knowledge to different courses. Codes obtained in affective social sense; it has come to the fore as the student's interest in the lesson and learning by having fun. It was concluded that the constructivist approach showed improvement in emotional and social areas such as providing a free environment in which students can express themselves, helping each other, enjoying the discussion environment, respecting the decisions taken by their peers, acting together, thinking that the lesson is getting boring, and liking to do research. It has been concluded that the activities and the time required to implement the activities are limited, the activities are similar to each other, the difficulties experienced by the students due to their prior learning, the disagreements within the group, the lack of equal responsibility within the group and the expectation of different materials are the negativities of the constructivist approach activities.

***Keywords*:** Constructivist approach, elementary second level, meta-thematic analysis.

* Master Student, Gaziantep University, Department of Education Science, ORCID: 0000-0001-8516-2276, e-mail: nznylcnbyndr@gmail.com
** Master Student, Gaziantep University, Department of Education Science, ORCID: 0000-0002-7406-7764, ,e-mail: deryaacaner@gmail.com
*** Master Student, Gaziantep University, Department of Education Science, ORCID: 0000-0002-1102-1806, ,e-mail busraburcak@hotmail.com
**** Master Student, Gaziantep University, Department of Education Science, ORCID: 0000-0003-362-8324, ,e-mail: kyzehra@gmail.com

Introduction

With the development of the era and technology, the concept of the individual has come to the fore in every field globally. The reflection of this situation in the field of education has been by leaving the traditional teaching approaches aside and using student-centered approaches. The teacher-centered and passive learner approach, which has been used for many years, has been replaced by the constructivist approach, which puts the student at the center of the learning process and where the learner plays an active role in the learning process (Hoşgörür, 2002).

The rapidly developing and changing innovations in science and technology affect all areas of education, especially in education programs, and make innovations necessary. In this constantly changing and developing age, traditionally designed educational environments seem to be insufficient for children to adapt to the new world (Tuncel & Öztürk, 2013). Educational objectives are to harmonize the education system with global criteria and to increase the quality (Başaran et al., 2020). Today, students are expected to produce information and find the information themselves rather than consuming information and ready-made information. Individuals accepted by the contemporary world are those who accept the information conveyed to them exactly, do not wait to be directed and formed, but participate actively in the process of creating meaning by interpreting the information (Yıldırım & Şimşek 1999). The innovations experienced on a global scale also affected our country and in 2005, the curriculum was renewed within the framework of constructivist theory (Batdı & Atik, 2020).

Today, multiple intelligence and constructivist education approaches adopted in education processes come to the fore (Akyol & Çiftçi, 2019). The concept of constructivism is used together with the concept of active learning (Açıkgöz, 2003). It deals with how the learner constructs knowledge. The subjective creation and reorganization of knowledge is the basis of the approach (Saban, 2004). The individual creates individual and social meanings based on the knowledge he has acquired. Hein (1991) states in his study that there is no information that is disconnected from the experiences of the individual in his life. The important point in acquiring knowledge is related to the learner's making sense of new information in learner's mind based on previous experiences, rather than the descriptive transfer of knowledge (Von Glasersfeld, 1996). When considered as the learning theory of the constructivist approach, it tries to explain the knowledge acquisition processes of people. In addition, its philosophical foundations are related to epistemology. In the process of structuring knowledge, the life of the individual is important. As a matter of fact, the process of making sense of the new situations faced by the individual is shaped according to the individual's existing mental schemas. The individual is faced with different processes in the face of new situations. In this case, the individual either adds to the existing schema, makes changes to the existing schema, or creates a new schema.

The constructivist approach is described as the active structuring of learning by the learner. It provides the opportunity for meaningful learning by associating the individual's previous learning with the newly acquired new knowledge. This situation provides convenience in terms of transferring the acquired knowledge to life (Demirel, 2012; Hesapçıoğlu, 2011; Senemoğlu, 2009). Constructivist approach provides interpretation of information. Information becomes meaningful if the individual can interpret the information he has acquired and use it in his life. In this respect, the constructivist approach prevents rote learning. It is among the important features of the constructivist approach that each new information acquired becomes meaningful structures by being associated with previous learned information, instead of learning that is not integrated into life, which is disconnected from each other for the individual. This situation is very important in solving the problems faced by the individual in life (Perkins, 1999). The structuring of knowledge by the individual forms the basis of the approach (Ün Açıkgöz, 2005). It is important for an individual to associate new knowledge with previous

knowledge in order to define the world (Brooks & Brooks, 1999). The basis of the constructivist approach is to associate the learner's knowledge and experience before the school environment with the benefits obtained in the educational environment (Eisenkraft, 2003; Saraç, 2018).

Innovations in the field of education deal with the teacher's teaching style and learner behaviors. While human's search for individual meaning causes a complex situation, the individual builds his learning on social interaction, his own life and experiences (Semerci & Batdı, 2015). Learning environments where the learner is actively involved in the process as a subject facilitates the transfer of acquired knowledge to life. The constructivist approach provides practicality at the point of application by counting the transfer of the knowledge learned at school to different situations encountered in life. The fact that the classical teacher transfers the textbook exactly causes deficiencies in the use of knowledge in life. Knowledge that is not integrated into life is not permanent. The constructivist approach transforms the teacher-dominated classroom atmosphere into an environment where the teacher is the guide (Hanley, 2005). Democratic design of learning environments is among the sine qua non of the approach. In the constructivist approach, the teacher is in the position of a guide rather than transferring information and prefers to listen rather than talk in the process (Erdem, 2001). In the constructivist approach, instead of following the textbook, it is important to make sense of the new information with various activities by using the existing knowledge of the student (Bağcı Kılıç, 2006). With the constructivist approach, the individual gets rid of his passive role in the traditional education process and takes on an active role. By integrating the technology of the age into education, it provides a multimedia environment by including different courses and various course materials covering these courses (Demiralp, 2007).

It supports the individual's active participation in the learning-teaching process and supports skills such as critical thinking, research and questioning, recognizing the existing problem and developing relevant solutions. It is aimed to ensure that the rights of individuals are protected and respected in a democratic classroom environment. It allows for collaboration and group work where individuals can communicate easily (Holmes, 1991). Designing the classroom environment according to a constructivist approach enables individuals who can think in a broad perspective and write what they think, as well as individuals who are open to critical comments and have effective communication skills (Ergin, 1998). The process of structuring knowledge is formed by the effort of creating meaning from the life of the individual as a result of the interaction between the individual and the environment (Sabancı, 2008). The development of related skills seems possible with the qualified structuring of learning environments and the use of appropriate methods and techniques. The constructivist approach helps the learner to be responsible for learning information by being involved in the learning process and to be effective in the decision-making process. According to their readiness level, students share the information they have learned beforehand to construct new information by talking to each other, and they construct new information by reflecting the information to each other. The knowledge learned in the constructivist approach is a resource used for a new configuration (Kirişçioğlu, 2007). Demirel (2002) said that the constructivist approach is more related to the concept of learning than to the concept of teaching and stated that it is important to structure and transfer new knowledge to a new situation in the constructivist approach. Many experts have developed opinions in many different fields about the constructivist approach, but the first ideas about the content of the concept of constructivism were put forward together with John Dewey and Piaget (Özden, 2003). According to Piaget (1955), the child creates knowledge individually as a result of his own experiences. The individual strives to make his thoughts and actions meaningful. In this stage, the individual adapts his thoughts to new ideas and new experiences by providing information and direction. This adaptation process, or cognitive structure, consists of assimilation and adaptation processes. The theory of mental development developed by Piaget formed a basis for cognitive constructivism. The theory, which talks about balance, imbalance, re-balance, deals with the process of encountering the mind with

information. While the mind using existing knowledge is in a state of balance, new knowledge acquired with a new learning experience leads to a state of imbalance in the mind. If the learned information is in harmony with the person's prior knowledge, the mind absorbs this information and reaches a state of balance again. If the new information learned is not in harmony with the old ones, the person regains a state of balance by structuring the information with new schemes in order to assimilate this information in his mind (Yönez, 2009).

In the constructivist approach, the roles of the teacher and the student in the learning process are among the factors affecting this process. In the constructivist approach, the teacher guides the student in reaching and structuring the information rather than transferring the information directly. The methods and techniques to be used in the learning process are shaped according to the knowledge that the student needs to learn (Yönez, 2009). The student, who needs to take the information presented by the teacher in the traditional method and process it in his mind, should make an effort to reach the information in the constructivist approach, and be able to create new schemes in his mind by making use of his prior knowledge. Foerster (1998) presented a different suggestion for understanding the constructivist approach in his study. Giving the answer to the question of whether the concepts are discovery or invention as an invention indicates that the emphasis is placed on structuring.

The teacher has an important role in the design and implementation of the classroom environment and learning activities in accordance with the curriculum. It is not always easy for theoretical and practical knowledge to meet on a common ground. Researches emphasize that some problems are encountered at the point of application of the constructivist approach. It is stated that the motivation of the teachers is high in the process, but there are different deficiencies at the point of application. Teachers' need for information and the inadequacy of technological equipment in physical environments are among the shortcomings mentioned (Arslan, 2008; Kurtdede Fidan, 2010).

The constructivist approach ensures that the learner is aware of ownership and a voice in the learning process from kindergarten to higher education. The learner assumes control and responsibility for their own learning. Teachers, on the other hand, have a facilitating role for the learner in reaching the goal (Bay et al., 2010; Gündoğdu, 2006). Creating a suitable classroom atmosphere allows the learner to learn what and how. The learner structures the learning process according to their own speed and methods (Doğan, 2012).

Purpose and Importance of the Research

The fact that the world is in a constant change creates the necessity of keeping the systems up-to-date. Today, education is a force that determines the global route and position of countries. Considering that the way to stay well is to try to be better, it is necessary to renew the educational environments in parallel with the global changes. The importance of the constructivist approach is undeniable today, where the traditional education system has been replaced by contemporary approaches. The main purpose of this research is to reveal the effectiveness of the constructivist approach by examining the constructivist approach studies in the second level of primary education. It is important to increase the number of studies conducted in this type, to investigate and prove the current situation on the subject and to expand the scope within the information obtained. It is anticipated that the results obtained in line with this research will fill the gap in the literature and will serve as a guide for possible future research on the subject. It is seen that the number of meta-thematic analyzes related to the constructivist approach in the literature is not sufficient, and it is aimed that the study will contribute to this field. The sub-objectives for the purpose of the research are given below.

It was created within the scope of meta-thematic analysis based on document analysis. In the light of the themes and codes examined, qualitative research based on participant views is examined and the effectiveness of the constructivist approach in the educational processes at primary education level is determined. In this research, it is aimed to determine the contribution of the constructivist approach to the cognitive dimension, the contribution of the constructivist approach to the affective-social dimension, negative aspects of the constructivist approach.

Method

In this research, qualitative studies on the effectiveness of the constructivist approach at the second level of primary education were examined and meta-thematic analysis was made. Studies that included participant opinions were included in the research. It is described as a type of analysis based on document and document review on the basis of meta-thematic analysis. It is explained as a type of analysis that deals with the findings in a holistic way by examining the findings in the content of the qualitative studies in detail and creating different codes and themes. It is described as the analysis of qualitative studies and making them meaningful with codes and themes that unite them on a holistic common denominator (Batdı, 2019). In the study, the effectiveness of the constructivist approach in the second level of primary education was determined by the meta-thematic analysis method. In this context, 680 qualitative studies were reached by scanning the Google Scholar and National Thesis Center database. Qualitative studies were accessed by scanning in English and Turkish using keywords such as "Constructivist approach, Constructivist approach, constructivist approach and its effect". As a result of duplication, 215 of the remaining 535 studies were excluded due to unrelated topic. When the abstracts that do not fit the main purpose were removed, 5 qualitative studies were found suitable for meta-thematic analysis in terms of scientific content, out of 230 studies suitable for inclusion, suitability and quality. Accessed studies were analyzed within the scope of content analysis within the scope of document review. Content analysis is described as a research technique that helps to obtain theoretical results from the texts related to the compilation and classification of the texts in the accessed data (Cohen, Manion, & Morrison, 2007). In order to ensure transparency in the Content Analysis process, it is important to specify the sentences from which the codes created within the scope of the study are taken (Yıldırım & Şimşek, 2018). For this purpose, the codes created in the content analysis process in the study and the expressions of the participants who were the source of the codes were transferred directly from the relevant study. It is anticipated that this transfer will contribute to the content analysis (Merriam, 2009).

Meta-Thematic Analysis Process

The theses included in the analysis were coded as T1, T2…. The foundations were formed from the codes extracted from the accessed studies. At this point, three themes were formed as "contribution to the cognitive dimension", "contribution to the affective-social dimension", and "negative aspects of the constructivist approach". In addition, the agreement between coders was calculated with the Cohen Cappa agreement value and it was determined that the agreement was at a good level. Presenting direct quotations from related studies during the coding and analysis of the findings in the study supports the reliability of the study. In this way, validity and reliability were tried to be ensured in the study. The flow chart of the studies included in the meta-thematic analysis is presented in figure-1.

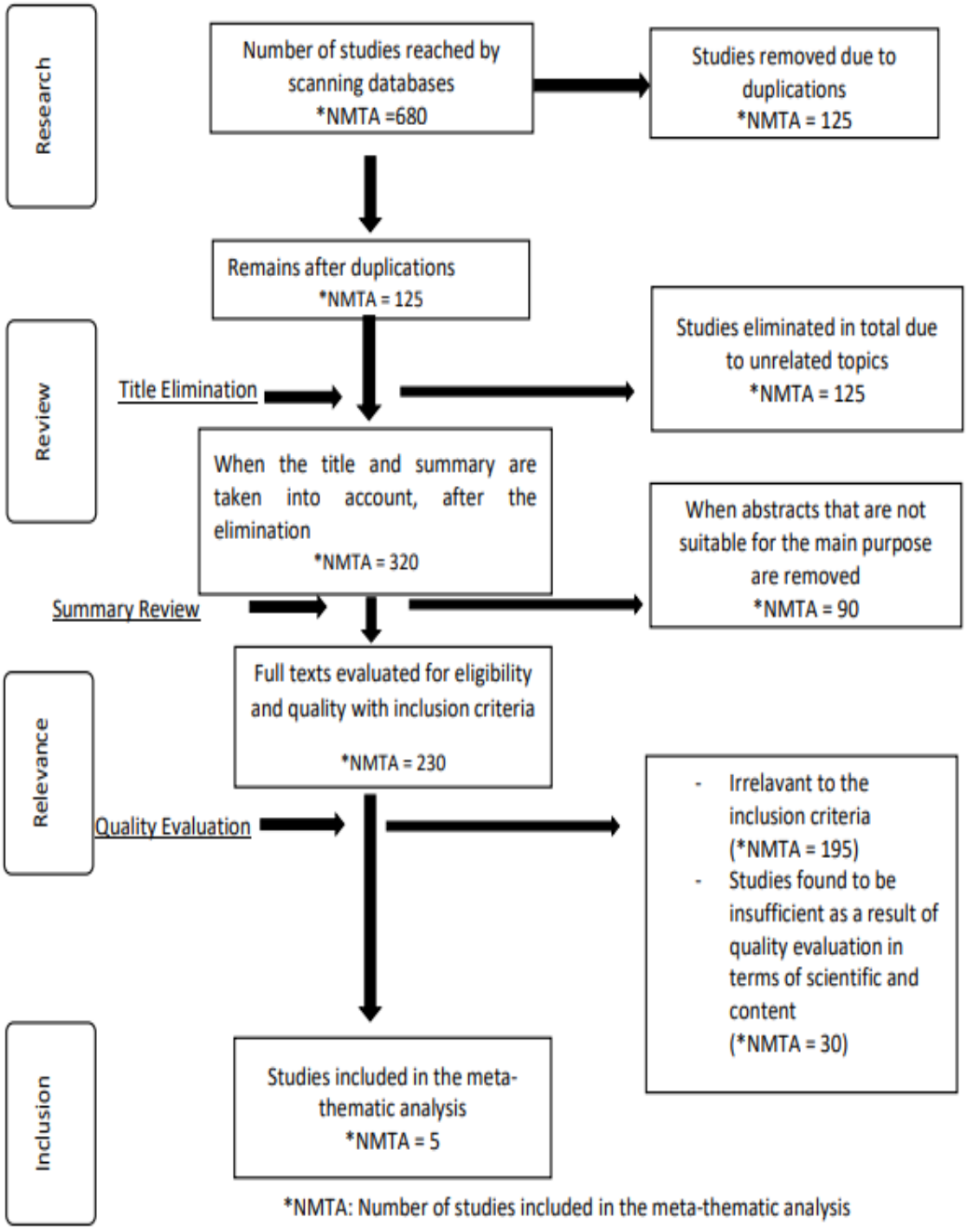

Figure 1**.** Flowchart of studies included in the meta-thematic analysis

Results

Meta-thematic analysis method, which is one of the techniques based on document analysis, was used in the research. Themes and codes created from the participant opinions in the studies examined were presented as models. In this context, the contribution of the constructivist approach to the cognitive dimension, the contribution of the constructivist approach to the affective and social dimension, and the negative aspects of the constructivist approach are presented as models based on the views of the participants.

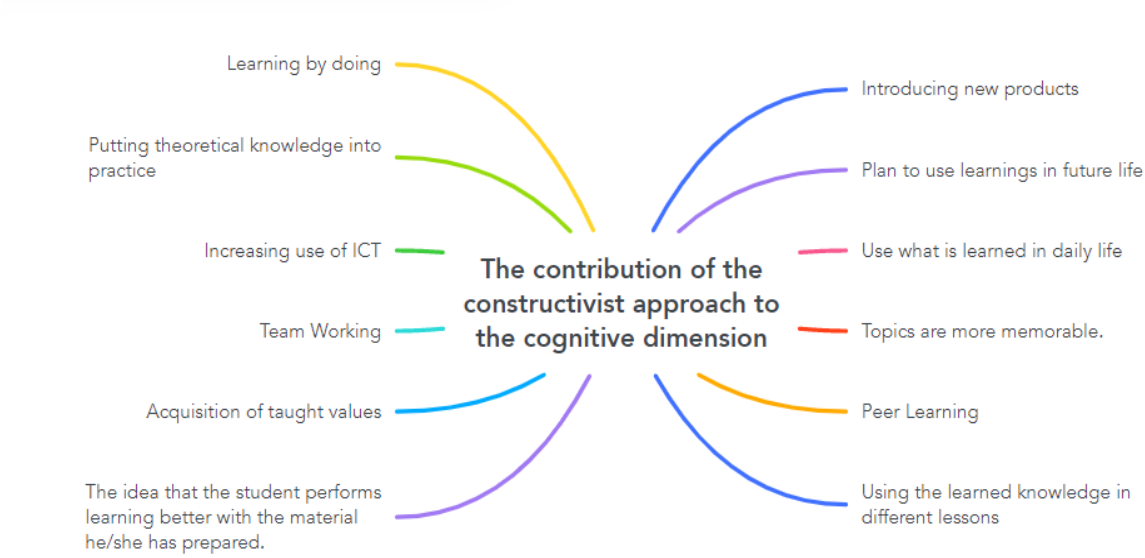

Figure 2. Contribution of the constructivist approach to the cognitive dimension

When Figure-2 is examined, some of the codes compiled from the views of the participants in the context of the contribution of the constructivist approach to the cognitive dimension can be given as "learning by doing, introducing new products, teamwork, making the subjects more memorable". In the study coded T1, “There are things that I learned a lot from this. I can do very well in the future and teach my children in the future and they can be very successful.”; In the T-2 coded study, “We learned together as a group in order to learn, we worked together and we succeeded together.”, “Everyone worked together in the group throughout all the activities. Everyone did one side of the event. All activities are shared as a group.” Their statements show that constructivist approach activities support students to work in teams. It can be said that integrating the learned information into life provides meaningful and permanent learning experiences in the process. It is seen that peer learning with a constructivist approach is supportive. In addition, it can be described as the contribution of the constructivist approach to the cognitive dimension of the student being active in the lesson, providing learning by doing and experiencing, and providing the opportunity to use the acquired knowledge in different lessons.

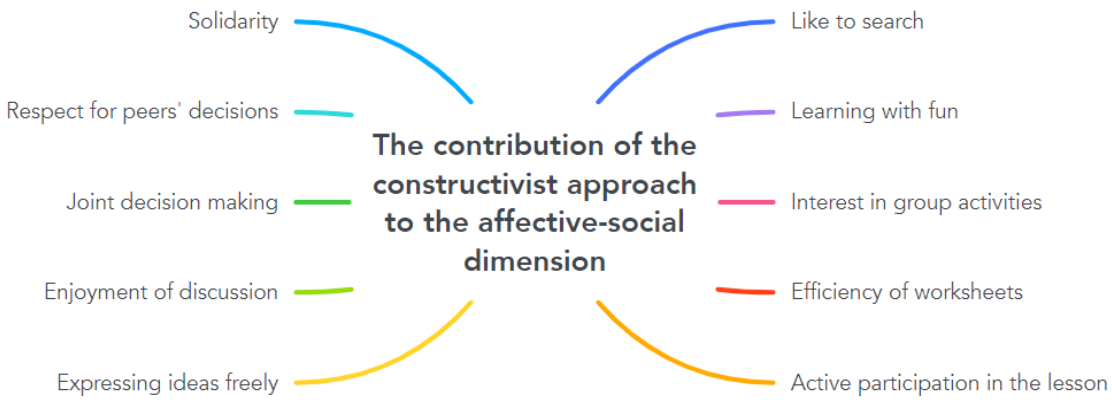

Figure 3**.** Contribution of the constructivist approach to the affective-social dimension

When Figure 3 is examined, the codes containing the contributions of the constructivist approach to the affective and social dimension are seen. The effects of the constructivist approach on the affective and social dimensions of the student are seen as follows: Active

participation in the lesson, increased interest in the lesson, free expression of ideas, learning with fun, cooperation, making common decisions. In the referenced T3 coded study "We did a great job with our friends, they say, what's wrong with one hand, two hands have a voice", "I do all the tasks, research and activities are very enjoyable… it is not boring at all, especially group tasks are very joyful… it is very enjoyable to do something together. ", in T 5 coded study "I am eager to participate at every stage of the lesson… the worksheets are so fun, we have fun like in kindergarten… I enjoy talking in discussions, our teacher cares about everything we say"", in T 2 coded study "We learned a lot, we had a lot of fun doing these exercises." When we look at their expressions, we can say that constructivist approach applications make the learning process of the students fun, so the interest in the lesson and active participation increase accordingly. Again, based on the views of the participants, it would be correct to say that the students' working as a team by supporting each other in the learning process improves the helping skills of the students. The fact that students enjoy the process, play an active role in learning activities, and positively affect their interests and attitudes towards learning are thought to be the benefits of the constructivist approach to the affective-social dimension.

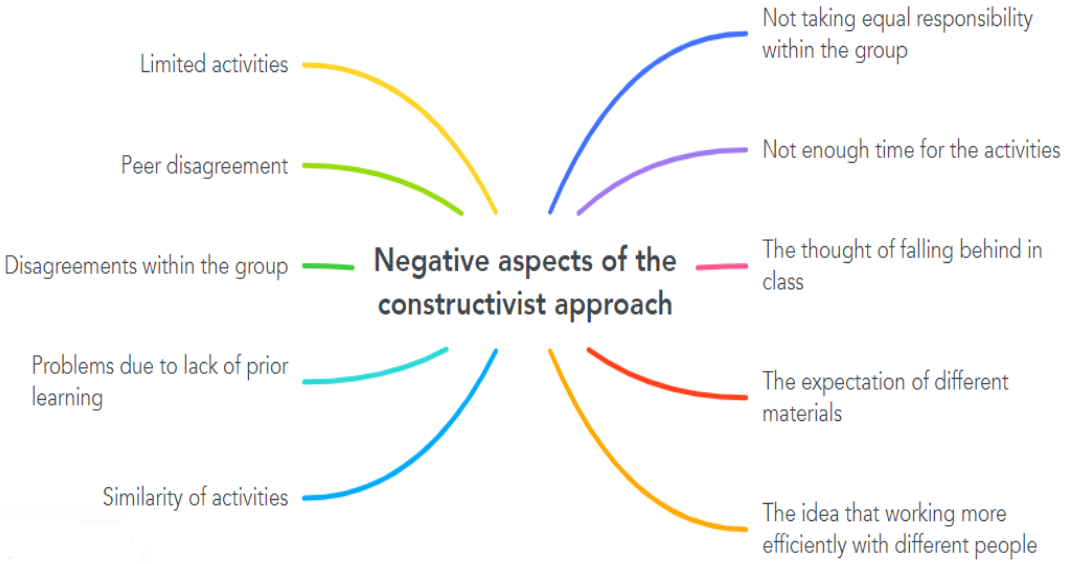

Figure 4. Negative aspects of the constructivist approach

When Figure 4 is examined, the model of the negative aspects of the constructivist approach based on participant views is presented. In the model created in line with the opinions of the participants, some of the negative aspects of constructivist approach practices were expressed by the participants with codes such as the similar nature of the activities, the lack of time to implement the activities, the expectation of different materials, the inability to take equal responsibility within the group, the difficulties arising from the lack of prior learning. From the opinions of the participants, In the referenced T4 coded study "The activities were limited, we only did one study on each subject.

If we had done more work, it could have been more permanent in our minds.", in T 3 coded study "We fell behind in the subjects", "We sometimes had difficulties while coding. If these were shown to us at an earlier age, we would not have experienced these difficulties.", "I think it was a very good application, but our time was limited, so many activities were limited" statements also support these codes. From this point of view, it is seen that there is not enough time for the activities applied in the constructivist approach, that the applied activities have similar characteristics with each other, and that there may be some disagreements due to the fact that the students do not take equal responsibility in group work. In addition, it can be said that

the process will be negatively affected if there are deficiencies caused by the pre-learning of the students. These findings obtained within the scope of the study are shown among the negative features of the constructivist approach.

Conclusion and Discussion

Within the scope of the research, the effectiveness of the constructivist approach was discussed with the meta-thematic analysis method. As a result of the analysis, many cognitive and affective field codes related to the constructivist approach were found. When these codes are examined, the contribution of the constructivist approach such as encouraging students to produce new products in the cognitive field, enabling learning by doing, enabling the application of theoretical knowledge, making the subjects more memorable, providing students with development in peer learning and working in groups, transferring the learned information to different courses. conclusion has been reached. Within the scope of the research, the effectiveness of the constructivist approach was discussed with the meta-thematic analysis method.

As a result of the analysis, many cognitive and affective field codes related to the constructivist approach were found. When these codes are examined, it is seen that the constructivist approach encourages students to come up with new products, provides learning by doing, allows the application of theoretical knowledge, makes the subjects more memorable, provides students with development in peer learning and group work, and transfers the learned information to different courses in the cognitive field. The student-centered constructivist approach ensures the permanence of the learned information as students actively participate in the learning process in its activities. In addition to this, gaining the values taught, using the learned information in their future lives, and using what is learned in the lesson in daily life are also the contributions of the constructivist approach activities to the cognitive development of the students. Batdı et al. (2021) emphasize that learning processes designed with a constructivist approach provide more academic success to students compared to traditional methods. He also states that the constructivist approach is effective in reaching meaningful and permanent outcomes in learning processes. Learning activities designed with a constructivist approach enable students to be active in the process and help increase the level of success (Aydın, 2007; Ayaz & Şekerci 2015).

Constructing the knowledge by the student increases the efficiency of the learning processes on the learner (Akyol & Fer 2010; Kaya & Zengin 2018). The findings obtained from this study show parallelism with the studies in the literature, and it is seen that the constructivist approach adds quality to the learning processes and offers qualified and productive learning experiences to the students in the cognitive dimension. Another of the themes created based on the views of the participants is the relationship of the constructivist approach with the affective and social field. The constructivist approach does not only contribute to the cognitive development of the student. While realizing new learning, the methods of realizing these learnings lead to some developments in the affective and social areas. In this context, when the codes created under the theme of the contribution of the constructivist approach to the affective and social field are examined, the increased interest in the lesson and the fun learning codes stand out. It has been concluded that the students who teach with a constructivist approach have developed in emotional and social areas such as freely expressing their ideas, enjoying in the discussion environment, helping each other, respecting the decisions of their peers, acting together, thinking that the lesson is getting boring, and loving to do research. Since group success is more important than individual work, especially in group activities, they had to learn to work and cooperate with their peers.

In their study, Savaş et al., (2012) stated that constructivist approach applications enable students to enjoy the lesson and thus internalize the lesson. As Vgotsky stated in his theory, the role of society and other people in learning is very important. Although learning is defined as an individual process, the effect of the social environment cannot be ignored (Arslan, 2007). Çetin and Günay (2007), in their study, examined the effect of educational activities created with a constructivist approach on success, and it was mentioned that information exchange became possible by establishing social interaction with the constructivist approach in the related study. The findings obtained in this context are supported by different studies in the literature, and it is seen that constructivist approach applications contribute to students in the social-affective sense. Although there are many positive features of constructivist approach activities, they also have some negative features (Şimşek, 2004). The negative aspects of the constructivist approach, which was created based on the views of the participants, were examined and codes were created in this direction. It has been concluded that the activities and the time required to implement the activities are limited, the activities are similar to each other, and the difficulties experienced by the students due to their prior learning and the expectation of different materials are the negativities of the constructivist approach activities. Different studies in the literature contain criticisms that the approach is inadequate in terms of application in crowded classrooms, which it may be functional in environments with strong technological infrastructure, and that different problems may occur in time management and evaluation (Ocak, 2010). In addition, there are some negative aspects especially in-group activities. It was concluded that peer conflict, intra-group disagreements, not taking equal responsibility within the group, and the idea that the student could work more efficiently with different people were among the negativities encountered in constructivist approach activities.

References

Açıkgöz, K. (2003). *Etkili öğrenme ve öğretme [Effective learning and teaching]*. Eğitim Dünyası Yayınları.

Akyol, C. (2019). Çoklu *ortam tasarımı destekli yapılandırmacı öğretim etkinliklerinin öğrencilerin akademik başarı, tutum ve motivasyonlarına etkisi [The effect of multimedia design supported constructivist teaching activities on students' academic achievement, attitudes, and motivation]*. (Unpublished doctoral dissertation). Konya: Necmettin Erbakan University.

Akyol, S., & Fer, S. (2010). Sosyal yapılandırmacı öğrenme ortamı tasarımının öğrenenlerin akademik başarılarına ve öğrenmenin kalıcılığına etkisi nedir? [What is the effect of social constructivist learning environment design on learners' academic achievement and permanence of learning?]. *International Conference on New Trends in Education and Their Implications*, Antalya, Turkey.

Arslan, M. (2007). Eğitimde yapılandırmacı yaklaşımlar [Constructivist approaches in education]. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, *40*(1), 41-61. http://dx.doi.org/10.1501/Egifak_0000000150

Arslan, A. (2008). *Yapılandırmacı öğrenme yaklaşımına göre hazırlanan Türkçe Dersi öğretim programının uygulanmasına ilişkin öğretmen görüşlerinin değerlendirilmesi. [Evaluation of teachers' views on the implementation of the Turkish Lesson curriculum prepared according to the constructivist learning approach]*. (Unpublished doctoral dissertation). Erzurum: Atatürk University.

Ayaz, M. F., & Sekerci, H. (2015). The effects of the constructivist learning approach on student's academic achievement: A meta-analysis study. *Turkish Online Journal of Educational Technology*, *14*(4), 143-156.

Aydın, S. (2007). *Yapılandırmacı yaklaşıma dayalı olarak hazırlanan yeni fen ve teknoloji öğretim programındaki etkinliklerin ilköğretim 6. sınıf öğrencilerinin kuvvet ve hareket ünitesindeki başarılarına etkisi* [*The effect of the activities in the new science and*

technology curriculum prepared based on the constructivist approach on the success of the 6th grade students in the force and movement unit]. (Unpublished master's thesis). Ankara: Gazi University.

Bağcı Kılıç, G. (2006). *Yeni yaklaşımlar işığında ilköğretim bilim öğretimi [Primary Education Science Teaching in the Light of New Approaches]*. Morpa.

*Baş, G. (2015) *sosyal-yapılandırmacı öğrenme ortamı tasarımının öğrenenlerin akademik başarılarına, derse yönelik tutumlarına ve bilişüstü farkındalık düzeylerine etkileri ile öğrenme sürecine katkıları. (Unpublished doctoral dissertation). Konya:* Necmettin Erbakan University.

Başaran, M., Kaya, Z., Akbaş, N., & Yalçın, N. (2020). Reflection of eTwinning activity on teachers' professional development in project-based teaching process. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi*, *6*(3), 373-392.

Batdı, V. (2019). *Meta-tematik analiz: Örnek uygulamalar* [*Meta-thematic analysis: in case studies*]. Anı Yayıncılık.

Batdı, V., & Atik, Ü. (2020). İstasyon tekniğinin meta-tematik analizi [Meta-thematic analysis of station technique]. *Uluslararası Eğitim Araştırmacıları Dergisi*, *3*(1), 60-70.

Batdi, V. Öztaş, C., & Talan, T. (2021). Fen bilgisi dersinde yapılandırmacı yaklaşım uygulamalarının karma-meta yöntem ile analizi [Analysis of constructivist approach in science lesson with mixed-meta method]. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, *40*(1), 33-44.

Bay, E., Gündoğdu, K., & Kaya, H. I. (2010). Öğretmen adaylarının yapılandırmacı öğrenme ortamının demokratik yönlerine ilişkin algıları [Pre-service teachers' perceptions of the democratic aspects of the constructivist-learning environment]. *Elektronik Eğitim Psikolojisi Araştırmaları Dergisi*, *8*(2), 617-642.

*Baytok, H. (2007). *Yapılandırmacı öğrenme kuramına dayalı öğretimin ilköğretim 7. sınıf basınç konusunda öğrenci başarısı ve tutumuna etkisi*. (Unpublished master's thesis). Balıkesir: Balıkesir University.

Brooks, J. G., & Brooks M. G. (1999). *In search of understanding the case for constructivist classrooms*. Association for Supervision and Curriculum Development.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge Falmer.

Çetin, O., & Günay, Y. (2007). Fen öğretiminde yapılandırmacılık kuramının öğrencilerin başarılarına ve bilgiyi yapılandırmalarına olan etkisi. Eğitim ve Bilim, 32(146), 24-38.

Demirel, Ö. (2002) *Kuramdan uygulamaya eğitimde program geliştirme* [*Curriculum development in education from theory to practice]* (4th ed.). Pegem.

Demirel, Ö. (2012). *Eğitimde program geliştirme* [*Curriculum development in education*]. Pegem Akademi.

Demiralp, N. (2007). Materials in geography education and 2005 geography curriculum. *Kastamonu Eğitim Dergisi, 15*(1), 373-384.

Doğan, Y. (2012). Adoption level of constructivist activities specified in the science and technology curriculum. *Kastamonu Eğitim Dergisi*, *20*(1), 167-186.

Eisenkraft, A. (2003). Expanding the 5'e model. *The Science Teacher*, *70*(6), 56-59.

Erdem, E. (2001). *Program geliştirmede yapılandırmacı yaklaşım* [*Constructivist Approach in Curriculum Development*]. (Unpublished master's thesis). Ankara: Hacettepe University.

Ergin, A. (1998). *Öğretim teknolojisi–iletişim* [*Instructional technology–communication*]. Anı.

Foerster, H. Von (1998). Entdecken oder Erfinden, Wie lasst sich Verstehen verstehen? In G. Foerster & S. Hejl (Eds.), *Watzlawick: Einführung in den konsrtruktivismus*, Müchen.

Hanley, S., (2005). *On constructivism, Maryland collaborative for teacher preparation*. The Universty of Maryland at College Park. www.inform.umd.edu/UMS+State/UMD

Hein, G. E. (1991). Constructivist learning theory. *Paper presented at the CECA* (International Committee of Museum Educators) Conference, Jerusalem Israel, 15-22 October 1991, 1-10.

Hesapçıoğlu, M. (2011). *Öğretim ilke ve yöntemleri eğitim programları ve öğretim* [*Teaching principles and methods curricula and teaching*] (7th ed.). Nobel Yayın Dağıtım.

Holmes, E. E. (1991). Democracy in elementary school classrooms. *Social Education*, 55,176-178.

Hoşgörür, V. (2002). Sınıf yönetiminde yapısalcı yaklaşım [Constructivist approach to classroom management]. *Eğitim Araştırmaları Dergisi, 9, 73-78.*

Kaya, E., & Zengin, E. (2018). 5E modelinin hücre bölünmesinin öğretiminde öğrenci başarısına etkisi [The effect of the 5E model on student achievement in teaching cell division]. *EKEV Akademi Dergisi, 22*(73), 415-427.

Kesal, F., & Aksu, M. (2005). Özel öğretim yöntemleri II derslerinde oluşturmacı öğrenme ortamı [Constructivist learning environment in Special Teaching Methods II courses]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *28*(1), 118-126.

*Kirişçioğlu, S. (2007). *İlköğretim 7. sınıf fen bilgisi dersi" basınç" konusunun yapılandırmacı öğrenme yaklaşımına dayalı öğretiminin akademik başarıya etkisi [The effect of teaching the subject of "pressure" in primary school 7th grade science lesson based on constructivist learning approach on academic success]*. (Unpublished master's thesis). Denizli: Pamukkale University.

Kurtdede Fidan, N. (2010). *Sınıf öğretmenlerinin yapılandırmacı yaklaşımın gerektirdiği niteliklere sahip olma düzeylerinin değerlendirilmesi: Afyonkarahisar İli örneği* [*Evaluation of primary school teachers' qualifications required by the constructivist approach: The case of Afyonkarahisar*]. (Unpublished dissertation). Ankara. Ankara University.

Ocak, G., (2010). Yapılandırmacı öğrenme uygulamalarına yönelik öğretmen tutumları [Teacher attitudes towards constructivist learning practices]. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, *30*(3), 835-857.

Özden, Y. (2003) *Öğrenme ve öğretme* [*Learning and teaching*]. Önder Matbaacılık.

Perkins, D. (1999). Yapılandırmacılığın birçok yüzü [The many parts of constructivism]. *Eğitim liderliği*, *57*(3), 6-11.

Piaget, J. (1955). *The language and thought of the child*. World Publishing.

Saban, A. (2004). *Öğrenme öğretme sureci: Yeni teori ve yaklaşimlar* [*The learning-teaching process: New theory and approaches*] (3rd ed.). Nobel Yayın Dağıtım.

Sabancı, A. (2008). Sınıf yönetiminin temelleri [Basics of classroom management]. M. Çelikten (Ed.), *Yapılandırmacı yaklaşıma göre sınıf yönetimi* [*Classroom management according to the constructivist approach*] in (pp. 27-56). Anı Yayıncılık.

Saraç, H. (2018). Yapılandırmacı yaklaşım öğrenme halkası modellerinin öğrenilen bilgilerin kalıcılığına etkisi: Meta analiz çalışması [The effect of constructivist approach learning loop models on the retention of learned information: A meta-analysis study]. *Kastamonu Eğitim Dergisi*, *26*(3), 753-764.

Savaş, B., Senemoğlu, N., & Kocabas, A. (2012). The effects of integrated unit and constructivist based teaching learning process on fourth grades students' learning levels, attitudes towards learning, academic self-confident. *Procedia-Social and Behavioral Sciences, 46*, 2811-2815. http://dx.doi.org/10.1016/j.sbspro.2012.05.569

Semerci, Ç., & Batdi, V. (2015). Meta-analysis of constructivist learning approach on students' academic achievement, persistence and attitudes. *Eğitim ve Öğretim Araştırmaları Dergisi, 3*(2), 171-180.

Senemoğlu, N. (2009). *Gelişim, öğrenme ve öğretim: Kuramdan uygulamaya* [*Development, learning and teaching: Teaching from theory*] (14th ed.). Pegem Akademi.

Şimşek, N. (2004). A critical look at constructivist learning and teaching. *Eğitim Bilimleri ve Uygulama, 3*(5), 115-139.

*Tuncel, G. (2008). *Yapılandırmacı öğrenme kuramına dayalı öğretim uygulamalarının ilköğretim 6. sınıf sosyal bilgiler dersi konularının öğretimi üzerine etkileri*. (Unpublished doctoral dissertation). İstanbul: Marmara University.

Tuncel, G., & Öztürk, C. (2013). The effects of teaching practices based on constructivist learning theory on the teaching of 6th grade social studies course subjects. *Marmara Coğrafya Dergisi*, *27*, 15-40.

Ün Açıkgöz, K. (2005). *Aktif öğrenme [Active learning]*. Eğitim Dünyası Yayınları.

Von Glasersfeld (1996). *Radikaler konstruktivismus, ideen, ergebnisse, probleme*. Frankfurt am Main.

Von Foerster, H. (1998) Entdecken oder Erfinden. Wie lässt sich Verstehen verstehen?. H. Gummin, & H. Meier, (Eds.), *Einführung in den konstruktivismus* in (pp. 41-48) Piper.

Yıldırım, A., & Şimşek, H. (1999). *Sosyal bilimlerde nitel araştırma yöntemleri* [*Qualitative research methods in the social sciences*]. Seçkin Yayınevi.

Yönez, S. (2009). *The effect of cooperative learning according to constructivism theory on the success and attitudes of primary education 5th grade students at science and technology class*. (Unpublished master's thesis). Ankara: Gazi University.