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Evaluating Orienteering-Based Guidance Material on Mitosis and Meiosis

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Abstract

This study aims to obtain science teachers' opinions about developing an orienteering-based guidance material for the 7th-grade subjects of mitosis and meiosis and using this developed material in teaching. The research uses the case study design, a qualitative research method. The research was carried out with 10 science teachers working in public schools in Turkey in the 2020-2021 academic year. A document with 17 open-ended questions prepared by the researchers was applied to the participants online. Content analysis is used for analyzing the data. The study has determined the codes, categories, and themes related to the data obtained from open-ended questions, presenting the findings as direct quotations without interpretation. As a result, the research has concluded teachers to want to use the developed guidance material in their lessons and receive training on this subject and to consider the material suitable for their students' grade and able to contribute to the students' learning. It is recommended to apply the opinions of teachers and students in future studies.

Keywords: mitosis, meiosis, guidance material, orienteering.

Mitoz - Mayoz Bölünme Konularında Geliştirilen Oryantiring Temelli Rehber Materyalin Değerlendirilmesi

Öz

Bu çalışma, 7. sınıf mitoz ve mayoz konuları için oryantiring temelli bir rehberlik materyali geliştirilmesi ve geliştirilen bu materyalin öğretimde kullanılmasına yönelik fen bilimleri öğretmenlerinin görüşlerini almayı amaçlamaktadır. Araştırmada nitel bir araştırma yöntemi olan durum çalışması deseni kullanılmıştır. Araştırma 2020-2021 eğitim öğretim yılında Türkiye'de devlet okullarında görev yapan 10 fen bilimleri öğretmeni ile gerçekleştirilmiştir. Araştırmacılar tarafından hazırlanan 17 açık uçlu sorudan oluşan bir doküman katılımcılara online olarak uygulanmıştır. İçerik analizi, verileri analiz etmek için kullanılır. Çalışmada açık uçlu sorulardan elde edilen verilere ilişkin kodlar, kategoriler ve temalar belirlenmiş, bulgular yorum yapılmadan doğrudan alıntılar şeklinde sunulmuştur. Sonuç olarak araştırma, öğretmenlerin geliştirilen rehberlik materyalini derslerinde kullanmak ve bu konuda eğitim almak istedikleri, materyali öğrencilerinin sınıf düzeyine uygun ve öğrencilerin öğrenmelerine katkı sağlayabileceğini düşündükleri sonucuna varmıştır. Gelecekte yapılacak çalışmalarda uygulama gerçekleştirilerek öğretmen ve öğrenci görüşlerine başvurulması önerilir.

Anahtar kelimeler: mitoz, mayoz, rehber materyali, oryantiring.

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INTRODUCTION

Developments in science and technology have affected almost every stage of our lives, especially education. Education systems have had to constantly keep track of innovations in order to keep up with the changes and developments in the field of science and technology. Some innovations are needed in the education system as a result of higher teaching standards, greater numbers of students in classrooms, and rapid technological developments. The constructivist approach, which supports the learning of subjects that are intertwined with technology, such as mathematics and science, which are the subjects that students have difficulty in constructing by educators, is one of these innovations (Gilbert, 2018; İsman et al., 2002). As a student-centered approach, the constructivist approach requires students to learn content by doing and experiencing, to discover information, to realize learning based on discussion and research, and to be active in the classroom. The teacher is positioned as a guide for students to access the information in this process (Jia, 2010).

Science is a course that teaches the basics of science and technology. Science forms the basis of a good education (İsman et al., 2002). In this context, students should be given a solid understanding of science, which can happen through competence in science education (National Research Council, 2012). Competence in science education requires students to learn by using the information they learn in their daily life through action and experience The information obtained as a result of these teaching activities should be far removed from memorization, and it should be meaningful and permanent (Rajan, 2012). A significant percentage of science teachers are seen to still prefer teacher-centered teaching methods in their lessons such as direct instruction and question-and-answer more often than student-centered teaching methods (Atila & Sozbilir, 2016). This situation brings along many problems such as lower student interest, motivation, and participation in the lesson because the lessons become monotonous. Teachers are expected to provide students with appropriate learning experiences rather than transferring information directly. In this sense, the teaching methods, approaches, and materials used in the lesson are thought to impact students' affective characteristics such as their attitudes toward the lesson, self-efficacy, motivation, and anxiety; these affective factors are also thought to affect student performance in the course and their academic success as a result (Peixoto et al., 2018). For this reason, teaching materials and use alternative methods and techniques need to be enriched in order to teach science concepts effectively (Grover & Pea, 2016). As a matter of fact, using different methods and techniques together is recommended in the science curriculum by taking into account students' individual differences (MoNE, 2018). At this point, the need comes to the fore for guidance materials that will help teachers and students (Tomlinson, 2013). Materials that can help meet these needs are called guide materials (Kaya, 2006).

Developing guidance materials is a time-consuming process that requires planned and scheduled work. Guidance materials developed within the framework of the unit can be assured to have many features not found in textbooks. Guidance materials that take students' prior knowledge and misconceptions into account, attract their attention, and include rich and numerous examples will make learning impactful (Senel Coruhlu, 2013). The guidance materials to be developed should be able to analyze the concepts related to the subject in detail, use models especially for teaching abstract concepts, provide students with one-on-one experiences, guide teachers and students, increase students' attitudes toward science, take into account students' individual differences, and contain different methods and techniques (Degirmençay, 2010).

One of these materials, orienteering, appeared in Scandinavia at the end of the 19th century; It started with the people of the region putting signs on certain routes to find their way under heavy snow and fog (Baster, 2020). With the development of technology over time, more detailed maps have been drawn, and orienteering has become the traditional sport of the country. Orienteering then developed and became a world sport. Orienteering is defined as a sport branch that increases students' problem-solving and analytical thinking skills and develops abstract-thinking and orientation skills by integrating physical movements with mental processes. Orienteering is an outdoor sport where check points on a map in a determined region are aimed to be completed as soon as possible; it increases individuals' ability to struggle with difficulties and solve problems independently by enabling the use of physical and mental processes together. Since orienteering includes many cognitive processes such as planning, thinking, remembering, recognizing, observing, making decisions, and problem solving (Johansen, 1997), it contributes to the mental development of the individual. Orienteering activities not only provide students with many benefits in terms of physical, mental, and educational aspects, but also allow students to develop individually and socially. Orienteering, which is easily accessible financially, also provides the excitement of competition and creates a competitive environment (MoNE, 2019). Additionally, orienteering requires individuals to think fast and determine the most appropriate route from one location to another. Therefore, orienteering has been described as

"playing chess by running" (MoNE, 2019). Orienteering can be integrated into many branches such as science, social studies, and mathematics by associated it with the learning outcomes in the curricula (Huikko & Raus, 2020; MoNE, 2019).

When examining the literature, a very limited number of studies on orienteering are found. While most of these studies are on physical education (Huikko & Raus, 2020; Jourand et al., 2018; Pulur & Akcan, 2017), other studies on orienteering are also found regarding geography education (Avcı, 2013; Imamoglu & Imamoglu, 2018; Tuna & Balci, 2013). However, no research is found regarding integrating orienteering into a science course.

Studies conducted on mitosis and meiosis generally investigate the effects of various teaching methods and techniques on students' academic achievement (Aksakal et al., 2015; Bedir, 2007; Karsli, 2015; Ozay, 2007; Ozbudak Kilicli, 2016; Ozkaya, 2013; Yucel, 2015), attitude (Bedir, 2007; Karsli, 2015; Ozbudak Kilicli, 2016; Ozkaya, 2013), and motivation toward science (Karslı, 2015). Various studies are seen to have aimed at detecting and eliminating the misconceptions of students from different education levels about mitosis and meiosis (Alkan et al., 2016; Alkan & Koksal, 2017; Akyurek & Afacan, 2012; Atilboz & Gokben, 2004; Aydin, 2011; Etobro & Banjoko, 2017; Kara, 2007). In addition, there are studies in the literature that use guide materials in the teaching of mitosis and meiosis. According to Karaca et al. (2021), benefited from card games. Alkan (2015), on the other hand, used a conceptual change model (material) for mitosis. The fact that students have many misconceptions about mitosis and meiosis reveals the necessity of the current study. The guidance material developed in this study will help teachers identify and eliminate the misconceptions that may occur within the scope of this subject. Within this context, the idea is that students will be prevented from carrying their misconceptions about the subject to future grades.

This research is thought to benefit teachers, students, academicians, and MoNE. The developed guidance material is thought able to guide teachers and students in terms of having rich teaching content, including applicable teaching activities, providing students with the opportunity to apply the theoretical knowledge they have acquired in daily life, revealing abstract concepts concretely, and incorporating contemporary methods and techniques in science education. In addition, this guide material, which is thought to be of such benefit to students, is expected to guide teachers in teaching mitosis and meiosis, and to be a material that they can use in a planned and programmatic way in their lessons. These materials are expected to be a resource for academicians for research on different courses and subjects related to orienteering. Orienteering is thought to be an activity that can be included in 7th-grade textbooks as a contribution to the MoNE. In addition, this research, can be considered among the first on orienteering and science course integration and is expected to be a source for future research. 7thFor these reasons, the aim of this study is to develop an orienteering-based guidance material for the subject of mitosis and meiosis in the 7th-grade science curriculum and to refer to the predictions of science teachers about whether this material can be used in teaching. In line with this purpose, the research question has been determined as "How are science teachers' views about the orienteering-based guidance material developed for mitosis and meiosis?"

METHOD

Research Design

This study uses case study design, a qualitative research design. In the case study, the researcher investigates in-depth information, describes situations, or creates themes at specific times using multiple sources of information such as observations, interviews, and documents regarding daily life or limited situations (Creswell & Poth, 2016). Because the present research aims to develop a guidance material for the subject of mitosis and meiosis and to have science teachers evaluate this material, it is thought that this aim will be achieved through case study.

Study Group

The research was conducted with the participation of 10 science teachers working in Turkey in the 2020-2021 academic year. Convenience sampling was used to determine the teachers included in the study group. Convenience sampling aims to select individuals or groups that are easy to access (Fraenkel et al., 2012). In the determination of the participants, attention was paid to the fact that science teachers gave lectures at the 7th-grade level. In addition, information about orienteering was provided before asking for the opinions of the participants. In addition, participants have experience in the use of guide materials. The demographic information of the teachers is given in Table 1.

Table 1. Participants' Demographic Information

Participants	Age range (years)	Gender	Work experience (years)	Residential area of the school	Education level
P1	30-34	Male	1-5	City	Bachelor's degree
P2	50-54	Female	20 or more	City	Bachelor's degree
P3	25-29	Female	1-5	City	Bachelor's degree
P4	35-39	Male	10-15	City	Master's degree
P5	30-34	Male	5-10	Village	Master's degree
P6	20-24	Female	1-5	City	Bachelor's degree
P7	35-39	Male	10-15	City	Master's degree
P8	30-34	Male	5-10	City	Bachelor's degree
P9	30-34	Female	5-10	City	Master's degree
P10	35-39	Female	10-15	City	Doctoral degree

Developing the Guidance Material

This research develops a guidance material for the 7th-grade mitosis and meiosis subject. When developing the guidance material, the steps below were followed using the guidance material development stages determined by Bakioglu and Karamustafaoglu (2017):

1. One of the researchers took an orienteering certificate by participating in in-service training in order to improve his orienteering skills.
2. Before developing the guidance material, a literature review was conducted on new approaches in science education, the constructivist approach in science education, the subject of Mitosis and Meiosis, how to prepare guidance material, and orienteering.
3. As a result of the literature review, the students were determined to have difficulty associating mitosis and meiosis with daily life and to have misconceptions about this subject (Akyurek & Afacan, 2012; Alkan et al., 2016; Atılboz & Gokben, 2004; Bedir, 2007; Kara, 2007; Kaya, 2019; Ozay, 2007).
4. The decision was made to base the guidelines on the constructivist approach; the material was prepared in this direction.
5. The learning outcomes from the mitosis and meiosis subject in the science curriculum were analyzed. The decision was made to prepare a guidance material that involves all the learning outcomes of the subject.
6. While preparing the guidance material, attention was paid to features good guidance materials should have (McAlpine & Weston, 1994). These features involve the guidance material being target-oriented; the information being clear, accurate, and reliable; attracting students' attention; having high technological quality; being effective on students; encouraging students to use them; and being suitable for the grade level as well as for cognitive, affective, and psychomotor behaviors and collaborative work.

Appendix 1 provides the guidance material that was developed by taking the above steps into consideration as well as the guidelines regarding the material.

Classroom Environment

The arrangement of the classroom environment facilitates teachers and students in performing the orienteering activities. The researcher prepared the images in Figure 1 using 3D software. As seen in Figure 1, the rows are arranged so that the students can move freely and are numbered left to right then front to back from 1 (closest to the teacher's desk) to 26 (farthest from the desk). The boxes with the information cards were placed on the numbered rows, then the stopping points were determined. A suitable place in the classroom (the triangle located on the back wall of the classroom) has been determined as the starting point. This point is the first step required to start orienteering activities. A suitable place in the classroom (the circle on the teacher's desk) has also been determined as the end point. This point is the last step required for orienteering activities to end. Students put the passwords they have obtained from the information cards in the check box they have and bring them to the end point. In the activity related to the stages of mitosis, the student will read the information cards (Appendix-2) on the relevant desks, select the correct image (Appendix-3) on the table and attach it to the check box in Appendix-7. In the activity related to the stages of meiosis, the student will read the information cards (Appendix-4) on the relevant tables, select the correct image on the table (Appendix-5) and attach it to the check box in Appendix-8. The images in Appendix-3 and Appendix-5 were edited and used from the website

(https://www.shutterstock.com/image-vector/mitosis-process-by-which-our-bodies-160428437). In the activity on the characteristics of Mitosis and Meiosis, the student will read the information cards (Appendix-6) on the relevant tables, select the correct image on the table (Appendix-6) and attach it to the check box in Appendix-9. In the study, a sample classroom environment where the application can be made is illustrated. Under the leadership of the teacher who will implement the activity, changes can be made according to the environmental conditions.

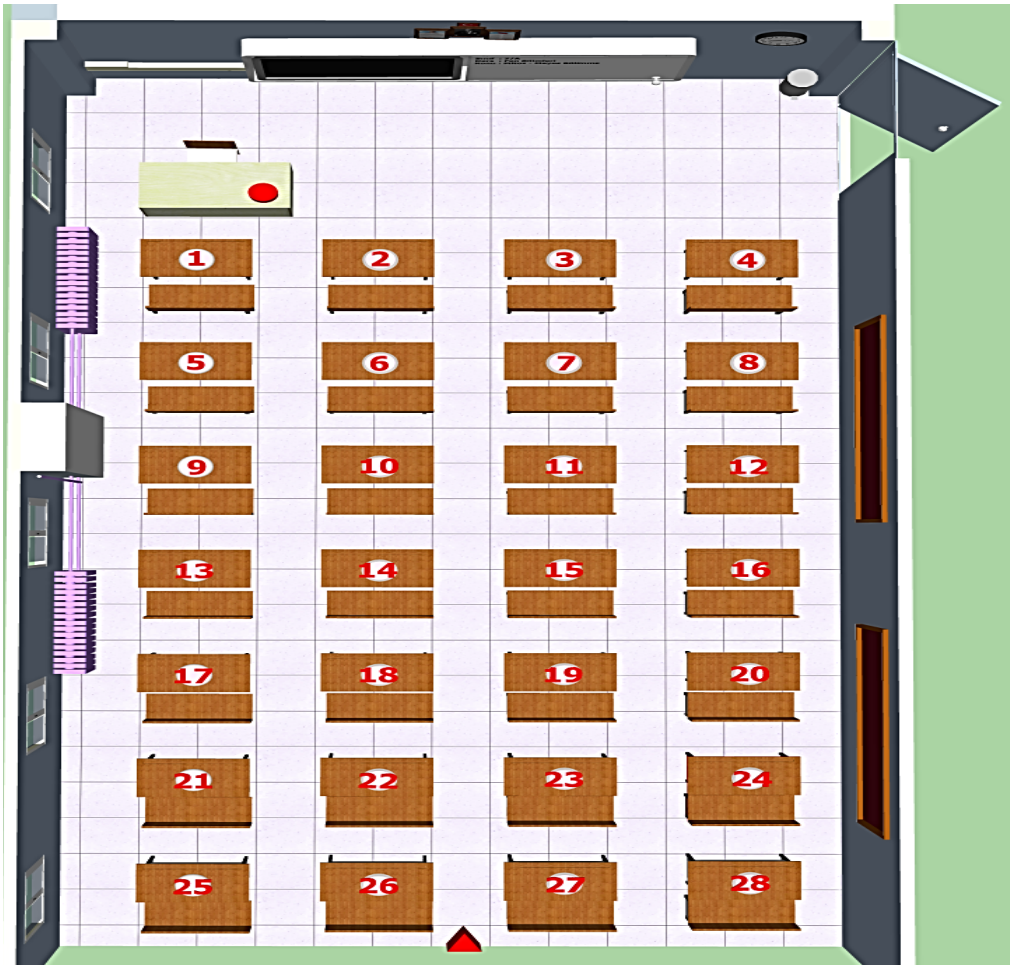


Figure 1. *The Classroom Environment Where the Guidance Material will be Applied*

Data Collection Tool

The most commonly used data collection tools in case studies on education are participant observations, in-depth interviews, and open-ended questions (Johnson & Christensen, 2019; Moser & Korstjens, 2018). In this study a document consisting of open-ended questions was used as a data collection tool. The researchers took certain criteria into consideration in the document they prepared as a result of the literature review (Gullu et al., 2019; Kutluca & Zengin, 2011; Yazlik, 2018). These criteria are generally about the instructional features of the developed guidance material and the positive and negative reflections on how to use this material in teaching. A draft document was formed first, and the opinions of a science education expert was taken in person and a Turkish teacher's opinions were received online.

A face-to-face interview was held with a science education expert regarding the draft document and some changes were made in the document in line with expert opinions. As a result of this interview, necessary arrangements were made considering the appropriateness of the evaluation of the material by the teachers in terms of different dimensions. For example, classroom discipline of the developed material, communication with the student, etc. The questions asked about its effect on the subjects were gathered in a single question and asked as its effect on classroom management. The questions in the document are divided as follows: The 1st and 2nd questions are classified as the student dimension; questions 3, 4, 5, 6, 7 and 8 are in the dimension of the teacher; questions 9, 10, 11, 12, 13 and 15 are in the lesson dimension; and questions 14, 16 and 17 are in the material dimension. As a result of the online interview with the Turkish teacher, the document was finalized after making

the necessary following arrangements in terms of miswriting, expression errors, and understandability regarding the draft document:

The word "a contribution" should be removed from the Question 7 (Do you think the developed guide material will make a contribution to you?), and the question should be revised as “Do you think the developed guide material will positively contribute to you?”

Question 15 states, “What do you think about adapting the developed guidance material to other topics?” and should be changed to “What do you think about the adaptability of the developed guidance material to other topics?”

Validity – Reliability

Internal Validity

Internal validity of a research implies the researcher’s consistency from the data collection process to data analysis and interpretation; it expresses the clear explanation of this consistency (Fraenkel et al., 2012). Within the scope of this research, the following precautions regarding threats to its internal validity have been taken:

Interviews were held to get the opinions of a science education expert and a Turkish teacher about the prepared draft document in order to evaluate the readability and understandability of the questions.

The document was hand-delivered to the science teachers, and they were informed about the document.

The findings include direct quotations regarding the science teachers’ statements of science teachers.

- This study did not triangulate the data, which is thought to be a threat limiting its internal validity.
- Meaningful codes, categories, and themes were determined as a result of the content analysis. Meaningless and irrelevant statements were not included in this analysis.
- The codes, categories, and themes were finalized through face-to-face interviews with a science education expert.

External Validity

A study’s external validity expresses the generalizability of the research results (Fraenkel et al., 2012). The following precautions were taken regarding threats to its external validity:

- The research steps are explained in detail.
- Participants’ identities remain anonymous and encoded as P1 to P10.

Internal Reliability

A study’s internal reliability expresses different researchers arriving at the same results using the same data (Fraenkel et al., 2012). The precautions taken regarding threats to internal reliability are as follows:

- Findings in the documents are presented in their raw form without comments.
- The research purpose and question are stated clearly and understandably.

External Reliability

External reliability expresses similar data being available in environments akin to that in the research (Fraenkel et al., 2012). The following precautions have been taken regarding threats to external reliability:

- The research findings and discussion are expressed clearly and comprehensibly.
- The research findings are explained in line with the opinions of a science education expert.

Data Analysis

The data obtained have been identified using content analysis in an attempt to reveal the implicit truths in these data. Content analysis is a kind of in-depth and systematic analysis that allows researcher to examine human behaviors indirectly by analyzing written communication patterns (Fraenkel et al., 2012). The current study aims to analyze in detail science teachers’ answers to the documents. In line with this goal, the study investigates the data obtained from the documents and creates codes. These codes have been placed under specific categories. The themes were then obtained based on these categories. In this study, 17 categories were created. Based on these categories, the theme was determined as "Guidance materials". Next, a science education expert examined these codes, categories, and themes, reaching consensus with the researchers. The points to be considered while determining the codes, categories, and themes are as follows: The categories summarize the interview questions, the codes summarize the participants’ responses, and the themes summarize the research subject (Table 2).

Table 2. Themes, Categories and Codes Obtained from the Document

Theme	No	Category	Code
Guidance materials	1	Suitability to students' level	Suitable
		Reason for suitability	Creative thinking, brainstorming, meaningful learning, permanent learning, clarity, being suitable for learning outcomes, facilitating learning, including visual elements
	2	Students' ability to use	Usable
	3	Effect on classroom management	Effective uses, causes confusion, communication disorder, makes classroom environment fun, depends on class size, discipline problem, allows students to discover
	4	Difference from previously used methods and techniques	Different, effective, provides permanent learning, promotes active participation, remarkable, innovative, fun, collaborative, competitive, increases motivation, raises awareness
	5	Advantages	Provides permanent learning, promotes active participation, innovative, collaborative, enables quick thinking, develops map-reading skills, ensures repetition of the topic, increases attitudes, economical, easy to adapt, fun, raises awareness
	6	Disadvantages	Yes, no
	7	Contributes positively to the participant	Yes
	8	Desire to receive training	Yes, no
	9	Effect on course achievement	Provides permanent learning, increases achievement, increases attitudes, promotes active participation, provides repetition of the subject, provides feedback, increases motivation, develops high-level skills
	10	Effect on interest in the course	Increases
	11	Thoughts on its use in science teaching	Should be used
		Reasons for being used in science teaching	Facilitates subject teaching, concretizes, draws attention, student-centered learning, provides permanent learning, teaches with games, increases motivation, collaborative
	12	Suitability to course duration	Suitable, partially suitable, not suitable
	13	Problems that may be encountered	Lack of materials, discipline issues, complexity, bias, lack of time
	14	Purpose of use	Assesses readiness, teaches the subject, the end-of-unit assessment, providing repetition of the unit
	15	Thoughts on its suitability to the content (subject)	Suitable
	16	Adaptability to other subjects	Adaptable
	17	Missing/ improvable point(s)	Yes, no

Research Ethics

Ethics committee approval was obtained for the research.

FINDINGS

Findings Regarding the Appropriateness of the Guidance Material to the Level of the Student and its Reasons

The science teachers were asked *"What do you think about the suitability of the developed guidance material for the students' level? Why?"* All the teachers were identified to consider the material developed to be suitable for students' level (see Table 3).

Table 3. Answers Regarding the Reasons for Suitability for the Students' Level

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Creative thinking	X									
Brainstorming	X									
Meaningful learning	X								X	
Permanent learning		X				X		X		
Clarity			X	X	X					
Suitable for learning outcomes							X			X
Facilitates learning						X		X		
Includes visual elements		X								X

Stating the guidance material to develop creative thinking, P1 expressed that the material allows students to brainstorm and would be useful in realizing meaningful learning. Participants stated that the material provides permanent learning and facilitates students' learning the subject. In this framework, P8 stated, *"I found the material suitable for the students' level; I think it is easier and permanent for students in the target age group to learn when the course topics are gamified."* P4's statements were "*the explanations made for the students in the guide material are sufficient*". P10's statements are "*associated with student achievements. Visual elements are included*".

Findings Regarding the Guidance Material's Effect on Classroom Management

Science teachers were asked, *"What do you think about the effect of the developed guide material on classroom management (e.g., discipline and communication)?"* The answers are given in Table 4.

Table 4. Answers Regarding the Guidance Material's Effect on Classroom Management

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Effective use	X								X	
Causes confusion		X			X	X				
Communication disorder			X	X	X			X		X
Makes classroom environment fun				X						
Depends on class size							X			
Discipline problem								X		
Allows students to discover								X		

Participants stated the material to cause situations such as effective use in classroom management, confusion, and increased communication. P8 expressed this situation as:

"When applying the material, the fact that the students are in constant communication with each other seems to be a negative situation in terms of maintaining classroom discipline, but this situation can be eliminated with appropriate guidance from the teacher. Also, having the teacher discover students' different characteristics is useful as a result of externally observing the students in the game."

Findings Regarding the Differences from Previously Used Methods and Techniques

The participants were asked, *"What kind of differences do you expect when you compare the developed guide material with the methods and techniques you've used before?"* The answers are given in Table 5.

Table 5. Answers Regarding the Differences from Previously Used Methods and Techniques

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Different	X									
Effective	X						X			
Provides permanent learning		X						X		
Promotes active participation			X					X		
Remarkable			X							
İnnovative				X	X					
Fun				X					X	
Raises awareness					X			X		
Collaborative						X				
Competitive						X				
Increases motivation										X
Raises awareness										X

The prepared activity is seen to differ from the methods and techniques the teachers had previously used. Stating the material to provide more permanent learning, P2 expressed his/her opinion as, *"I think it is able to make learning more permanent."* Some participants stated the activity to support active participation and to be remarkable (P3), innovative (P4) and fun (P4). In this regard, P4 stated, *"I think it is a new technique which seems more fun than the techniques I use."* Expressing the activity to be one that offers students both a collaborative and competitive environment, P6 stated, *"I think the activity enables students to experience both working in cooperation and in competition by addressing students through different aspects."* Thinking the activity to be different in how it increases motivation and creates awareness in students, P10 said, *"I think it will improve students' motivation to learn and enable them to learn better. Thanks to this game, students can complete deficiencies in their own learning."*

Findings Regarding the Advantages of the Guidance Material

The participants were asked *"What do you think about the advantages of the developed guidance material?"* The answers are given in Table 6.

Table 6. Answers Regarding the Advantages of the Developed Material

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Provides permanent learning	X	X	X							
Promotes active participation			X		X		X	X		
Innovative				X						
Collaborative					X	X				X
Enables quick thinking					X				X	
Develops map-reading skills					X					
Ensures repetition of the topic						X				
İncreases attitudes						X			X	
Economical								X		
Easy to adapt								X		
Fun				X		X				X
Raises awareness										X

According to the participants, the developed material has advantages such as it provides permanent learning, promotes active participation, is collaborative, enables quick thinking, and develops map-reading skills. Regarding the advantages, P5 stated, *"I believe it offers many contributions such as active participation, cooperative learning, quick thinking, and map-reading knowledge"* and P6 said, *"This material is advantageous in terms of teaching students to work cooperatively, providing repetition of the subject, and increasing interest and attitude toward the course."* P4's statements were "*I think its biggest advantage is that it is a new technique used in the lessons. I also think it will attract students' attention*". P8's statements are "*Economic, student-centered, the number of students is not an obstacle because different places can be used, and it can be easily adapted to different subjects*". P10's statements are: "*A subject that is difficult to learn can be taught by making it fun. Thus, students reinforce their own learning and learning together with the group*".

Findings Regarding the Disadvantages of the Guidance Material

The teachers were asked, *"What do you think about the disadvantages of the developed guide material?"* Two participants saw no disadvantages (P1 and P2), while eight participants stated it could be improved (P3, P4, P5, P6, P7, P8, P9 and P10). Stating the material to be disadvantageous in that applying them in crowded classrooms is difficult, P4 said, "*The difficulty in applying it in crowded classrooms can be a disadvantage.*" P1 made a statement as "*I do not see any disadvantages*".

Findings Regarding the Guidance Material's Contributions to the Participant

The participants were asker, *"Do you think the developed guidance material positively contributes to you?"* All teachers were seen to think the developed material positively contribute to them. On this subject, P5 stated, "*Different methods and techniques contribute positively to my professional competence; I am also thinking of designing activities at different grade levels by participating in the trainings based on these activities.*"

Findings Regarding Desire to Receive Training on the Guidance Material

The participants were asked, *"Would you like to receive training on the developed guide material?"* Nine teachers answered this question in the positive. Meanwhile, P7 expressed not wanting to receive training, saying, "*I can implement this without any training.*"

Findings Related to the Guidance Material's Effect on Course Achievement

The participants were asked, *"What do you think about the developed guidance material's effect on course achievement (teaching the subject)?"* Their answers are given in Table 7.

Table 7. Answers Regarding the Developed Material's Effect on Course Achievement

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Provides permanent learning	X		X	X		X	X	X	X	
Increases achievement		X		X	X	X				
Increases attitude					X	X				
Promotes active participation					X					
Provides repetition of the subject						X				
Provides feedback								X		
Increases motivation										X
Develops high-level skills										X

P6 thought the developed material to have affected course achievement in terms of providing permanent learning, increasing achievement, raising attitudes, and providing subject repetition and stated: "*I think the success of the course will be directly affected by lifting students' attitudes. In addition, if we consider it in terms of being an effective method for subject repetition and evaluation, I think it will increase the subject's memorability and thus course achievement as well."*

Stating the material to affect course achievement in terms of increasing motivation and developing high-level skills, P10 said, "Student motivation and desire to learn increase. It develops higher-level skills."

Findings Regarding the Guidance Material's Effect on Interest in the Course

The participants were asked, *"What do you think about the developed guidance material's effect on interest in the lesson?"* All participants stated that the material increases interest in the lesson, which P9 stated as *"Because students like to be active and use materials in the lesson, their interest is high."*

Findings on the Use of Guide Materials in Science Teaching and Its Reasons

The participants were asked, *"Do you think the developed guidance material should be used in science teaching? Why?"* All teachers stated that the developed material should be used in science teaching citing different reasons (see Table 8).

Table 8. Answers Regarding the Reasons for Using the Developed Material in Science Teaching

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Facilitates subject teaching	X						X			
Concretizes		X								
Draws attention			X	X	X	X				
Student-centered learning								X		
Provides permanent learning									X	
Teaches withgames										X
Increases motivation										X
Collaborative										X

P1 stated that "*it provides easy teaching of subjects to children*". P2 stated that "it should be used to concretize the issues". P3 stated that "*I think that learning will also be provided because it will attract attention from students*". P8, on the other hand, stated that "*Since I have observed that student-centered teaching methods are more effective than classical methods in science teaching, I think that the developed guide material should be used in schools*". P9 stated that "*it will be positive for students to apply especially on subjects that are difficult to remember*". P10 stated, *"I think teaching with games is very necessary for abstract topics students have difficulty understanding. Thus, students can learn while having fun. Their motivation increases. They learn together by doing group work."*

Findings Regarding the Guidance Material's Suitability to the Course Duration

The participants were asked, *"What do you think about the developed guidance material's suitability for the course duration?"* Four participants found the course duration sufficient, four participants had concerns about this issue, and two participants found it insufficient (see Table 9).

Table 9. Answers Regarding the Developed Material's Suitability for the Course Duration

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Suitable				X			X	X	X	
Partially suitable	X	X	X		X					

Not suitable					X				X	

P7 stated the lesson duration to be sufficient by expressing, *"If the necessary preparations are made beforehand and the students are informed, the activity can be applied during the course hour,"* whereas P10 thought the lesson duration might be insufficient by stating, *"Extra time may be required for students to understand the game rules and work in teams."* P5 stated that *"one class hour will not be enough for large classes, but I think the course period is appropriate for an ideal class"*.

Findings Related to Problems That May Be Encountered

The participants were asked, *"What kind of problems might you encounter while using the developed guidance material in your lessons?"* The answers are given in Table 10.

Table 10. Answers Regarding the Problems That may be Encountered

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Lack of materials	X									
Discipline issues		X			X		X	X	X	
Complexity			X	X						
Bias				X	X					
Lack of time						X	X			X

The teachers are seen to think that problems such as lack of materials, discipline issues, complexity, bias, and lack of time may be encountered when implementing the activity. While P1 expressed this by saying, *"There may be a lack of materials"* and P4 stated, *"Some students may be biased, but they will adapt over time. They may have problems if I don't give enough explanations."*

Findings Regarding the Purpose for Using the Guidance Material

Participants were asked, *"For what purpose would you use the developed guidance material in the lesson?"* Their answers are given in Table 11.

Table 11. Answers Regarding the Purposes for Which the Guidance Material Will be Used

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Assessing readiness					X			X		
Teaching the subject	X	X	X	X	X		X		X	X
The end-of-unit assessment					X	X	X	X		
Providing repetition of the unit					X	X		X	X	

The participants stated that the material could be preferred especially for teaching the subject, and also stated that it could be used for assessing readiness, the end of unit assessment and providing repetition of the unit. P5 statements are "*I would use it to determine readiness, to teach the subject, to evaluate the end of the unit, to repeat the unit*".

Findings Regarding the Guidance Material's Suitability to the Content (Subject)

The participants were asked, *"What do you think about the developed guidance material's suitability to the content (subject)?"* All teachers are seen to think the developed material to be suitable to the content (subject). P5 stated "*It is suitable for the content. Because it covers all the learning outcomes.*"

Findings Concerning the Guidance Material's Adaptability to Different Subjects

The participants were asked, *"What do you think about the developed guidance material's adaptability to different subjects?"* All teachers were seen to answer the developed material to be adaptable to other subjects. P3 made a statement as "*applicable*".

Findings Related to the Missing or Improvable Points

The participants were asked, *"Are there any missing or improvable points in the developed guidance material? If so, what are they?"* Eight teachers (P1, P2, P3, P4, P6, P8, P9, P10) saw no shortcomings regarding the developed material, while two teachers found material improvable. In this sense, P5 expressed, "*It could have been designed as an out-of-class (but in-school) activity.*" P8 made a statement on this subject as "*There is no missing information point in the material*".

DISCUSSION & CONCLUSION

This study has concluded the orienteering-based guidance material developed on mitosis and meiosis cell division to be suitable to the students' level. This result parallels Avci's (2013) study that obtained the opinions of 9th- and 10th-grade students on the use of orienteering activities in geography lessons and reached very positive results in this regard. In addition, the current study has concluded orienteering activities to be suitable to the students' level as they enable creative thinking and brainstorming, contribute to meaningful learning, provide permanent learning, are understandable as an activity, are suitable for learning outcomes, easy to learn, and add visuality. Similarly, Avci (2013) concluded orienteering activities to increase interest in the lessons, teach how to use theoretical knowledge in daily life, and reinforce knowledge.

This study concluded that students can use orienteering activities. Parallel to this finding, Avci (2013) reached the conclusion that orienteering activities can be used in geography lessons. In addition, Imamoglu and Imamoglu (2018) concluded that using orienteering sport as an activity would be beneficial in classes for achieving learning outcomes in the secondary education curricula. The present study has concluded teachers to intend to use orienteering activities to determine readiness, teach the subject, evaluate the end of the unit, and repeat the unit.

This study concludes orienteering activities to be able to be used effectively in classroom management and to have positive contributions such as increasing communication, providing a fun classroom environment, and allowing students to discover; this situation will depend on classroom size, and the activities may also lead to disciplinary problems and confusion. In their study, Imamoglu and Imamoglu (2018) concluded students to be able to improve themselves in many ways, such as making decisions on their own and taking responsibility. Considering this result, students are believed will support the teacher in classroom management.

The study has found orienteering activities to have different methods and techniques than those teachers had previously used in terms of providing permanent learning and active participation; being remarkable, different, innovative, collaborative, competitive, more effective, and entertaining; increasing attitude and motivation; and raising awareness. Avci's (2013) study also concluded that students learn lessons by having fun and increasing awareness of the natural environment in which they live and that orienteering activities should be used as a teaching method in lessons. In this context, Avci (2013) concluded the activities to enable learning a subject by having fun and increasing awareness of the natural environment; therefore, orienteering activities should be used as a teaching method in lessons. In this respect, the views of teachers and students overlap with each other. Similarly, Yavuz Konokman et al. (2016) concluded in their study that elementary school prospective teachers' enjoyed designing innovative materials other than existing materials.

According to the participants, the developed material has been concluded to have advantages such as providing permanent learning and active participation, being collaborative, enabling quick thinking, and developing map-reading skills; it also has the disadvantage of being difficult to apply in crowded classrooms. According to the participants, the material developed provides permanent learning and active participation, being collaborative, providing quick thinking, improving map reading skills; It also has the disadvantage that it is difficult to implement in crowded classrooms. Atakurt et al. (2017) determined that orienteering trainings have a positive evaluation on the memory and attention of Europeans. Demir et al. (2022), on the other hand, state that the speed of orienteering events and their positive effects on visual memory. These results show parallelism with carrying out permanent learning from the existing results. Kara (2020), directed towards young children, was perceived to be effective in women's understanding of the concepts of place/direction. This result shows parallelism with the development of map reading skill.

The present study has concluded orienteering activities to contribute to teachers and almost all teachers to have stated wanting to receive training on orienteering. Moreover, the developed material has been concluded to increase students' interest in the lesson. This finding is in parallel with the conclusion that Avci (2013) obtained in his study that the students took great pleasure and enjoyed orienteering. The research has also concluded the orienteering-based guidance material developed on the subjects of mitosis and meiosis to usable in science lessons; it can facilitate the teaching of the subject; embody the subject; be remarkable and student-centered; provide permanent learning, collaborative learning and teaching with games; and will increase student motivation. In addition, it was determined in line with the opinions of the teachers that orienteering activities could be adapted to other subjects in science lessons. Likewise, Avci (2013) concluded orienteering as a sport to also be usable in different topics in geography courses. Therefore, the sport of orienteering is considered adaptable to many courses and subjects; in this way, it can be used as a method or technique for teaching a subject.

Different opinions have been concluded to exist about whether the recommended course duration is sufficient for conducting the activity developed in the current research. Considering that four participants found the time sufficient, four participants stated the duration to possibly vary based on class size, and two participants found the time insufficient, the recommended duration is considered able to be increased. This result is in parallel with the other studies. Cetgin (2021), as a result of the research, stated that one of the most critical factors of the orienteering game program is time wasting. Similarly, there are many international studies that show that the use of alternative teaching methods and techniques in the classroom environment causes time problems (Ceyhan et al., 2019; Cheng et al., 2019; Gursoy, 2021).

Lastly, the research has concluded that problems such as lack of materials or time, discipline issues, complexity, and bias may be encountered in conducting the activity. Avci (2013) concluded that applying orienteering in school playgrounds or gymnasiums would increase its applicability. Considering these findings together, the environment in which the activities will be carried out is thought should change.

As a result of this study, it is predicted that orienteering activities can be used in science lessons, ensure active participation and cooperation of students in the lesson, improve students' quick thinking and map reading skills, and be useful in affective care such as attitude. It may be beneficial to teachers and students in motivation and teaching-learning.

Recommendations

In light of its results, the study makes the following recommendations:

- This study aimed to develop an orienteering-based guidance material for the 7th-grade subject of mitosis and meiosis. Future studies can investigate the effect of using the guidance material developed on the 7th-grade topic of mitosis and meiosis in terms of students' academic achievement and attitudes.
- This research has discussed the 7th-grade subject of mitosis and meiosis. Future research can be carried out on different grades and classes.
- This research has used documents as the data collection tool. Future research can be supported by interviews and observations.
- During the process of developing the orienteering-based guidance material for the 7th-grade topic of mitosis and meiosis, interviews can also be made with students to address their misconceptions about the subject.
- In-service trainings can be organized for teachers on developing guidance materials and orienteering.
- In this study, only guide material was developed and teachers' opinions were consulted. In line with these predictions, this guide material was found to be applicable. In future studies, teachers and students can be consulted by applying the application.
- This study was conducted with 17 open-ended questions and 10 open-ended questions were asked. It is recommended to refer to the evaluation of 34 teachers who are at least twice as high in future studies.
- In the study, the opinions of teachers between the ages of 20-54 were consulted. In future studies, it is recommended to determine age groups at equal intervals.

REFERENCES

Akyurek, E. & Afacan, O. (2012). Determining the 8th grade students' misconceptions in the unit of "Cell Division" by using roundhouse diagramming. *International Journal of Curriculum and Instructional Studies, 2*(3), 47-58.

Alkan, I. (2015). *Development of conceptual change-based model (material) for teaching mitosis* (Thesis No. 405462) [Master's thesis, İnönü University]. YÖK Thesis Center.

Alkan, I., Akkaya, G., & Koksal, M. (2016). Determining misconceptions of prospective science teachers by using modeling approach as a data collection way. *Ondokuz Mayis University Journal of Faculty of Education, 35*(2), 121-135.

Alkan, I. & Koksal, M. (2017). Development of a conceptual change-based material for teaching mitosis. *Inonu University Journal of the Graduate School of Education, 4*(8), 66-83.

Atakurt, E., Sahan, A., & Erman, K. A. (2017). *The effect of orienteering education on attention and memory. Spormetre the Journal of Physical Education and Sport Sciences, 15*(4), 127-134.

Atilboz, G. & Gokben, N. (2004). 9th grade students' understanding levels and misconceptions about mitosis and meiosis. *Gazi University Journal of Gazi Educational Faculty, 24*(3), 147-157.

Atila, M. E., & Sozbilir, M. (2016). Application of constructivist principles in science and technology curriculum into practice by teachers. *Erzincan University Journal of Education Faculty, 18*(2), 1418-1457.

Avci, M. (2013). Geography students' views on the use of orienteering activity in geography education (Thesis No. 333451) [Master's thesis, Gazi University]. YÖK Thesis Center.

Aydin, G. (2011). *The effect of constructivist approach on removing students' misconceptions and on forming mental models related to the subjects of "Cell division and heredity"* (Thesis No. 286527) [Doctoral dissertation, Dokuz Eylul University]. YÖK Thesis Center.

Bakioglu, B., & Karamustafaoglu, O. (2017). A study on developing a guide material for science classes supported by out-of-school learning. *Universal Journal of Educational Research, 5*(5), 773-786.

Baster, P. (2020). Use of geodesy materials in bike orienteering marathons. *Geomatics, Land Management and Landscape, 1,* 79-89.

Cetgin, F. (2021). *Use of action bound program in art education. Idil Journal of Art and Language, 10*(81), 845-852. https://dx.doi.org/10.7816/idil-10-81-11

Ceyhan, G. D., Mugaloglu, E. Z., & Tillotson, J. W. (2019). Teaching socio-scientific issues through evidence-based thinking practices: Appropriateness, benefits, and challenges of using an instructional scaffold. *Ilkogretim Online, 18*(4), 1405-1417.

Cheng, S. C., Hwang, G. J., & Chen, C. H. (2019). From reflective observation to active learning: A mobile experiential learning approach for environmental science education. *British Journal of Educational Technology, 50*(5), 2251-2270.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches.* Sage Publications.

Degirmençay, A. S. (2010). *Effects of guide materials based on diversified 5E teaching model on conceptual change: "Heat diffusion and expansion"* (Thesis No. 270715) [Doctoral dissertation, Karadeniz Technical University]. YÖK Thesis Center.

Demir, M., Aydin, A., Koc, M., & Bayar, K. (2022). *Investigation of visual memory and speed skills in orienteering athletes*. 1st Health Sciences Student Symposium, 12-17.

Etobro, A. B., & Banjoko, S. O. (2017). Misconceptions of genetics concepts among pre-service teachers. *Global Journal of Educational Research, 16*(2), 121-128.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education (Eight Edition)*. New York: McGraw-Hill.

Gilbert, J. (2018). Untangling constructivism, knowledge, and knowledge-building for "future-oriented" teaching. *Set: Research Information for Teachers, 2*, 18–24. https://doi.org/10.18296/set.0095

Grover, S., & Pea, R. (2016*). Designing a blended, middle school computer science course for deeper learning: A design-based research approach*. Singapore: International Society of the Learning Sciences.

Gullu, D., Kocabas, H., & Ozata-Yucel, E. (2019). Evaluation of the material developed for the subject of ınclined plane in line with teacher and student opinions. *Journal of Science Teaching, 7*(2), 139-155.

Gürsoy, G. (2021). Digital storytelling: Developing 21st century skills in science education. *European Journal of Educational Research, 10*(1), 97-113.

Huikko, P., & Raus, S. (2020). *Online orienteering guide for teachers*. Unpublished thesis, Haaga-Helia University of Applied Sciences.

Imamoglu, M., & Imamoglu, A. (2018). Effect of orienteerıng sport on learning outcomes of geography and physical education and sport lessons in secondary education. *The Journal of Kesit Academy*, *16*, 198-207.

İsman, A., Baytekin, Ç., Balkan, F., Horzum, M. B. & Kiyici, M. (2002). Science education and constructivist approach. *The Turkish Online Journal of Educational Technology, 1*(1), 41-47.

Jia, Q. (2010). A brief study on the implication of constructivism teaching theory on classroom teaching reform in basic education. *International Education Studies, 3*(2), 197-199.

Johansen, B.T. (1997). Thinking in orienteering. *Scientific journal of orienteering*, *13*, 38-46.

Johnson, R.B., & Christensen, L. (2019). *Educational research: Quantitative, qualitative, and mixed approaches* (5th ed.). Sage publications.

Jourand, C., Adé, D., Sève, C., Komar, J., & Thouvarecq, R. (2018). Dynamics of student interactions: An empirical study of orienteering lessons in physical education. *Physical Education and Sport Pedagogy, 23*(2), 134-149.

Kara, B. (2020). *The effect of orienteering training program on the concept of development 60-71 months old children* (Thesis No. 659040) [Master's thesis, Aydın Adnan Menderes University]. YÖK Thesis Center.

Kara, Y. (2007). The effects of teaching aimed computer softwares on students' achievements, misconceptions and attitudes towards biology on the issue of mitotic and meiotic division. *Buca Faculty of Education Journal*, *21*, 49-57.

Karaca, M., Oner Armagan, F., & Bektas, O. (2021). Educational card game example: Mitosis and meiosis division. *Dicle University Journal of Ziya Gökalp Faculty of Education, 1*(40), 9-20.

Kaya, Z. (2006). Öğretim teknolojileri ve materyal geliştirme. Pegem A Yayıncılık.

Kutluca, T., & Zengin, Y. (2011). Evaluation of views of students about using geogebra in teaching of mathematics. *Dicle University Journal of Ziya Gokalp Faculty of Education*, *17*, 160-172.

McAlpine, L., & Weston, C. (1994). The attributes of instructional materials. *Performance Improvement Quarterly, 7*(1), 19-30.

Ministry of National Education [MoNE]. (2018). *Primary and secondary schools science curriculum (Grades 3, 4, 5, 6, 7 and 8).* Ankara.

Ministry of National Education [MoNE]. (2019). *Orienteering" training from the Teacher Training and Development General Directorate.* https://www.meb.gov.tr/ogretmen-yetistirme-ve-gelistirme-genel-mudurlugunden-oryantiring-egitimi/haber/18657/tr

Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. *European Journal of General Practice, 24*(1), 9-18.

National Research Council (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Committee on a Conceptual Framework for New K-12 Science Education Standards. Washington, DC: The National Academies Press.

Peixoto, A., Castro, M., Blazquez, M., Martin, S., Sancristobal, E., Carro, G., & Plaza, P. *(2018, April). Robotics tips and tricks for inclusion and integration of students.* IEEE Global Engineering Education Conference (EDUCON) (pp. 2037-2041).

Pulur, A., & Akcan, İ. (2017). Orienteering elite athletes of the relationship between the visual reaction time with decision making styles. *Gaziantep University Journal of Sport Science*, *2*(1), 53-61.

Rajan, S. (2012). *Methodology of Teaching Science*. Pearson Education India.

Senel Coruhlu, T. (2013). *Determining the effectiveness of guided materials based on enriched 5E instructional model related to solar system and beyond: Space puzzle unit* (Thesis No. 344492) [Doctoral dissertation, Karadeniz Technical University]. YÖK Thesis Center.

Tomlinson, B. (2003). Materials development courses. In B. Tomlinson (ed.), *Developing materials for language teaching* (pp.445-461). London: Continuum.

Tuna, F. & Balci, A. (2013).The effects of orienteering on prospective geography teachers' self-efficacy perceptions. *Marmara Geographical Review*, *27*, 1-14.

Usul, C. (2012). *The effect of the orienteering sport for socialization of people with disabilities.* Unpublished master's thesis, Bahçesehir University, İstanbul.

Yavuz Konokman, G., Yokus, G., & Yanpar Yelken, T. (2016). The Effect of Designing Innovative Material on the Elementary School Pre-service Teachers' Innovativeness. *Bartın University Journal of Faculty of Education, 5*(3), 857-878. http://dx.doi.org/10.14686/buefad.v5i3.5000203433

Yazlik, D.O. (2018). The views of teachers about use of concrete teaching materials in mathematics teaching. *OPUS-International Journal of Society Researches, 8*(15), 775-805.

Yucel, Y. (2015). *Investigation of the achievement level of students in "Cell division and heredity" unit with computer assisted teaching approach* (Thesis No. 418056) [Unpublished master's thesis, Erciyes University]. YÖK Thesis Center.

APPENDIX

Appendix 1. Guidance Material Instructions

Lesson	**Science**
Grade level	7
Topic/unit	**F.7.2.2.** Mitosis/**F.7.2.** Cell and Divisions
	F.7.2.3. Meiosis/**F.7.2.** Cell and Divisions
Learning objectives	**F.7.2.2.1.** Explain the importance of mitosis for living things.
	F.7.2.2.2. Explain that mitosis consists of different successive phases. (The names of the stages of mitosis are not given.)
	F.7.2.3.1. Explain the importance of meiosis for living things. (The stages of meiosis are given as Meiosis I and Meiosis II.)
	F.7.2.3.2. Shows how meiosis takes place in reproductive cells on the model. (Cell names are not mentioned during gamete formation. Only sperm and egg are stated.)
	F.7.2.3.3. Compares the differences between meiosis and mitosis. (While the differences between meiosis and mitosis are given, the differences in the division stages are not mentioned.)
Materials/ equipment	Orienteering map, Orienteering target (6 pieces) - Part 1
	Orienteering map, Orienteering target (11 pieces) - Part 2
	Orienteering map, Orienteering target (10pieces) - Part 3
Duration	40 min.
Activity name	Mitosis and Meiosis
Objectives	To enable students to learn the subjects of “mitosis and meiosis” by using "Orienteering techniques" in science course
	It is aimed that the students proceed towards the determined objectives by using the three different maps (mitosis stages, meiosis stages, the differences between mitosis and meiosis) given to them, and write down the stages of mitosis and meiosis according to the information given in these objectives and the differences of these divisions in the “checkbox” on the map correctly and in the correct order.
	While the students’ progress towards the targets set on the map, they will both have fun, attain permanent learning and meet the sport of orienteering with this educational game activity.
Place	In-class / ***In-school***
Adaptation	Labyrinth, Grid
Implementation	First of all, the Orienteering map is drawn. The drawn map is reproduced and given to each student. Students are divided into teams of three. Students in each team are given individual maps. The first of these maps is about the stages of mitosis, the second is about the stages of meiosis, and the third is about the differences between mitosis and meiosis. The parkours created on the maps are planned as a "classical parkours" with 6, 11 and 10 targets. When the team members exit together with the teacher's command, for example, one member of a team will list the stages of mitosis, the other will list the stages of meiosis, and the other will correctly match the differences between mitosis and meiosis. Students progressing to the goals meet at the finish point.
Assessment	The team that reaches the target the fastest and in the correct way wins the first place.
Part 1 (F.7.2.2.1. and F.7.2.2.2.)	The information given on the map in this section relates to the stages of mitosis. Information cards of 10x5 cm, in which the characteristics of a certain stage of mitosis are given, are prepared in sufficient numbers by the teacher. In addition, at each target point there are many small cards with different stages of mitosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of a certain phase of mitosis are given and paste the appropriate phase into the "control box" on the map.
Part 2 (F.7.2.3.1. and F.7.2.3.2.)	The information given on the map in this section relates to the stages of meiosis. Information cards of 10x5 cm, in which the characteristics of a certain stage of meiosis are given, are prepared in sufficient numbers by the teacher. In addition, at each target point there are many small cards with different stages of meiosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of a certain stage of meiosis are given and paste the appropriate stage in the "control box" on the map.
Part 3 (F.7.2.3.3.)	The information given on the map in this part is about the differences between mitosis and meiosis. Information cards of 10x5 cm, in which the characteristics of mitosis and meiosis are given, are prepared in sufficient numbers by the teacher. Also, at each target point, there are two different little cards called mitosis and meiosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of mitosis and meiosis are given and paste the appropriate card into the "control box" on the map.

Appendix 2.

Stop Number: 26

- The cell prepares to divide before undergoing mitosis.
- DNA replicates, and double its number.
- The number of organelles increases.
- Energy production and consumption accelerate.

Stop Number: 23

- Karyokinesis begins.
- Chromosomes are formed.
- Chromosomes consist of structures with exactly the same genetic structure, called sister chromatids, which are formed as a result of DNA replication.
- Chromosomes are attached to the spindle fibers formed during this time.

Stop Number: 20

- Chromosomes get aligned at the center of the cell.

Stop Number: 11

- A cleavage furrow begins to form in the middle of the cell.
- Sister chromatids are pulled to different poles by spindle fibers.

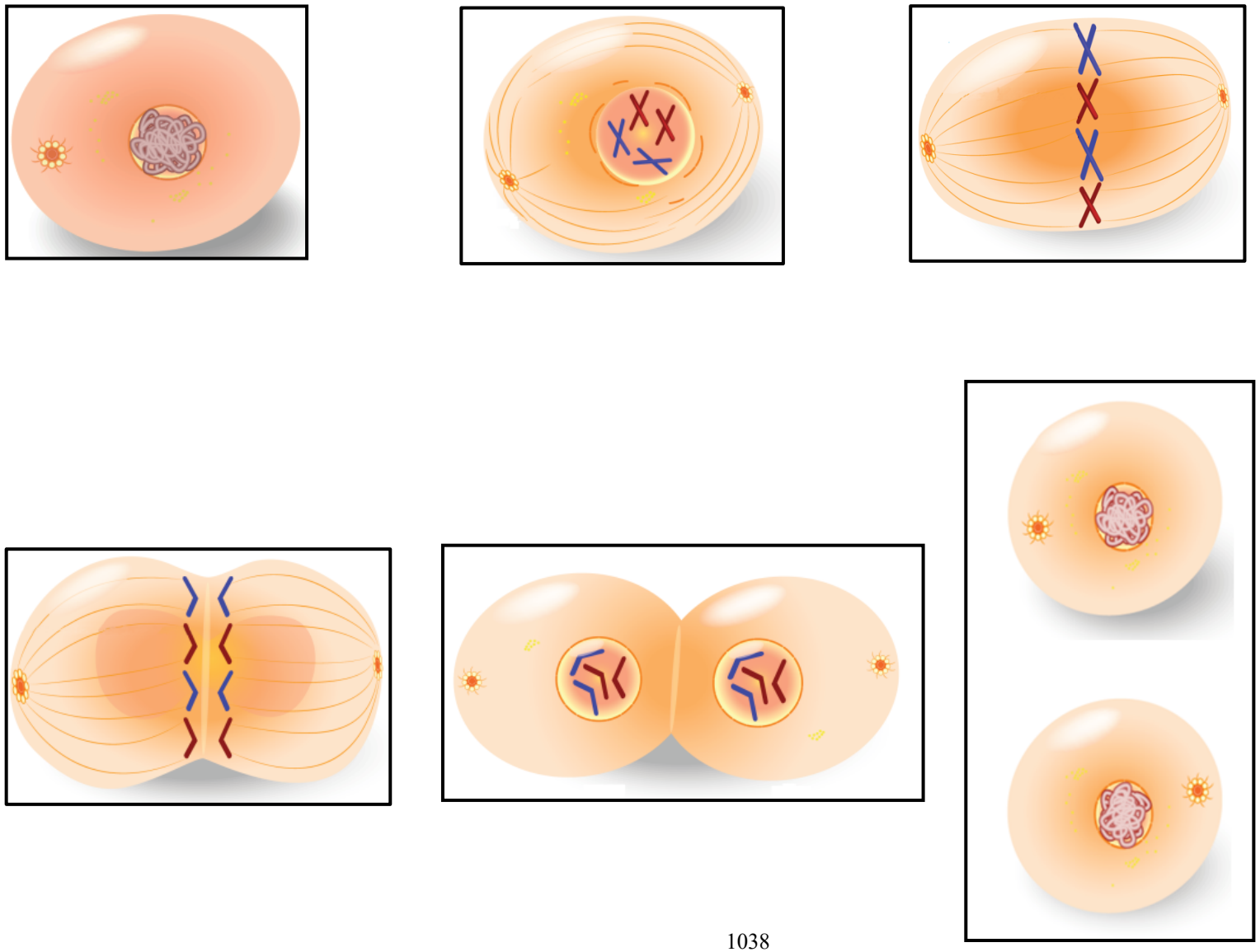
Stop Number: 5

- Equal distribution of chromosomes to the cells is completed.
- Since each of the sister chromatids passes into separate cells, the genetic structures of the new cells formed are exactly the same.

Stop Number: 2

- Two new cells are formed with the completion of the cleavage furrow.
- Since the amount of DNA doubles before division and then halves again, the DNA amount and chromosome number of the cells will be the same as the original mother cell.

Appendix 3.



Appendix 4.

Stop Number: 25

- DNA replication occurs.
- The number of organelles increases.

Stop Number: 21

- Spindle threads are formed.
- Exchange of parts occurs between homologous chromosomes.

Stop Number: 22

- Homologous chromosomes get aligned at the center of the cell.

Stop Number: 19

- Homologous chromosomes are pulled to opposite poles by spindle fibers.

Stop Number: 16

- A cleavage furrow begins to form in the middle of the cell.
- The number of chromosomes is reduced to half.

Stop Number: 14

- Two cells are formed, genetically different from each other and with half the number of chromosomes of mother cell.

Stop Number: 13

- The nuclear membrane disappears.
- Chromosomes are attached to spindle fibers.

Stop Number: 12

- Chromosomes get aligned at the center of the cell.

Stop Number: 7

- Sister chromatids are pulled to different poles by spindle fibers.

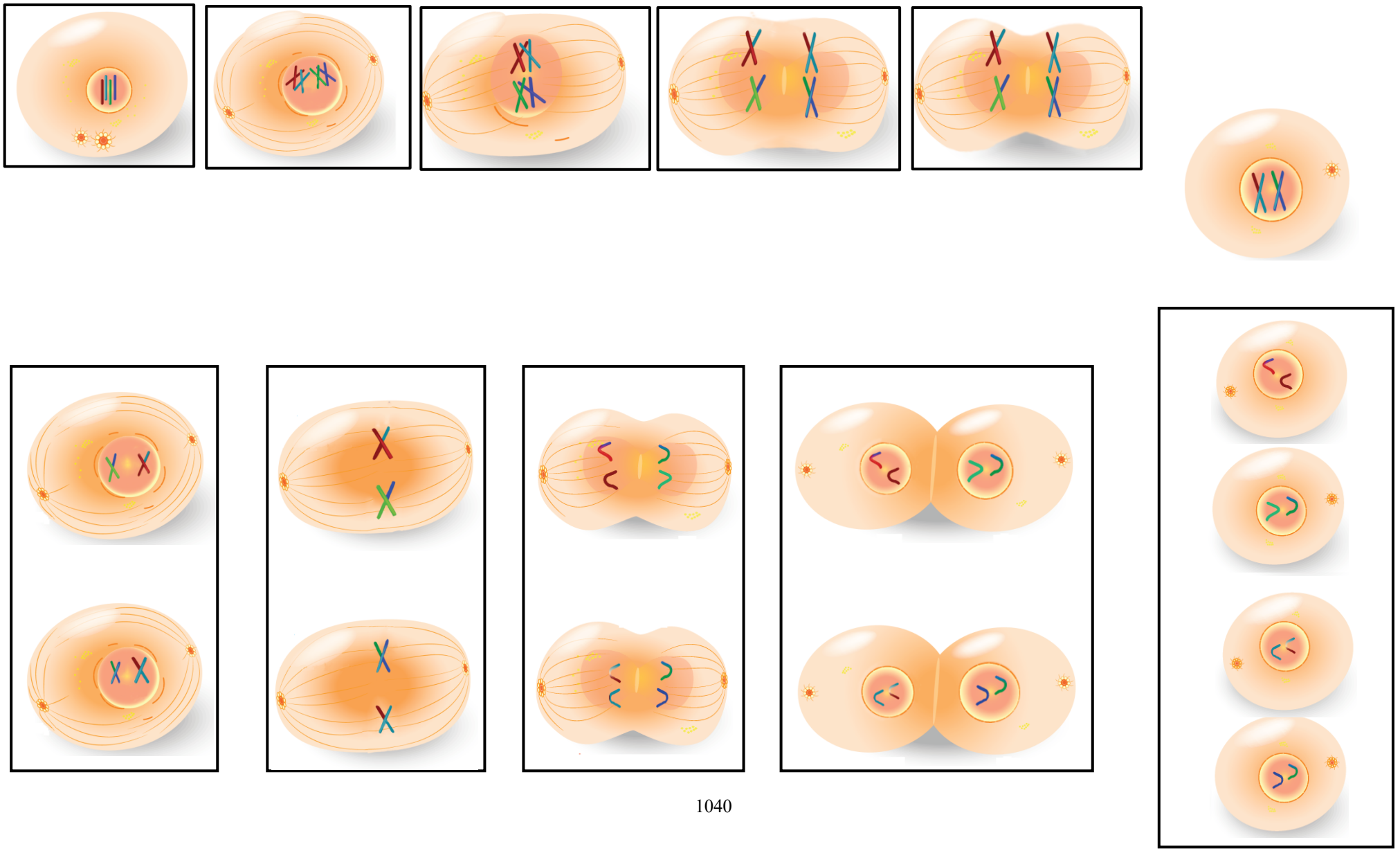
Stop Number: 3

- Equal distribution of chromosomes to the cells is completed.

Stop Number: 4

- Four new cells are formed with the completion of the cleavage furrow.

Appendix 5.



Appendix 6.

Stop Number: 27

- It is seen in body cells.

Stop Number: 28

- It provides the formation of reproductive cells.

Stop Number: 24

- Chromosome number is halved.

MITOSIS

Stop Number: 17

- The genetic structure of the cells formed as a result of division is different from the mother cell.

Stop Number: 15

- It provides reproduction in single-celled organisms, and growth, development and repair of wounds in multi-celled organisms.

Stop Number: 9

- Chromosome number does not change.

MEIOSIS

Stop Number: 8

- Four cells are formed as a result of division.

Stop Number: 6

- It is seen only in reproductive mother cells.

Stop Number: 1

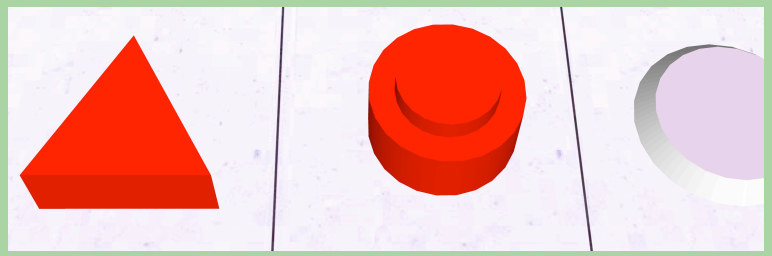
- The structure of the cells formed as a result of division is the same as the mother cell.

Stop Number: 10

- As a result of division, two cells are formed.

Appendix 7.

INSTRUCTIONS



START | END | STOP

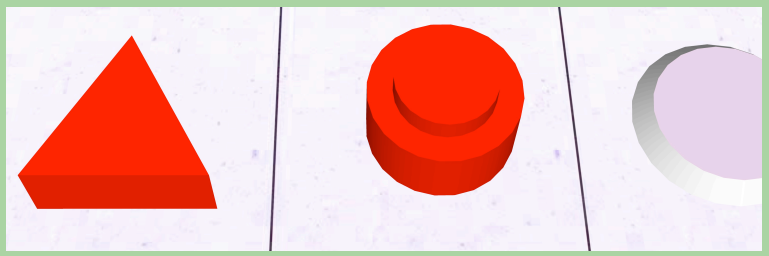
Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

26	23	20	11	5	2

Appendix 8.

INSTRUCTIONS



START | END | STOP

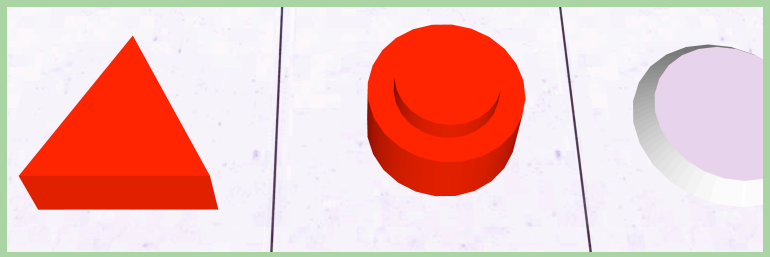
Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

25	21	22	19	16	14
13	12	7	3	4	

Appendix 9.

INSTRUCTIONS



START | END | STOP

Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

27	28	24	18	17	15
9	8	6	1		