



SELF-ASSESSMENT OF PRESERVICE TEACHERS ABOUT DESIGNING MATERIALS FOR PHYSICS AND CHEMISTRY COURSES

Sevgül ÇALIŞ¹, N. Remziye ERGÜL²

Article Info	Abstract
DOI: 10.19171/uefad.657739	<p>The use of instructional materials in physics and chemistry courses makes the content more understandable. These subjects, which students often find difficult, require a blend of both cognitive and psychomotor skills. The current study aims to reveal the difficulties that candidate teachers experience in preparing and using instructional materials for physics and chemistry courses at high school. To this aim, candidate physics and chemistry teachers receiving pedagogical training at Bursa Uludağ University Faculty of Education were asked to prepare and present sample instructional materials over a 10-week period. At the end of this period, they were asked to make self-evaluations for finding relevant materials, preparing materials, and using them effectively. Self-evaluation forms consisted of nine open-ended questions. The participants were asked to evaluate their proficiency in designing original materials, designing and conducting experiments, determining topics for projects, preparing posters, power-point presentations and worksheets. The participants' responses were analyzed by determining the code, category and themes by using the content analysis. Findings reveal that the candidate teachers generally had more difficulty in designing and preparing activities/ experiments.</p>
<i>Article History:</i>	
Received 10.12.2019	
Accepted 26.05.2020	
<i>Keywords:</i>	
Physics teaching, chemistry teaching, teacher candidate, material design, self-assessment.	

ÖĞRETMEN ADAYLARININ FİZİK/KİMYA DERSLERİNİN ÖĞRETİMİNDE MATERYAL TASARLAMAYA YÖNELİK ÖZ DEĞERLENDİRMELERİ

Makale Bilgisi	Özet
DOI: 10.19171/uefad.657739	<p>Fizik ve kimya derslerinde anlatılan konu içeriklerine yönelik olarak materyal kullanımı, dersleri daha anlaşılır hale getirmektedir. Bu dersler hem bilişsel hem de psikomotor becerilerin harmanlandığı bir yapıdadır. Bu nedenle araştırmada, 2017-2018 eğitim-öğretim yılında Bursa Uludağ Üniversitesi Eğitim Fakültesinde formasyon eğitimi alan fizik ve kimya öğretmen adayları ile çalışılarak, fizik/kimya derslerinde lise müfredatında yer alan ve genellikle öğrencilerin anlamakta güçlük çektiği bazı konuların gerektirdiği ilgili materyalleri bulma, materyal hazırlama ve etkili kullanmaya yönelik olarak öz değerlendirme yapmaları istenmiştir. Bu amaçla on hafta süren bir uygulama ile öğrencilerden anlatacakları konular ile ilişkili olacak materyal örnekleri hazırlamaları ve sunmaları istenmiştir. On haftalık uygulamaların sonunda, ilgili materyalleri bulmak, materyal hazırlamak ve bunları etkin bir şekilde kullanmak ile ilgili öz değerlendirmeler yapmaları da istenmiştir. Çalışmada veri toplama aracı olarak, araştırmacılar tarafından hazırlanan materyal hazırlama ve sunma sürecine yönelik 9 adet açık uçlu soru içeren, öz değerlendirme formları verilmiş ve öğretmen adaylarının bu formları doldurmaları sağlanmıştır. Formlarda öğretmen adaylarının poster, power-point sunusu, çalışma yaprağı hazırlama orijinal materyal tasarlama, deney tasarlayıp yapma, proje konusu belirleme gibi konulardaki yeterliliklerini değerlendirmeleri istenmiştir. Öğretmen adaylarının verdiği cevaplardan, nitel araştırma yöntemlerinden içerik analizi metodu kullanılarak kod, kategori ve temalar belirlenerek analiz edilmiştir. Araştırmada elde edilen bulgular, öğretmen adaylarının genellikle etkinlik / deney tasarlama ve hazırlama konusunda daha fazla zorluk yaşadıklarını ortaya koymaktadır.</p>
<i>Makale Geçmişi:</i>	
Başvuru 10.12.2019	
Kabul 26.05.2020	
<i>Anahtar Kelimeler:</i>	
Fizik öğretimi, kimya öğretimi, öğretmen adayı, materyal tasarlama, öz değerlendirme.	

¹ Doç. Dr., Bursa Uludağ Üniversitesi, Eğitim Fakültesi, Matematik ve Fen Bilimleri Eğitimi Bölümü, scalis@uludag.edu.tr, OrcID: 0000-0002-5195-3210

² Doç. Dr., Bursa Uludağ Üniversitesi, Eğitim Fakültesi, Matematik ve Fen Bilimleri Eğitimi Bölümü, ergulr@uludag.edu.tr, OrcID: 0000-0001-9901-6798

1. INTRODUCTION

At all stages of education, the use of teaching materials has an important effect on having students learn more efficiently and permanently by keeping their attention alive and concretizing abstract concepts. Since concepts in physics and chemistry lessons are abstract, the use of materials make course content more understandable. Teaching materials facilitate effective student learning in the learning environment, individualize teaching and provide teaching services across large groups (Koşar, Yüksel, Özkılıç, Avcı, Alyaz & Çiğdem, 2003). Teaching materials do not only help to carry out teaching programs, but they also save students from getting bored in the lesson by making lessons entertaining, shortening the learning duration and increasing the yield of the lesson (Kazu & Yeşilyurt, 2008). Because physics/chemistry lessons require a blend of both cognitive and psychomotor skills, preservice teachers' learning how to prepare and use teaching materials is an important competence. Teaching Technologies and Material Design (TTMD) is one of the main courses of teacher education programs, and it aims to help students acquire knowledge and skills related to the preparation and the use of materials. Preservice teachers learn about different teaching tools to use in teaching, how to prepare materials for a certain purpose by using technology, and how to evaluate existing teaching materials. TTMD develops preservice teachers' skills of using teaching tools to a large extent (Saka & Saka, 2005), affects their creativity skills positively and has them acquire the skill of looking at events from multiple perspectives (Kolburan Geçer, 2010). In this context, preservice teachers are made to design materials related to their fields for certain purposes in the lesson and use the materials which they have prepared within teaching practices in the classroom environment (Higher Education Institution [YÖK], 2007; Yelken, 2009). Moreover, Acer (2011) states that TTMD facilitates preservice teachers to acquire such competences as designing creative products by using materials, looking at objects from a different perspective, and realising that materials can also be designed without being dependent on materials. The main approach in choosing and preparing teaching materials is to make materials appropriate for objectives or learning outcomes in teaching programs (Demirel, Seferoğlu & Yağcı, 2004). Moreover, while choosing teaching materials, it is necessary to pay attention to the fact that they should be suitable for the teaching-learning competences of teachers and students and chosen technological tools should be available or procurable at the school (İşman, 2011).

Purpose of the Study

The current study aims to reveal the difficulties that preservice teachers have in preparing and using effectively the materials related to physics and chemistry courses in high school, which are often difficult for students to comprehend. They were asked to make self-assessments for finding relevant materials, preparing materials and using them effectively. The study was carried out during four lesson periods per week over ten weeks. Specifically, material on the determined subjects was prepared one week and presented the following.

To this aim, the current study sought answers to the following questions.

1. Do preservice teachers have difficulty in preparing materials as posters, powerpoint presentations, concept maps, worksheets and experiment/activity designs for the subjects they choose?
2. What kind of materials do preservice teachers have difficulty in preparing most?
3. Do preservice teachers find the high school curriculum sufficient in preparing materials?

2. METHOD

2.1. Design of the Study

This is a qualitative study carried out with the aim of having the preservice teachers make self-evaluations in relation the finding of related materials required by some subjects in the high school curriculum and the preparation and the use of them. In the study, the descriptive survey model was used and the data obtained were analysed using content analysis. Descriptive research is usually carried out to clarify a given situation, make evaluations in line with standards and reveal possible relationships between events. The main purpose of this type of research is to get to know and explain a situation in detail (Çepni, 2018).

2.2. Participants

The sample of the study consisted of 63 preservice teachers (27 physics, 36 chemistry) taking formation education at the Education Faculty of Bursa Uludağ University during the 2017-2018 academic year.

In Turkey, students from similar backgrounds choose the physics/chemistry programs of the science faculties of different universities, thus the backgrounds of the participants were accepted as similar. Criterion sampling, a purposeful sampling method, was used to determine

the sample. This method requires participants to be selected from among people with certain qualities (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2008). In the selection of the current sample, being a senior student or a graduate of a physics/chemistry of a science faculty and being enrolled on TTMD were determined as the main criteria.

2.3. Data Collection Instrument

The data were collected with an open-ended self-evaluation form that was prepared by the researchers. It consisted of nine open-ended questions related to the process of material preparation and presentation. Expert opinion was taken on the questions, and the necessary corrections were made and implemented. The data collection tool specifically focused on difficulties in preparing posters and powerpoint presentations, preparing concept maps and worksheets and designing activities/experiments. In order to assess the suitability of the questions, a pilot study was conducted with eight preservice teachers. The results of the pilot study were evaluated together with the two researchers.

The data collection instrument was administered to the preservice teachers enrolled on the TTMD course during the spring semester of the 2017-2018 academic year. The preservice teachers were asked to write the answer to the questions clearly. Hence, it was aimed to make the number of participants yield the sum of the frequencies of the codes.

2.4. Data Analysis Procedures

The data obtained from the study were analyzed using the content analysis method. The purpose of the content analysis is to gather sets of data having similar meanings under codes and themes and present them to the reader (Çepni, 2018). First, the responses given by the preservice teachers to each question in the data collection instrument were coded. Second, the categories were formed by taking similarities and differences of the codes into consideration. Finally, the themes were obtained from the categories. The themes were supported via direct quotations. In order to carry out the reliability study, after having evaluated the sets of data independently from one another, the researchers came together to examine the created codes, categories and themes together and worked on them until they reached an agreement. As a result of the calculation made by applying the formula suggested by Miles and Huberman (1994), the reliability of the study was found as 91%, and the coding system was accepted as reliable. For internal consistency, the coding system was presented to an academician, who was an expert in qualitative research. Necessary corrections were made, and the final version was formed.

3. FINDINGS

In this section the findings related to the preparation of materials belonging to various physics/chemistry subjects are presented in Table 1 and Table 2. The preservice teachers were informed about course materials within the first weeks of the TTMD course and asked to prepare some materials for the subjects which they were to choose from the physics and chemistry lessons as given in the high school curriculum. They were asked to present the materials, which they had prepared over ten weeks, by integrating them with the subject, which they had chosen, in the classroom environment. In this context, the subjects which the preservice teachers determined in order to prepare materials and their opinions in relation to the preparation of materials about these subjects are given in Table 1 for preservice physics teachers, and in Table 2 for preservice chemistry teachers.

Table 1.

Results regarding the difficulties in preparing materials in relation to the pre-determined physics subjects

Selected Topic	Number of participants	Material Type									
		Difficulties in preparing posters		Difficulties in preparing power-point		Difficulties in preparing concept map		Difficulties in preparing worksheets		Difficulties in preparing designing experiment/activity	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Electrostatic	3	--	3	3	-	1	2	1	2	2	1
Magnetism	4	1	3	--	4	--	4	--	4	--	4
Optical	4	--	4	--	4	--	4	--	4	1	3
Impulse-momentum	3	--	3	--	3	--	3	--	3	--	3
Mass and weight	2	--	2	--	2	2	-	--	2	2	--
Computer support-Equipment	5	--	5	--	5	--	5	4	1	4	1
Electronics(Robotics)	6	--	6	--	6	3	3	5	1	5	1

Tablo 2.

Results regarding the difficulties in preparing materials in relation to the pre-determined chemistry subjects

Selected Topic	Number of participants	Material Type									
		Difficulties in preparing posters		Difficulties in preparing power-point		Difficulties in preparing concept map		Difficulties in preparing worksheets		Difficulties in preparing desining experiment/activity	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Acids-Bases	6	--	6	1	5	--	6	1	5	1	5
Chemistry everywhere	6	--	6	--	6	--	6	--	6	1	5
Mixtures	3	--	3	--	3	--	3	--	3	1	2
Chemistry in our lives	3	--	3	--	3	1	2	--	3	3	--
Solubility/Solutions	5	--	5	--	5	1	4	--	5	3	2
Electrochemistry	5	1	4	1	4	--	5	--	5	1	4
Clean energy sources	8	1	7	2	6	2	6	3	5	5	3

Results in Table 1 and Table 2 show that, apart from the experiment/activity designs belonging to different physics/technology and chemistry units, the number of preservice teachers who stated they had had difficulty in preparing such teaching materials as posters, power point presentations, concept maps, worksheets, is rather low. When all the preservice teachers were taken into consideration, the frequencies of difficulty in preparing teaching materials were found as follows: poster (5%), powerpoint presentation (11%), concept map (16%), worksheet (22%) and designing experiments (46%).

In the content analysis made to see if the preservice teachers had difficulty in preparing posters, firstly, codes were prepared according to the preservice teachers' answers, then six codes and two categories were formed. Finally, they were gathered under the theme of preparing posters.

Table 3.

Results belonging to the analysis of the question related to the preservice physics and chemistry teachers' having difficulty in preparing posters

Codes	f	%	Category	Theme
Using a readymade template	47	75	Enough to prepare	Poster preparation
Pre -knowledge	20	32	poster	
Follow the rules of poster preparation	3	5		
Difficulty in preparing effective posters	2	3	Inadequate in	preparing poster
Not knowing photoshop	1	2		
Difficulty in creating remarkable posters	1	2		

Results in Table 3 show that a great majority of the preservice physics and chemistry teachers stated having used readymade templates in preparing posters, or that they knew how to prepare posters before. However, 5% of them stated that they had prepared the poster without difficulty by following what they had learned about preparing posters during the TTMD course. Moreover, the preservice teachers, who found preparing posters difficult, mentioned the challenge of preparing effective, attractive posters, and stated having difficulties because they did not know certain computer software and design applications, such as Photoshop.

Some of the preservice teachers' opinions about preparing posters are as follows:

S6: 'Since I wanted to prepare a different and attractive poster, I made changes on it continuously and I worked a lot.'

S23: 'Since I had prepared posters in the undergraduate years, I did not have any difficulty.'

S29: 'Since I had wanted the poster to be attractive, I had difficulty.'

S34: 'Since I prepared it by paying attention to the rules of preparing a poster, which our instructor had taught us in lessons, I did not have any difficulty.'

In the content analysis conducted to see if the preservice physics and chemistry teachers had difficulty in preparing powerpoint presentations, first, codes were prepared according to the preservice physics and chemistry teachers' responses. Second, eight codes and two categories were formed. Finally, they were gathered under the theme of preparing powerpoint

presentations. The frequency values belonging to the codes given in the tables do not represent the number of participants, but the number of codes.

Table 4.

Results of the analysis of the question related to the preservice physics and chemistry teachers' difficulty in preparing power point presentations

Codes	f	%	Category	Theme
Pre -knowledge	55	87	Enough to prepare power-point	Powerpoint preparation
Difficulty adjusting to slide transition	2	3	Inadequate in preparing power-poi	
Difficulty in simplifying the presentation	1	2		
Difficulty in visual aesthetics of presentation	2	3		
Difficulty in finding suitable images	1	2		
Difficulty in presentation attractiveness	2	3		
Problem adjusting font size	1	2		
Inability to prepare a power point	2	3		

As it is seen in Table 4, 87% of the preservice physics and chemistry teachers stated that they had already known how to prepare powerpoint presentations. However, the preservice teachers who reported having difficulty in preparing powerpoint presentations generally mentioned different reasons, stating that they had not prepared powerpoint presentations before. Some of the preservice teachers' opinions about preparing posters are as follows:

S1: 'I had difficulty related to the simplicity of the content.'

S2: 'I had difficulty because I was sensitive about the layout and I wanted it to be visually more aesthetic.'

S3: 'I mulled it over so as to make the subject in order and support the previous one.'

S7: 'Since I had made tens of presentations until that day, I prepared it easily.'

In the content analysis made to see if the preservice teachers had difficulty in preparing concept maps, first codes were formed according to the concepts obtained from the preservice physics and chemistry teachers' answers; and, finally, they were gathered under the theme of preparing a concept map.

Table 5.

Results belonging to the analysis of the question about the preservice physics and chemistry teachers' opinions about difficulty in preparing concept maps

Codes	f	%	Category	Theme
To have sufficient information	53	84	Enough to prepare concept map	Concept map preparation
Lack of information	8	13	Inadequate in preparing	
Too many concepts	2	3	concept map	
Difficulty in building relationships between concepts	2	3		

As it is seen in Table 5, 84% of the preservice physics and chemistry teachers stated that they did not have difficulty in preparing concept maps. However, the preservice teachers who reported having had difficulty in preparing concept maps stated that they had insufficient knowledge, generally because they had not prepared concept maps before. Moreover, they had difficulty in associating these concepts with one another because there were too many concepts in their subjects.

Some of the preservice teachers' opinions about preparing concept maps:

S20: 'I could not prepare a very detailed concept map.'

S21: 'Since there were a lot of concepts, I could not know where to start.'

S22: 'I learned that the same concept cannot be written on a concept map.'

In the content analysis made to see if the preservice teachers had difficulty in preparing worksheets, first, codes were prepared according to the concepts obtained from the preservice physics and chemistry teachers' answers; then six codes and two categories were formed; finally, they were gathered under the category of preparing worksheets.

Table 6.

Results belonging to the analysis of the question related to the preservice physics and chemistry teachers' having difficulty in preparing worksheets

Codes	f	%	Category	Theme
To have sufficient information	15	24	Enough to prepare worksheets	Worksheets preparation
To be ready on the internet	34	54		
Preparing worksheets for the first time.	8	13	Inadequate in preparing worksheets	
Difficulty being remarkable.	2	3		
Difficulty preparing questions	3	5		
Difficulty in preparing puzzles	5	8		

As it is seen in Table 6, 78% of the preservice physics and chemistry teachers stated having prepared the worksheet easily by using the Internet, or due to having sufficient knowledge. However, the preservice teachers having had difficulty in preparing the worksheet generally stated that they had not prepared worksheets before, which is why they had difficulties in preparing questions, creating puzzles and making the worksheet attractive.

Some of the preservice teachers' opinions about preparing worksheets are as follows:

S24: 'I worked a lot to make it appeal to students.'

S3: 'I had difficulty in preparing the evaluation questions in the worksheet.'

S63: 'I had difficulty in preparing questions related to the subject.'

S61: 'I worked a lot to prepare a worksheet with visuality.'

S30: 'I had a lot of difficulty because I prepared a worksheet for the first time.'

In the content analysis made to see if the preservice teachers had difficulty in designing activities/experiments, first, codes were formed in accordance with the concepts obtained from the preservice physics and chemistry teachers' answers; second, nine codes and two categories were formed; finally, they were gathered under the theme of designing experiments.

Table 7.

Results of the analysis of the question related to the preservice physics and chemistry teachers' having difficulty in designing activities/experiments

Codes	f	%	Category	Theme
Finding from the internet	34	54	Designing experiments enough	Designing experiments
Using an experiment	5	8		
Difficulty to find interesting experiments	8	13	Designing experiments insufficient	
Difficulty finding the appropriate experiment for the subject and level	5	8		
Difficulty to find interesting experiment	2	3		
Finding experiments to help you learn	2	3		
Difficulty in reaching the result in the experiment	5	8		
Material and insufficient facilities	7	11		
Inability to find on the internet	2	3		

As it is seen in Table 7, 62% of the preservice physics and chemistry teachers stated that they did not have difficulty because of benefiting from the Internet or using a known experiment/activity carried out before. However, the preservice teachers who reported having had difficulty in designing experiment/activity generally mentioned different difficulties regarding finding experiments/activities.

Some of the preservice teachers' opinions about preparing activity/experiment design are as follows:

S1: 'Since I had problems in obtaining some materials, I had difficulty. Moreover, we did not have sufficient possibilities.'

S2: 'I spent a lot of effort to obtain results which I desired in the experiments.'

S31: 'I had difficulty in finding an experiment with which I could teach my subject better.'

S34: 'I could find an experiment related to my subject on the Internet.'

S37: 'I watched many experiments on websites, but I could not find an experiment which was to catch students' interest.'

S38: 'I used a experiment carried out before.'

From the findings belonging to the third question of the study, it was concluded that while 37% of the preservice teachers found the program content insufficient in preparing and using materials, 63% found it sufficient.

Some of the preservice teachers' opinions about this subject are as follows:

S23: "There is insufficient material in the book of MNE".

S8: "In order to clarify the subjects mentioned in the curriculum, I benefited from other resources".

S22: "Since the subjects are taught via the direct method in the book of MNE and the examples fall short of explaining the subjects, I needed some other materials".

4. DISCUSSION AND SUGGESTION

According to the findings obtained in the study, it is understood that the preservice teachers did not have difficulty in preparing powerpoint presentations and posters. Although the preservice teachers had frequently prepared powerpoint presentations and posters in previous years and showed this as a reason why they did not have difficulty in preparing them, when the materials which they prepared and presented were examined, some important insufficiencies such as the harmony of the transitions between the powerpoint slides, the slide content not emphasizing the important points of the subject, not including the skill of presenting the subject as a harmonic whole, the slide content not allowing for student interaction and their not including updated and life-based knowledge were determined and, what's more, it was observed that such subjects as their not being suitable for the levels of students and the purpose were not paid sufficient attention.

From these findings, it was understood that the preservice teachers evaluated the power point presentations and the posters only with their formal dimensions and, in this sense, they saw themselves sufficient. It is observed that the obtained findings overlap the ones obtained by Usta (2015) in relation to the visual design, which is necessary for taking into consideration in the preparation of materials. Additionally, the preservice teachers, who stated having difficulty in preparing powerpoint presentations and posters, expressed that they generally used the readymade templates from the Internet and thought that it was enough to follow the rules of preparing posters. These results also overlap the findings of Özer and Tunca (2014).

In the interviews held with the participants, these insufficiencies were discussed, and many preservice teachers clearly stated having noticed the insufficiencies in the powerpoint presentations and the posters which they had prepared.

That the use of concept maps as an effective learning technique develops students' thinking, analyzing, problem solving and creating abilities was stated by many researchers (Novak & Gowin, 1984). For this purpose, it is considered that it is important that preservice teachers should have the skill of preparing quality concept maps as materials. Although many preservice teachers saw themselves sufficient at preparing concept maps in the study, it was observed when their works were examined that they either included too many concepts or they prepared the concept maps in complex structure or in a way they had insufficient contents. Some students considering to have had difficulty, expressed that they had fallen short of establishing the relationships between the concepts and simplifying them sufficiently. These results are similar with the findings of Aksüt and Bahar (2017).

Moreover, about the worksheets, another material which the preservice teachers were asked to prepare, the preservice teachers generally stated not having had any difficulty. However, when their works were examined, it was observed that they could not exhibit a performance in which they exhibited their originality and creativity. They preferred to depend on the examples available on the Internet and various resources. Moreover, the preservice teachers, who stated having had difficulty, explained this situation generally by attributing to technological insufficiencies. In the study, although the preservice teachers expressed that the use of worksheets in physics and chemistry lessons would provide many benefits and be effective on the determination of students' learning levels, it was seen that the preservice teachers preferred the worksheets mostly in the end of the lesson with the aim of evaluation. This finding overlaps those of Bozdoğan (2007) in relation to the use of worksheets.

The findings obtained in the study reveal that the preservice teachers generally had more difficulty in designing and preparing activities/experiments. When the reasons which they stated are examined, it is seen that they prefer to perform existing, known activities and experiments instead of using their own creativity and knowledge. In fact, the preservice teachers, who stated not having difficulty, expressed that they completely used the activity/experiment examples which they took readily from the Internet and other resources. The main problem seen about this matter was the preservice teachers' knowledge insufficiencies about designing experiments. This result has also been reported in many studies (Aydoğdu, Tatar, Yıldız & Buldur, 2012; Pekbay & Kaptan, 2014; Çelik & Özbek, 2013). For, a laboratory

activity includes much more than performing a pre-determined ctivity. The act of performing an experiment has a structure covering and integrating all the steps of the scientific method; that is to say, the act of performing an experiment is a whole. Comprehending the hierarchical structure of the scientific method becomes possible through having students acquire these skills. Hence, it is clear that our students' knowledge and skills of designing and performing experiments (Ergül, 2016).

In conclusion, it can be stated that the preservice teachers did not attach sufficient importance and allocate the required time to the preparation and the use of materials and, in this context, try to exhibit such important characteristics as being original, creative and inquisitive. This situation can also be evaluated as a conclusion of existing practices in our education system. Based on these results, it can be suggested in the direction of the findings obtained, that the infrastructure of the education faculties is increased to the level where the preservice teachers can gain a lot of experience, creating platforms where teacher candidates can share their material development experiences, and emphasizing the importance of using imagination and knowledge together in preparing materials.

REFERENCES

- Acer, D. (2011). Okulöncesi öğretmen adaylarının materyal geliştirme dersine ilişkin görüşlerinin incelenmesi. *İlköğretim Online*, 10(2), 421-429.
- Aksüt, P., & Bahar, M. (2017). Fen Bilgisi Öğretmen Adaylarının Zihinsel Yapısına İlişkin Tanılayıcı Bir Çalışma. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 17 (2), 526-549.
- Aydoğdu, B., Tatar, N., Yıldız, E., & Buldur, S. (2012). İlköğretim Öğrencilerine Yönelik Bilimsel Süreç Becerileri Ölçeğinin Geliştirilmesi. *Kuramsal Eğitimbilim Dergisi*, 5(3), 292-311.
- Bozdoğan, A. (2007). *Fen bilgisi öğretiminde çalışma yapıları ile öğretimin öğrencilerin fen bilgisi tutumuna ve mantıksal düşünme becerilerine etkisi*. Yayımlanmamış yüksek lisans tezi, Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü, Adana.
- Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. A., Karadeniz, Ş., & Demirel, Ş. (2008). *Bilimsel Araştırma Yöntemleri*. Ankara: Pegem Yayıncılık.

- Çelik, H., & Özbek, G. (2013). 7E Öğretim modelinin hipotez kurma ve değişken belirleme becerileri üzerine etkisi. *Gazi Üniversitesi Endüstriyel Sanatlar Eğitim Fakültesi Dergisi*, Sayı: 31, 13-23.
- Çepni, S. (2018). *Araştırma ve Proje Çalışmalarına Giriş*, Trabzon: Celepler Matbaacılık.
- Demirel, Ö., Seferoğlu, S., & Yağcı, E. (2004). *Öğretim teknolojileri ve materyal geliştirme*. Ankara: Pegema yayıncılık.
- Ergül, R. (2016). Overview of the Experimentation Procedures and Reflections on Science Education, *Developments in Educational Sciences* (pp.652-663). Sofia: St. Kliment Ohridski University Press.
- İşman, A. (2011). *Öğretim teknolojileri ve materyal tasarımı*. Ankara: Pegema yayıncılık
- Kazu, H., & Yeşilyurt, E. (2008). Öğretmenlerin öğretim araç-gereçlerini kullanım amaçları. *Fırat Üniversitesi Sosyal Bilimler Dergisi*, 18 (2), 175-188.
- Kolburan Geçer, A. (2010). Teknik öğretmen adaylarının öğretim teknolojisi ve materyal geliştirme dersine yönelik deneyimleri. *Yüzüncü Yıl Üniversitesi, Eğitim Fakültesi Dergisi*, 7(2), 1-25.
- Koşar, E., Yüksel, S., Özkılıç, R., Avcı, U., Alyaz, Y., & Çiğdem, H. (2003). *Öğretim teknolojileri ve materyal geliştirme*. Ankara, Pegema yayıncılık
- Miles, M. B., & Huberman, A. M. (1994). *qualitative data analysis: an expanded sourcebook*. (2nd ed). Thousand Oaks, CA: Sage.
- Novak, J., & Gowin, D.B.(1984). *Learning how to learn*. Cambridge: Cambridge University Press.
- Özer, Ö., & Tunca, N. (2014). Öğretmen adaylarının materyal hazırlama ve kullanmaya yönelik görüşleri. *Route Educational and Social Science Journal*, 1(3), 214-229.
- Pekbay, C., & Kaptan, F. (2014). Fen Eğitiminde laboratuvar yönteminin etkililiği ile ilgili fen bilgisi öğretmen adaylarının farkındalıklarının artırılması: Nitel bir çalışma. *Karaelmas journal and educational science*, 2, 1-11.
- Saka, A. Z., & Saka, A. (2005). Öğretmen adaylarının öğretim teknolojileri ve materyal geliştirme dersinde mesleki becerilerini geliştirme düzeyi: Sakarya örneği. *Sakarya Üniversitesi Eğitim Fakültesi Dergisi*, 10, 81-177.

- Usta, E. (2015). Öğretmen adaylarının öğretim materyali geliştirme süreçlerinin görsel ve mesaj tasarımı ilkeleri açısından incelenmesi. *Gazi Eğitim Bilimleri Dergisi*,1((1), 1-14.
- Yelken Yanpar, T. (2009). Öğretmen adaylarının portfolyoları üzerinde grup olarak yaratıcılık temelli materyal geliştirmenin etkileri. *Eğitim ve Bilim*, 34(153), 83-98
- YÖK (Yüksek Öğretim Kurumu). (2007). *Eğitim fakültesi öğretmen yetiştirme lisans programları*. 26.11.2014 tarihinde www.yok.gov.tr adresinden alınmıştır. Web-erişim: [https://www.yok.gov.tr/documents/10279/1\(1\), 1-14](https://www.yok.gov.tr/documents/10279/1(1), 1-14).

GENİŞLETİLMİŞ ÖZET

Eğitimin bütün basamaklarında öğretim materyallerinin kullanılması, öğrencilerin dikkatlerini canlı tutarak, soyut kavramları somutlaştırıp öğrencilerin daha kolay ve kalıcı öğrenmelerini sağlamada önemli bir etkiye sahiptir. Özellikle fizik /kimya derslerinde kavramların soyut olması sebebiyle materyal kullanımı dersleri daha anlaşılır hale getirmektedir. Fizik/kimya derslerinin hem bilişsel hem de psikomotor becerilerin harmanlandığı bir yapıda olması sebebiyle öğretmen adayları tarafından öğretim materyallerinin nasıl hazırlanacağını ve kullanılacağını öğrenilmesi önemli bir yeterlidir. Öğretim Teknolojileri ve Materyal Tasarımı (ÖTMT) dersi, materyal hazırlama ve kullanmaya ilişkin bilgi ve becerilerin kazandırılmasını amaçladığı için, öğretmen eğitimi programlarının temel derslerinden birisidir. Bu derste öğretmen adayları, öğretimde kullanabilecekleri farklı öğretim araçlarını tanımanın yanı sıra teknolojiyi kullanarak bir amaca yönelik olarak nasıl materyal hazırlayabileceklerini ve var olan öğretim materyallerini nasıl değerlendirebileceklerini öğrenmektedirler.

Bu çalışmada, formasyon eğitimi alan fizik/kimya öğretmen adaylarının, fizik ve kimya derslerinde lise müfredatında yer alan ve genellikle öğrencilerin anlamakta güçlük çektiği bazı konuların gerektirdiği ilgili materyalleri bulma, materyalleri hazırlama ve bu materyalleri etkili şekilde kullanmasına yönelik olarak öz değerlendirme yapımları istenmiştir. Çalışmalar on hafta boyunca haftada 4 ders saati olarak gerçekleştirilmiştir. Bu amaç doğrultusunda aşağıdaki sorulara cevaplar aranmıştır.

1. Öğretmen adayları seçtikleri konularda poster, powerpoint sunumları, kavram haritaları, çalışma yaprakları ve deney/aktivite tasarımları gibi materyalleri hazırlamada güçlük çekiyor mu?

2. Öğretmen adayları en çok hangi materyalleri hazırlamada güçlük çekmektedir?
3. Öğretmen adayları materyal hazırlamada lise müfredatını yeterli buluyor mu?

Araştırmada betimsel tarama modeli kullanılmış ve elde edilen veriler içerik analizi yöntemiyle incelenmiştir. Betimsel araştırmalar, genelde verilen bir durumu aydınlatmak, standartlar doğrultusunda değerlendirmeler yapmak ve olaylar arasında olası ilişkileri ortaya çıkarmak için yürütülür. Bu tür araştırmalarda asıl amaç, incelenen bir durumu etraflıca tanımak ve açıklamaktır (Çepni, 2018).

Araştırmanın katılımcılarını 2017-2018 eğitim-öğretim yılında Bursa Uludağ Üniversitesi Eğitim Fakültesinde formasyon eğitimi alan ve ölçütleri sağlayan 27 fizik ve 36 kimya olmak üzere toplam 63 öğretmen adayı oluşturmaktadır. Araştırmanın verileri, yapılandırıcı görüşme tekniklerinden açık uçlu anket yardımıyla toplanmıştır. Veri toplama aracı olarak araştırmacılar tarafından hazırlanan materyal hazırlama ve sunma sürecine yönelik olarak 9 adet açık uçlu soru içeren, öz değerlendirme formları kullanılmıştır. Veri toplama aracı, öğretmen adaylarının poster, power point, kavram haritaları, çalışma yaprakları hazırlama ve etkinlik/deney tasarlamadaki zorlukları ile ilgili açık uçlu soruları içermektedir. Hazırlanan sorular alanında çalışmaları olan iki uzmanın görüşüne sunulmuş, gerekli düzeltmeler yapılarak uygulamaya konulmuştur.

Araştırmadan elde edilen veriler, içerik analizi yöntemi ile analiz edilmiştir. İçerik analizinde amaç, anlamsal olarak birbirine benzeyen verileri kod ve temalar altında toplayarak bunları okuyucuya sunmaktır (Çepni, 2014). Araştırmada yöneltilen her soruya ilişkin öğretmen adaylarının verdiği cevaplar kendi içinde kodlanmıştır. Kodların benzerlik ve farklılıkları dikkate alınarak kategoriler oluşturulmuş ve kategorilerden de temalara geçilmiştir. Temalar doğrudan alıntılarla desteklenmiştir. Araştırmanın güvenilirlik çalışmasını yapabilmek için veriler araştırmacılar tarafından birbirinden bağımsız olarak değerlendirildikten sonra araştırmacılar bir araya gelerek oluşturulan kod, kategori ve temaları birlikte inceleyerek görüş birliği sağlanıncaya kadar üzerinde çalışmış ve sonuçlandırmıştır.

Miles ve Huberman'ın (1994) önerdiği güvenilirlik formülü uygulanarak yapılan hesaplama sonucunda araştırmanın güvenilirliği %91 olarak bulunmuş ve araştırma güvenilir kabul edilmiştir. İç geçerliliğin sağlanması için hazırlanan araştırma nitel araştırma konusunda uzman bir akademisyene sunulmuştur. Uzmandan gelen görüş ve öneriler doğrultusunda gerekli düzeltmeler yapılarak son şekli verilmiştir.

Çalışmada elde edilen bulgulara göre, fizik/kimya öğretmen adaylarının power point ve poster hazırlamada güçlük çekmediği anlaşılmaktadır. Öğretmen adayları daha önceki yıllarda sıklıkla power point ve poster hazırladıklarını bu nedenle zorlanmadıklarını ifade etmişlerdir. Ancak hazırladıkları ve sınıf ortamında sundukları materyaller incelendiğinde; genellikle power point slaytları arasındaki geçişlerin uyumlu olmadığı, slayt içeriğinin öğrenci etkileşimine imkân vermemesi, güncel ve yaşam temelli bilgileri içermemesi gibi önemli eksiklikler saptanmış ve ayrıca öğrenci düzeyine ve amaca uygunluk gibi konulara yeterince dikkat etmedikleri görülmüştür. Bu bulgulardan, power point ve posterleri sadece şekilsel boyutuyla değerlendirdikleri ve bu anlamda kendilerini yeterli gördükleri anlaşılmıştır. Elde edilen bulguların Usta (2015) 'nın çalışmasında da belirtilen materyal hazırlamada dikkat edilmesi gereken görsel tasarıma ait bulgularla örtüştüğü görülmektedir. Ayrıca power point ve poster hazırlamada zorlanmadığını ifade eden öğrenciler, genellikle internetteki hazır şablonları kullandıklarını ve poster hazırlama kurallarına uymanın yeterli olduğunu ifade etmişlerdir. Öğretmen adaylarıyla yapılan görüşmelerde bu eksiklikler tartışılmış ve pek çok aday hazırladıkları power point ve posterlerdeki eksiklerin farkına vardığını açık bir şekilde belirtmişlerdir.

Etkili bir öğrenme tekniği olan kavram haritası kullanımının öğretmen adayları açısından önemli olduğu düşünülmektedir. Yapılan çalışmada, kavram haritası hazırlamada pek çok aday kendini yeterli görmekte birlikte, çalışmalarını incelendiğinde; ya çok fazla kavramı dahil ettikleri karmaşık yapıda ya da kapsamı yetersiz olacak şekilde hazırlanmış kavram haritaları görülmüştür. Bazı öğretmen adayları, kavramlar arası ilişkileri kurmakta yetersiz kaldıklarını ve yeterince sadeleştiremediklerini ifade etmişlerdir. Bu sonuçlar Aksüt, ve Bahar, (2017)'ın bulgularıyla örtüşmektedir.

Öğretmen adaylarından hazırlamaları istenen bir diğer materyal olan çalışma yaprakları konusunda da adaylar genellikle güçlük çekmediklerini ifade etmişlerdir. Ancak çalışmalar incelendiğinde, özgünlük ve yaratıcılıklarını sergiledikleri bir sonuç ortaya koyamadıkları görülmüştür. İnternet ve çeşitli kaynaklarda mevcut örneklerle bağlı kalmayı tercih etmişlerdir. Güçlük çektiğini ifade eden adaylar da bu durumu genellikle bilgisayar kullanımındaki eksikliklerine bağlayarak açıklamışlardır. Yapılan çalışmada, öğretmen adaylarının çalışma yapraklarını en fazla değerlendirme amacıyla dersin sonunda kullanmayı tercih ettikleri görülmüştür.

Fizik/kimya öğretmen adaylarının özellikle etkinlik/deney tasarlama ve hazırlamada daha fazla güçlük yaşadıklarını görülmektedir. Öğretmen adaylarının kendi yaratıcılıklarını ve

bilgilerini kullanmak yerine, mevcut bilinen etkinlik ve deneyleri yapma yolunu tercih ettikleri anlaşılmaktadır. Güçlük çekmediğini ifade eden öğretmen adaylarının tamamı sınıf içi sunumda internet ve diğer kaynaklardan hazır olarak aldıkları deney/etkinlik örneklerini kullandıklarını ifade etmişlerdir. Temel sorun, adayların deney tasarlama konusundaki bilgi eksiklikleri olarak görülmüştür. Laboratuvar etkinliği önceden belirlenmiş bir aktiviteyi yapmaktan çok daha fazlasını içerir. Deney yapma eylemi, bilimsel yöntemin bütün basamaklarını kapsayan ve birleştiren yapıdadır; yani deney yapma eylemi bir bütündür. Bilimsel yöntemin kavranması, bilimsel süreç olarak tanımlanan hiyerarşik yapıdaki bu becerilerin kazandırılmasıyla gerçekleşir. Dolayısıyla öğrencilerimizin deney tasarlama, yapma bilgi ve becerilerinin yeterli olmadığı açıktır (Ergül, 2016).

Çalışmanın genelinde ulaşılan sonuç olarak; öğretmen adayların materyal hazırlama ve kullanma işine yeterince önem vermeyip gerekli zamanı ayırmadıkları, bu bağlamda önemli olan özgünlük, yaratıcılık, araştırmacılık gibi özelliklerini sergileme gayretini göstermedikleri söylenebilir. Bu durum, eğitim sistemimizdeki mevcut uygulamaların bir sonucu olarak da değerlendirilebilir. Elde edilen bulgular doğrultusunda eğitim fakültelerinde, öğretmen adaylarının hayal gücü ve bilginin birlikte kullanılmasıyla bütünleşen materyal geliştirme deneyimlerini paylaşabilecekleri ortak platformlar oluşturması önerilebilir.