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ARTICLE

THE ATTITUDE AND BELIEFS OF CANDIDATE TEACHERS CONCERNING STRATEGY-METHOD-TECHNIQUE AND ASSESSMENT-EVALUATION IN SCIENCE AND TECHNOLOGY COURSE

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ABSTRACT

The aim of this study is to investigate the attitudes and beliefs of teacher candidates concerning the instructional strategy-method-technique and assessment-evaluation components of Pedagogical Content Knowledge (PCK) regarding Science and Technology course. Teacher candidates studying in the Department of Science, School Teaching, and Gifted Teaching in Faculty of Education in the 2016-2017 academic year at TRNC participated the research. The study is progressed as exception case study as part of qualitative research. In order to collect the data, semi-structured interview technique and open-ended questions are used. Sixty teacher candidates responded to the open-ended questions and 20 of them participate to semi-structured interviews. The data of the research are subject to content analysis. As a result of the study, it is determined that teacher candidates have different beliefs and attitudes towards instructional strategy-method-technique and assessment-evaluation. It is established that the teacher candidates are confused about the instructional strategy-method and technique. It is also found that some of the teacher candidates have short and rote information about the instructional strategy-method-technique and assessment-evaluation; they are unable to give in-depth information and examples and have misconceptions.

KEY WORDS
Pedagogical Content Knowledge, Teacher Candidates, Strategy-method-technique and

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INTRODUCTION

The qualified people are needed for the advancement of societies while scientific information is constantly evolving, technological innovations are always developing, and science and technology are effective in every part of our lives. The training of the qualified people can be also provided by the qualified teachers. A qualified teacher should have the makings of content knowledge, subject content knowledge, vocational and personal qualifications and pedagogical knowledge [1, 2]. A teacher, who has the professional competence, should have the information about how and when to do learning, which strategy-method-techniques to use, and how to evaluate students when implementing training program for a defined group of students [3]. Among the personal qualifications expected to be a qualified teacher, the teaching to use in teaching depending on the beliefs and attitudes of the teacher with strategy-method-technique and measurement-evaluation can be mentioned. Each teacher has their own beliefs and attitudes. The beliefs and attitudes of the teacher affect the sufficiency of the teaching, the current strategy-method-technique and assessment-evaluation techniques, the participation of the student to learn and the students' understanding the teachings hence the efficiency and the permanence of the teaching process substantially [4, 5].

In 1987, Shulman [6] specifies the field, which is thought to be used during the education and the planning the teaching, as field information, understanding the students and pedagogical information. Shulman also mentions that besides teachers' field and vocational information, teachers should have pedagogical content knowledge, which is stated as using the field and pedagogic information together, in order to create active learning environment. Pedagogical content knowledge (PCK) contains the components such as subject field information in the process of transforming teaching into learning, teaching strategy-method-technique information and assessment-evaluation information and understanding students. The term PCK is firstly mentioned by Shulman [7] in 1986. According to Shulman, PCK is the information that distinguishes the biology teacher from biologist and it contains "demonstrations and formatting used to make the subject more understandable during teaching" [7]. Based on the studies of Shulman and Grossman, Magnusson, Krajcik and Borko [8] reveal that PCK is comprised of the some components in Science teaching. The studies about the pedagogical content knowledge are quite a lot in abroad countries. However the topics about the pedagogical content knowledge have recently begun to be discussed in our country.

The reason and importance of the study

It is expected that candidate teachers who graduate from teacher training programs would be equipped with sufficient information such as SFI, PI and PCK because teachers are dependent on the existence of certain standards in order to be qualified [9, 10, 11]. Features such as the professional and personal qualifications of the teachers can be mentioned as the expected characteristics of qualified teachers for an effective science teaching [12]. Even though, there are lots of studies about the teachers' pedagogical content knowledge within the scope of science and technology field in abroad, it is stated that there are quite a little studies in our country. It is seen that the studies intended to the pedagogical content knowledge in our country has increased but it is also seen that these studies are not enough. When these

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reasons are considered, it can be thought that this research would contribute to the future studies in regard to pedagogical content knowledge of teacher candidates in Science and Technology field.

The aim of the study

This study specifies the beliefs and attitudes of the

This study identifies beliefs and attitudes of the teacher candidates about instructional strategy-method-technique and assessment-evaluation information from PCK components depending on their own ideas on Science and Technology field. Within the scope of the purpose of the study, the following sub goals are determined.

The sub goals of the study

In order to achieve the objective of this study research, the following two sub goals are specified:

1.To identify the beliefs and attitudes of the teacher candidates related to instructional strategy-method and techniques in Science and Technology lecture,
2.To identify the beliefs and attitudes of the teacher candidates related to assessment and evaluation using in Science and Technology lecture.

Theoretical framework

Curriculum, instruction schedule and syllabus

The curriculum is the formation of the learning experiences through the activities within a specific plan in and outside school. How to be gained the requested behavioral change in the individual is included in the training program. For this reason, the quality of the education is depended to the used curriculum. There are four main goals in the curriculum. These goals are imported as following:

1."Goal" included the behaviors wanted to be gained,
2. "Content " included in the program to be applied for behaviors required to be learned,
3. "Learning-teaching process" included in the determination of the teaching strategies-methods and techniques applied for the behaviors desired to be learned,
4. "Assessment and evaluation" included in determining the degree of attainment of the behaviors desired to be learned.

The change on any one of these four goals of the program (goal, content, learning-teaching process and assessment-evaluation) affect the whole program.

The instruction schedule also includes the all activities in the specified plans inside and outside of the school for the learner. The syllabus is the all activity plans related to how to gain the target behaviors determined during the course.

Within the scope of the purpose of the research, the information about the instructional strategy-method-technique and assessment-evaluation partaking in the four main goals of the curriculum is given in following.

Strategy, method and techniques in teaching

The question “How should I teach?” includes the process such as strategy, method and techniques. The question “How should I teach?” is based on the instructional strategies, methods and techniques. The instruction strategy is a general approach that directs the determined method, technique and equipment, which provides to reach the goals of the lecture. The instruction strategies are the teaching strategies through the display, invention (exposure) and search-examination. The teaching method is the applied well-ordered way in order to reach the goals of the course. Teaching methods are the expression, problem solving, discussion, case study and exhibition-execution. Teaching technique is also defines as the way of the application of the teaching method. The teaching techniques are demonstration, brainstorming, question-answer, experiment, group works, observation, mind map, other discussion techniques (panel, conference, etc.), case study, role playing, station, group works, individual teaching techniques, psychomotor executions, simulation, reasoning techniques and analogy [13].

Assessment and evaluation in education

Assessment is defined as “observing a certain characteristic and expressing observation results with numbers or symbols” in the widest sense. Evaluation is defined as “work of reaching a value judgment as a result of comparison of measurement results with a criterion” [14]. The types of assessment and evaluation are divided into two as traditional assessment and evaluation techniques and supplementary assessment and evaluation techniques. The traditional assessment and evaluation techniques are written examinations, multiple-choice tests, oral exams, short answer questions, true-wrong questions and

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matching questions. On the other hand, supplementary assessment and evaluation techniques are portfolio project, performance assessment, grading keys, diagnostic tree, structured grid, word binding tests, problem solving, mind map, interview and student evaluations [15].

The beliefs and attitudes in education

Beliefs are generally psychological, including knowledge, thought and religion. In education, there are goals like upskilling and gaining knowledge to the individuals and making changes on the behaviors of the individuals in good manner. However, when the knowledge and skills that are tried to be gained are turned to beliefs, attitudes and behavior then it means that the goal is attained. Beliefs include the thoughts and information of the individuals about a state or fact. Mostly, beliefs become as the fundamental principles of the individuals. Individuals show their information, thoughts and beliefs about a fact or event by their attitudes and behaviors. Therefore there are beliefs that individuals have on the basis of their attitudes. Attitudes are special to the individual. Attitudes provide individuals' emotions, thoughts and behaviors to be coherent. There are lots of factors that affect the forming of the attitudes such as family, society, environmental factors, point of interest and mass communication. Attitudes are formed by three components as cognitive, emotional and behavioral. The cognitive component has good-bad, positive-negative evaluation about the subject. Emotional component contains attitudes like fear, anger, love, hatred. Behavioral component is like preliminary preparation for the object.

The components of pedagogical content knowledge in science education

Science curriculum mainly aims to raise individuals, who are based on the basic principles and methods of science are researchers, inquisitors, who know how to reach science, and who can use science and technology [16, 17]. The growth of these individuals is also provided by the strategy-method-technique and evaluation knowledge that the teachers use during the planning the education and training process. The pedagogical content knowledge in Science education are comprised of five components such as science teaching orientation, knowledge of science program, knowledge of students' understanding of science, knowledge of science teaching, knowledge of teaching strategies Magnusson et al. [8] mentions that the idea that the teacher related to science teaching about orientations towards science affects the decisions to be made in teaching. Science program information is approached as in two parts as "general and specific goals information" and "program information oriented to a specific field". Teacher should be able to achieve the general and specific goals that the field requires and know the science field well. A teacher should be aware of the understanding of science and the preliminary information that students have in order to teach any scientific knowledge, and they should also have awareness about the students' ideas oriented to this information. There are two titles related to the information of the education strategies: "knowledge of specific field strategies" and "knowledge of specific topic strategies". Specific field strategies information is more extensive than the specific topic strategies and it contains all strategies need to know about science field. In order to teach students concept and connections directed to a specific topic, teacher should benefit from different method and techniques such as demonstration, problem solving, simulations, researches and experiments during the exercises. The teacher should be very well aware of how and where assessment methods can be used in assessing science teaching. The teacher evaluates the learning of the students' content through the evaluation methods they have chosen during their education.

Related researches

Pedagogical content knowledge (PCK) is a new research topic in our country. For this reason, limited number of studies is run across. In this part, some of these studies are given:

When the studies related with PCK is examined, it is seen that there are studies that investigate PCK's of the teacher candidates and the components of PCK: topic field information, understanding student knowledge, instructional method-technique and assessment and evaluation information [18, 19, 20, 21, 22, 23, 24, 25]. It is emphasized in the study that the components of the pedagogical field information composed by understanding student information, instructional method-technique and assessment and evaluation information components show difference for each teacher candidate [18] and it is resulted that the theory and application information need development for the curriculum and education methods of Science and Technology lecture [19, 26]. Moreover, SFI is emphasized as the preliminary requirement for PCK [20] and it is determined that teacher candidates see themselves partially adequate in the subject field of knowledge (SFI) [24] and they do not have enough information to teach the subject [22]. It is also said that teacher candidates do not have difficulty to establish the mistakes of the students but they have difficulties with only verbal expressions [25]. While expressing that the field information have positive effect on PCK and education applivaations [21], it is mentioned that the field information of the teacher candidates is insuffient and there is no relationship between their field information and PCK components [23].

It is possible to come across a lot of studies about PCK, which are conducted abroad. In this part, some of these studies are given:

While the studies of PCK are examined, it is seen that studies examined PCK of the teachers and teacher candidates and the components of PCK, which are subject field information, learning difficulties,

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presentation information, the tendency towards science education, science program information, information required for students to understand science topics, assessment and education strategy are studied [27, 28, 29, 30, 31]. In this study, it is mentioned that the experience has an important role in the development of pedagogical content information. It is also found that PCK that teachers have is considerably low [29]. Furthermore, it is also resulted that teacher candidates have a number of difficulties on the connections of different concepts, misconceptions and inadequate information [31]. It is emphasized that the classroom activities are essential in terms of the development of pedagogical content information of teacher candidates [27]. Henze et al. [30] mentions that education methods information is developed in time but assessment information is not changed substantially. So, because of the fact that the teacher education creates a little part of the learning to teach process, it can be said that the development of PCK would be in restricted topics [28].

During analyzing the conducted studies, it is seen that there are a few studies about Science and Technology field in our country in respect to abroad countries. In this sense, the study discusses the attitudes and beliefs on the strategy-method-technique and assessment-evaluation situated in the components of PCK, which are used in science and technology lecture by teacher candidates.

MATERIALS AND METHODS

Research design

In the research, the qualitative research method is used in order to determine the teacher candidates' beliefs and attitudes towards instructional strategy-method-technique and assessment- evaluation, which are PCK components, used in Science and Technology lecture. Qualitative research is defined as the research where information gathering methods are such as observation, interview and document examination and where the process is followed by revealing perceptions and events in a natural and realistic way [32]. The research is continued as special case study within the scope of the qualitative research. With Special Case Study, a group of people, subjects, problems or programs can be closely examined [33].

Study group

60 teacher candidate in for 38 females and 22 male participate to the study for open-ended questions. 5 teacher candidate, 3 females and 2 males, from Science Teaching department; 36 teacher candidates, 26 females and 10 males, from Primary School Teaching department; and 19 teacher candidates, 9 females and 10 males, from Giftedness Teaching department participate to the study.

For the semi-structured interview, 20 teacher candidates, who are 16 females and 4 males, participate to the study. 5 teacher candidate, 3 females and 2 males, from Science Teaching department; 22 teacher candidates, 11 females and 11 males, from Primary School Teaching department; and 3 teacher candidates, 2 females and 1 male, from Giftedness Teaching department participate to the study.

The academic year of the students, who participate to the study, is different from each other. However, these students are the ones that take Science Teaching Lab. Practices I and Science Teaching Lab. Practices II course as common course in the same classroom environment. Moreover, it is observed that the teacher candidates take common "field information" courses (Mathematics, Biology, History, Chemistry, Turkish, Physics, and Science and Technology Lab. Practices) as common course in their period of study. Thereby, it is aimed to reach the information about the relationship between "field information" courses that teacher candidates take and PCK.

Data collection tools

In the study, open-ended questions and semi-structured interviews with more than one data collection tool are used. As proper to the special case study, open-ended questions are asked in the research. Open-ended questions allow the individual to write their own answers [34].

The most important convenience that the semi-structured interviewer presents to the researcher is to provide more systematic and comparable information on the basis of continuing the interview based on the pre-prepared interview protocol [32].

In open-ended and semi-structured interview questions, the teacher candidates are asked for which strategy-method-technique and assessment-evaluation techniques they would use in science and technology teaching and which strategy-method-technique and assessment-evaluation techniques they would use in science and technology teaching when they become teacher.

In semi-structured interviews, except for the two questions in Appendix-1, probing questions are asked in the direction of answers given by teacher candidates to the questions. Generally information and probing questions are mentioned as open-ended [34]. Some of the probing questions that are used in this study are: Do you mean student-centered education? Do you mean the teacher also affects the personality of the student? Do you mean you cannot just tell the subject? Are you saying that there would be chaos

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during the narration when there are more than one person in group work? Do you mean that the experiment would change according to the age group?

Data collection process

In the study, the open-ended questions related to the instructional strategy-method-technique and assessment-evaluation of PCK components are asked when the participants are ready after they done with their classroom exercises. Questions comprise of four itemed open-ended questions and it lasts for 30 minutes. Because of the missing participants, open-ended questions are applied again one week later in the same course after the students are done with their classroom exercises.

Furthermore, semi-structured interview questions comprise of four itemed open-ended questions and it lasts approximately 15-25 minutes. The interviews with teacher candidates are finished in 14 daily processes at the appointed time.

Analysis of data

During the data analysis process, first of all the sound recordings of the answers to the open-ended questions and the semi-structured interview audio recordings are converted to the written text on the computer. So, this allows the researcher to see the obtained data as a whole. The answers of the teacher candidates given for the intstructional strategy-method-technique and assessment-evaluation by semi-structured interview technique is accepted as raw data and they are grouped in these two contexts by the researcher and it is switched to the coding process. Within this period, the answers given to the research questions are grouped under the intstructional strategy-method-technique and assessment-evaluation titles, not as question-based. The reason for the need for such a process is that students have expressed their responses as complicated to the contexts. A table is constituted by the components determined within the research. Data are firstly organized as instructional strategy-method-technique and assessment-evaluation techniques used in science and technology course considering this table. Secondly, the instructional strategy-method-technique and assessment-evaluation techniques used in science and technology course are organized under the categories when they become teacher. Later on, the content analysis of these documents is done. The basic process done in content analysis is to combine similar data within the framework of the certain concepts and themes and to interpret them in a way that the reader can understand [32]. As a result of this, the instructional strategy-method-technique and assessment-evaluation techniques that teacher candidates especially dwell on are turned into tables. During the process of reporting, the obtained data are evaluated as a whole in order to reveal the perception and thoughts about the pedagogical content information of the candidate teachers. The similarities and differences of the results are identified. Interpretation of the findings by establishing a causal relationship between findings is provided by the researcher's comments.

The role of the researcher

The time of the application of the open-ended questions are made with the classroom unattended observation researcher, the consultant in the participating observation process, and the classroom teacher. Also, constant interaction with teacher candidates is made about the tasks that would be done during the research and the planning is done as not to affect the processing of science and technology course. Mutual expectations are expressed explicitly and in this direction the regulations are done. Then a common time is determined with the teacher of the class and candidate teachers and open-ended questions are delivered to the students at the time of the course.
After the researcher delivers the open-ended questions to the students, he takes the permission from the classroom teacher to make 'observations' in the science and technology course for a complete understanding of the expressions and thoughts of the students while they respond the questions. The observation is a view and listening to specific targets in order to gather information about a specific person, place, event, object, condition and conditional information [35]. Later on, the researcher participates to the course. The classroom teacher teaches the lesson as ‘participant observer’. The participant observer behaves like one of them; ideally, it is also unknown that he is an observer [35]. On the other hand, the researcher follows the course as ‘unattended observer’ during the course. The unattended observer observes the group or person objectively from the outside by staying out of the observed group or event [36].

For the semi-structured interview technique, after the content analysis of the open-ended question application are done, in the process of unattended observation, in which 20 teacher candidates are found to spend time and effort on their own rich thoughts in open-ended questions, attract the attention of the advisor and course teacher in the participatory observation process. These teacher candidates are asked to participate in the research to include more in-depth thinking. By appointment with each of the teacher candidates, a common time for the semi-structured interview is determined.

Validity and reliability

The interview forms used oriented to pedagogical content information are examined during the constitution of the open-ended and semi-structured interview questions [20, 31, 37] and the studies conducted on Pedagogical Content Information are benefited from [38, 39]. The questions that could

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reveal the opinions of the teacher candidates on the PCK components are identified. During determining the questions, it is paid attention to be clear and understandable, not to be leading, to prepare alternative questions, and to the logical arrangement of the questions for each component. After preparing the open-ended and semi-structured interview questions, since similar studies in the literature on PCK have been used, it has been determined that the research is sufficient to find the answer to the question. For the coding and categorization process; after the answers of 5 randomly selected students are analyzed by the consultant and the researcher separately and after the codes and possible categories are assigned, they debate together and continue discussions until they both have same idea. In pursuit of the determined codes and categories, the researcher complete the coding and categorization process single-handed thereby solving the problem by consulting the consultant when there is a problem.

RESULTS

Beliefs and attitudes emerge as a result of content analysis of perceptions and thoughts on instructional strategy-method-techniques and assessment-evaluation techniques that the teacher candidates and when they become teachers would use in science and technology lecture. Hence, results are organized as two sub parts that contain perceptions and thoughts about the instructional strategy-method-techniques and assessment-evaluation techniques, which they would use in science and technology course when they become teachers. The sub goals of this study are to determine the beliefs and attitudes of the teacher candidates towards the instructional strategy-method-techniques and assessment-evaluation information of PCK components depending on their specific thoughts.

Innovative strategy-method and techniques: Differently from the information in the literature, teacher candidates mention the instructional strategy-method and techniques that they would usein science and technology lecture when they become teachers. These strategy-method and techniques are stated as “Innovative strategy-method and techniques” and they are titles as course trip, materials and technological instruments, teacher-students communication, curriculum-syllabus, student-centered education, presentations (Individual, Group), portfolio and parents.

Innovative assessment and evaluation: Teacher candidates talk about the assessment and evaluation techniques used in science and technology lecture when they become teacher differently from the information that is found in literature. These techniques are mentioned as ‘Innovative assessment and evaluation techniques’ and seen as a contribution to research. These techniques are individual differences, assessment tests, experiment, activities-exercises, feedback, responsibility and classroom behavior.

In this context, in open-ended questions and semi-structured interview teacher candidates are asked the question ‘Which are the strategy-method-techniques and assessment-evaluation techniques used in science and technology course?’ and ‘Which strategy-method-techniques and assessment-evaluation techniques would you use when you become a teacher?’. Later on, the strategy-method-techniques and assessment-evaluation techniques that are used in science and technology course considered as appropriate by the teacher candidates are collected un [Table 1].

The following open-ended questions and semi-structured interview findings provide general descriptions of teaching strategy-method-technique and assessment-assessment that most of the prospective teachers have concentrated on are given.

The belief and attitudes of teacher candidates on instructional strategy, method, and techniques

In this study, the beliefs and attitudes of teacher candidates towards instructional strategy, method and technology that would use in science and technology course and when they become teacher are collected with the open-ended questions and semi-structured interview with their unique thoughts regardless of the theoretical and conceptual knowledge of the candidate teachers.

The beliefs of candidate teachers on instructional strategy, method and techniques

The beliefs of the candidate teachers on instructional strategy, method and techniques used in science and technology course when they become teacher are collected under three sub-titles under Teaching Strategies, five sub-titles under Teaching Methods, five sub-titles under Teaching Techniques and they are collected under nine sub-titles under Innovative strategy-method-technique title. It is collected under twenty two titles in total.

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Table 1: Beliefs and Attitudes Obtained with Open-Ended Questions and Semi-Structured Interview – Strategy-Method-Technique and Assessment and Evaluation in Education

INSTRUCTIONAL STRATEGY-METHOD-TECHNIQUE	ASSESSMENT AND EVALUATION
1.Teaching Strategies(Approaches) 1.1.Teaching strategy by presentation 1.2. Teaching strategy by exposure 1.3. Teaching strategy by research-analysing 2.Teaching Methods 2.1.Discourse 2.2.Demonstration 2.3.Project 2.4.Problem Solving 2.5.Discussion 3.Teaching Techniques 3.1.Brain Storming 3.2.Experiment 3.3.Observation 3.4.Role Playing 3.5.Question-Answer 4. Innovative Teaching Strategy-Method-Technique 4.1.Course Trips 4.2. Materials and Technological instruments 4.3. Teacher-Student Communication 4.4.Curriculum-Syllabus 4.5.Student-Centered Education 4.6.Teacher-Centered Education 4.7.Presentations 4.7.1.Individual Presentations 4.7.2.Group Presentations 4.8.Portfolio 4.9. Parents	1.Traditional Assessment and Evaluation 1.1. General Information on Traditional Assessment and Evaluation 1.2.Gap-filling and Completion 1.3.Multiple Choice Exams 1.4.Verbal Exams 1.5.Written Exams 2. Supplementary Assessment and Evaluation 2.1. Homeworks 2.2.Performance Project 2.3.Posters 2.4.Project Papers 2.5.General Information on Supplementary Assessment and Evaluation 2.6. Presentations 2.6.1.Individual Presentations 2.6.2.Group Presentations 2.7.Portfolio 3.Innovative Assessment and Evaluation 3.1.Individual Differences 3.2.Assessment Tests 3.3.Experiment 3.4.Feedback 3.5.Activities-Exercises 3.6.Classroom Behaviors 3.7.Responsibilities

Beliefs related to teaching strategies

The beliefs of the candidate teachers related to teaching strategies used in science and technology course when they become teacher are collected under Teaching Strategies as three sub-titles: teaching strategies through Presentation, Exposure (discovery), Research-Analyze. While most of the teacher candidates accentuate on teaching strategies through presentation in open-ended questions, they dwell on teaching strategies through research-analyze in semi-structured interview. The general expressions of the teacher candidates on teaching strategies through presentation and research-analyze are given the following.
When the beliefs of teacher candidates on teaching strategies through presentation by open-ended questions are looked at:

It is an ideal strategy during the teaching facts and generalizations in science. The teacher lectures as the first strategy. Question-answer technique is used. Teaching with presentation is the best way of teaching. In teaching with presentation strategy, there is teaching by showing. It appeals to students' sense of sight and hearing. So, this leaves better impressions on the student.

When the beliefs of teacher candidates on teaching strategies through research-analyze by semi-structured interview are looked at:

First of all, the information about the experiment to be done should be obtained. How to do experiment? How to research? It should be learned. The experiment to be done should be tried at home several times in order not to aggrieve in front of students in the classroom environment, to be able to complete the experiment fully in class. The reports about the experiments should be prepared in order to determine the phases of the experiment, the aim of the experiment, which instruments should be used in it.

Beliefs on teaching methods

The beliefs on teaching methods of the teacher candidates used in science and technology course when they become teachers are collected under Teaching Methods title as five sub-titles: Discourse, Demonstration, Project, Problem Solving, and Discussion Method. Teacher candidates dwell on Demonstration method during the open-ended questions and semi-structured interview. The general statements of the teacher candidates related to Demonstration method are given in the following:

Doing-experiencing teaching activites take place during teaching. Students learn better by doing and experiencing. The interest of the students in the course increases. The students learn by experimenting

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and acquiring more efficient information. The information is outlasted more in mind by the demonstration method.

Moreover, in this method the dominance of teachers is drawn attention:

The exercises of the course should be tought and done by the teacher firstly. Later on, the teachers' exercises should be done with the students. In the very last, the students should do exercises by themselvesand they should ask questions to the teacher by creating their own questions.

Beliefs on teaching techniques

The beliefs on teaching methods of the teacher candidates used in science and technology course when they become teachers are collected under Teaching Methods as five sub-titles:

Brain Storming, Experiment, Observation, Role Playing and Question-Answer. Most of the teacher candidates dwell on experiment technique in open-ended questions and semi-structured interview. The candidate teachers' general statements related to Experiment technique is given in the following.

The best way of learning is to learn by working on the experiment. Students should hypothesize in the experiments. Teacher should ask questions constantly during the experiment in order to make students active in the course. In the experiments, it is necessary that the test materials are taught to the students and that the students should have full knowledge about the materials during the experiments. Experiments appeal to five senses. There is teacher-students communication in the experiments. If the experiments are not done in laboratory environment then it would not be efficient and permanent.

Also, the teacher candidates express their information about the experiment process:

First of all, the experiment materials are introduced in the experiments. Hypothesis should be established to the students constantly. The name of the experiment is asked to the student. The result is not said. The result should be evaluated by the student. Experiment method is definitely an effective and permanent technique.

Beliefs on innovative instructional strategy-method and techniques

The beliefs on instructional strategy-method and techniques of the teacher candidates used in science and technology course when they become teachers are collected under Innovative Instructional strategy-method and techniques title in nine sub-titles: Course Trip, Materials and Technological Instruments, Teacher-Student Communication, Curriculum-Syllabus, Student-Centered Education, Teacher-Centered Education, Presentations (Individual, Group), Portfolio and Parents. While teacher candidates dwell on Presentations (individual, group) in open-ended questions, they dwell on teacher-students communication in semi-structured interview. The general statements of the candidate teachers on presentations (individual, group) and student-teacher communication are given in the following. Presentations are expressed as two types by the teacher candidates. These are individual and group presentations.

While it is looked at the beliefs of the teacher candidates on individual presentations with open-ended questions:

The students reach the information by using presentation method. Student has all information that should be learned by the individual presentations. The lecture would be more productive during the individual presentations. It provides to increase their confidence. It helps students to behave freely and confident in the society. During the preparation process of the experiment, students collect information by themselves. With individual presentations, students connect the lecture with the every aspect of their life. Presentation provides experiences to the student. Student would understand the subject with the presentations. Student comprehends the subject more.

When it is looked at the beliefs of the teacher candidates on group presentations in open-ended questions:

Group presentations provide students to reach the information more quickly. The group presentations make students more active in the lecture. Student learns the subject better because of being active in class and the learning is made more permanent. Student's consciousness of responsibility is developed. The information shareness between the students is provided by the group presentations. The group presentations are helpful in terms of cooperation and solidarity. Group studies can provide better quality and different experiments.

When the beliefs of the teacher candidates on student-teacher communication in the semi-structured interview are looked at:

If the teacher is authoritative then student would not want to come to class. Student would not understand the lecture. Prejudice occurs. For this reason, student should not have fear. Student should be comfortable

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and should tell his/her opinions even it is wrong. Student should be active. Teacher should treat all students equally. Students who understand the lesson only should not be cared.

Attitudes towards instructional strategy method and techniques

The attitudes of the candidate teachers towards instructional strategy, method and techniques used in science and technology lecture when they become teachers are collected under two titles as Positive Attitudes and Negative Attitudes.

Positive attitudes of teacher candidates towards instructional strategy method and techniques

The positive attitudes of the candidate teachers towards instructional strategy, method and techniques used in science and technology lecture when they become teachers are collected under Teaching Strategies in three sub-titles: Presentation, Exposure (discovery), and Research-Analyze. It is also collected under Teaching Methods in five sub-titles: Discourse, Demonstration, Project, Problem Solving, and Discussion Method. Also, it is collected under teaching techniques in five sub-titles: Brain Storming, Experiment, Observation, Role Playing and Question-Answer. Moreover, it is collected under Innovative instructional strategy-method and techniques title in nine sub-titles: Course Trip, Materials and Technological Instruments, Teacher-Student Communication, Curriculum-Syllabus, Student-Centered Education, Teacher-Centered Education, Presentations (Individual, Group), Portfolio and Parents.

Negative attitudes of teacher candidates towards instructional strategy method and techniques

The negative attitudes of the candidate teachers towards instructional strategy, method and techniques used in science and technology lecture when they become teachers are collected under teaching technique in one sub-title: Experiment technique. It is also collected under innovative instructional strategy-method and techniques title in three sub-titles as teacher-centered education, teacher-student communication and parents. When the negative attitudes of the teacher candidates towards experiment technique in open-ended questions are looked at:

The learning would not be efficient and permanent; if the experiments are not done in laboratory environment (Science Technology course is meant).

When the negative attitudes of the teacher candidates towards teacher-centered education in semi-structured interview are looked at:

Student would not be active in teacher-centered education. Teacher only lectures. Only teacher discuss the subject. Student only listens.

When the negative attitudes of the teacher candidates towards teacher-student communication in semi-structured interview are looked at:

If the teacher is authoritative then student would not want to come to class. They would not understand the lecture, would have prejudice. So, students should not have fear about the teacher and course.
When the negative attitudes of the teacher candidates towards the beliefs in semi-structured interview are looked at:

If the parent cannot make their child to study at home and is not interested about it, then the child would not move across.

The Belief and Attitudes of Candidate Teachers towards Assessment and Evaluation
The belief and attitudes of the candidate teachers towards assessment and evaluation techniques used in science and technology lecture when they become teachers in open-ended questions and semi-structured interview are collected by their own thoughts regardless of their theoretical and conceptual information.

The beliefs on assessment and evaluation techniques

The beliefs of the candidate teachers on assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under traditional assessment and evaluation title in five sub-titles; collected under supplementary assessment and evaluation title in seven sub-titles and collected under innovative assessment and evaluation title in seven sub-titles. There are seventeen sub-titles in total.

The beliefs on traditional assessment and evaluation techniques

The beliefs of the candidate teachers on traditional assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under traditional assessment and evaluation techniques title in five sub-titles: General Information on Traditional Assessment and

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Evaluation, Gap-filling and Completion, Multiple Choice Exams, Verbal Exams, and Written Exams. While most of the teacher candidates dwell on written exams in open-ended questions, they dwell on verbal exams in semi-structured interview. The general statements of the teacher candidates related to written and verbal exams are given as following. When the beliefs of the teacher candidates on assessment and evaluation of written exams with open-ended questions are looked at:

The written exams are done to understand if the student understands the subject. Written exams are done for students to submit their information to the paper. The assessment and evaluation might be inadequate because of the excitement of the students. Also, the assessment and the evaluation might be inadequate because of the fact that the students might be concerned about the exam and they might deviate on the information. No assessment should be tied to a single test case.

When the beliefs of the teacher candidates on assessment and evaluation of verbal exams with semi-structured interview are looked at:

If there are no exams, students would not study. Verbal exams should be done. Verbal exams should be done about the subjects that the students have to learn about, which is important. For example, between the two tests, verbal exams must be made absolutely.

The beliefs on supplementary assessment and evaluation techniques

The beliefs of the candidate teachers on supplementary assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under supplmentary assessment and evaluation techniques title in seven sub-titles: Course Trip, Materials and Technological Instruments, Teacher-Student Communication, Curriculum-Syllabus, Student-Centered Education, Teacher-Centered Education, Presentations (Individual, Group), Portfolio and Parents. While in open-ended questions, most of the candidate teachers dwell on project home works, in semi-structured interview they dwell on presentations (individual, group). The general expressions of the teacher candidates on project home works and presentations (individual, group) are given as following.

When the beliefs of the teacher candidates on assessment and evaluation of verbal exams with open-ended questions are looked at:

It is used by students to research, learn knowledge, skills, abilities and interests. Students embody the thoughts in their minds both in writing and in their imagination. Students should embody what they think by combining their dreams with both writings and pictures. Students apprehend the subject better. It is more permanent because it is oriented towards application and research. Presentations were expressed by teacher candidates as two types. These are individual presentations and group presentations.

When the beliefs of the teacher candidates on assessment and evaluation of individual presentations with semi-structured interview are looked at:
In individual presentations, students are observed if they can develop their abilities. Can they do experiments? Can they hypothesize? Can they describe the lecture effectively? Does the class of students understand? Do they ask questions? It is assessed by the prepared reports after the experiment. In this manner, they gain self-confidence and this works for them.

When the beliefs of the teacher candidates on assessment and evaluation of group presentations with semi-structured interview are looked at:

Students should be assessed individually, not as group in group presentations because one of them might be pushful and others might fall behind. The teacher should assess all by their individual being active situation. Their responsibilities should be assessed. In group works, some of them do and some not but all of them should do something for the group work. So, the ones that make something should be separated from others, who do not make anything.

The beliefs on innovative assessment and evaluation techniques

The beliefs of the candidate teachers on innovative assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under innovative assessment and evaluation techniques title in seven sub-titles: Individual Differences, Assessment Tests, Experiment, Feedback, Activities-Exercises, Classroom Behaviors and Responsibilities. Most of the teacher candidates dwell on Experiment in open-ended questions and semi-structured interview. The general statements related to experiment are given following. At the end of the experiment, data analysis technique is used. The results related to quantitative data at the end of the experiment. The cause and effect relationship should be made after the experiment.
Teacher candidates also express their information about to their experiment process.

Are the experiment presentations done as they can understand? If there are any harmful instruments then how are they used? How is the form of expression? Do the students get attention? Can the class be managed? And the most importantly, can the students learn anything? Teacher should assess if they understand the experiments or not. If there are students that cannot understand the experiment then it

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should be repeated. Teacher notes the positive and negative sides of the experiment with the written notes as a result of the experiment presentations. The reports related to the experiments should be prepared (Science Technology course is meant).

The attitudes of teacher candidates on assessment and evaluation techniques

The attitudes of the candidate teachers based on the beliefs on assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under two subtitles: Positive attitudes and negative attitudes.

The positive attitudes of teacher candidates on assessment and evaluation techniques

The positive attitudes based on the beliefs of the candidate teachers on assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under Traditional Assessment and Evaluation title in five sub-title: General Information on Traditional Assessment and Evaluation, Gap-filling and Completion, Multiple Choice Exams, Verbal Exams, and Written Exams. It is also collected under Supplementary Assessment and Evaluation title in seven sub-titles: Home works, Performance home works, posters, project home works, the general information on supplementary assessment and evaluation, presentations (individual, group) and portfolio. Moreover, it is also collected under innovative assessment and evaluation title in seven subtitles: individual differences, experiment, evaluation exams, experiment, activities-exercises, feedback, responsibility and behaviors in class.

The negative attitudes of teacher candidates on assessment and evaluation techniques

The negative attitudes based on the beliefs of the candidate teachers on assessment and evaluation techniques used in science and technology lecture when they become teachers are collected under traditional assessment and evaluation in four subtitles: general information on traditional assessment and evaluation, gap-filling and completion, written and verbal exams. It is also collected under innovative assessment and evaluation title in one title as Experiment. When the negative attitudes based on the beliefs of the teacher candidates on traditional assessment and evaluation of general information with open-ended questions are looked at:

The traditional assessment and evaluation gives inadequate information about the development process of the student.

When the negative attitudes based on the beliefs of the teacher candidates on gap filling and completion questions with open-ended questions are looked at:

There would be no good brainstorming because of writing first thing come to mind to the gaps.
When the negative attitudes based on the beliefs of the teacher candidates on verbal exams with semi-structured interview are looked at:

Students would not study, if there are no verbal exams.

When the negative attitudes based on the beliefs of the teacher candidates on written exams with open-ended questions are looked at:

The interest and information of the student on the course would be less for written exams.

When the negative attitudes based on the beliefs of the teacher candidates on experiment with open-ended questions are looked at:

If the experiment is unsuccessful then this can mean that student has not worked on the experiment (the course Science and Technology is meant). If the experiment is unsuccessful then the student get bad grade.

CONCLUSION AND DISCUSSION

When the beliefs and attitudes of the teacher candidates on strategy-method and techniques are looked at, teacher candidates talk over about presentation, discovery and research-analyze as the teaching strategies. While most of the teacher candidates dwell o presentation as teaching strategy in open-ended questions, it is dwelled on the research-analyze as teaching strategy in semi-structured interview. When the beliefs of the teacher candidates on presentation as teaching strategy in open-ended questions, it is expressed that teaching with presentation is the best way of the education. When the beliefs of the teacher candidates on research-analyze as teaching strategy in semi-structured interview, they say that there is an ideal strategy that would be used in experiments. When the beliefs of the teacher candidates on teaching strategy in semi-structured interview and open-ended questions, they have positive attitudes towards teaching strategies such as presentation, discovery and research-analyze. Teacher candidates mention teaching methods as demonstration, show-make, problem solving, project and discussion methods; they do not mention just case method. In open-ended questions and semi-structured interview,

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most of the teacher candidates dwell on showing and making method. In open-ended questions, teacher candidates express that do-experience teaching activities take place in teaching for make-do method. On the other hand, in semi-structured interview, they mention that activities about the topic should be taught and done by the teacher firstly related to show-make method. Differently from the semi-structured interview, teacher candidates speak of problem solving method in open-ended questions. When the data from open-ended questions and semi-structured interview related to the teacher candidates' teaching methods are analyzed, it is determined that they have positive attitudes based on their beliefs towards exposition, demonstration, project, problem solving and discussion methods.

Teacher candidates talk about brainstorming, experiment, observation, role playing and question-answer techniques as teaching techniques but they do not talk about mind map, other discussion techniques (panel, conference, etc.), case study analysis, station, individual teaching techniques, psychomotor applications, simulation, reasoning techniques and analog techniques. Teacher candidates mostly talk about the experiment technique in open-ended questions and semi-structured interview. When the beliefs of the teacher candidates related to experiment in open-ended questions and semi-structured interview are looked at, it is seen that the best wat of teaching is learning by working on the experiment. Definitely, experiment is an effective and permanent technique. As the difference between the data obtained from the open-ended questions and semi-structured interview, while the brain storming technique is talked about in open-ended question, observation and role playing techniques are expressed in semi-structured interview. When the data related to the teaching techniques of the teacher candidates in open-ended questions and semi-structured interview are investigated, it is determined that they have positive attitudes towards brain storming, observation, question-answer and role playing techniques. Moreover, it is found out that teacher candidates have both positive and negative attitudes towards experiment technique.

Teacher candidates mention course trips, materials and technological instruments, student-teacher communication, curriculum-syllabus, student-centered education, teacher-centered education, presentations (individual, group), portfolio and parents as innovative instructional strategy-method and techniques. While most of the teacher candidates dwell on presentations (individual, group) in open-ended questions, they dwell on teacher-student communication in semi-structured interview. When the beliefs of the teacher candidates on individual and group presentations in open-ended questions are looked at, with presentations students own every information they should learn. Student reaches information more quickly. Moreover, when the beliefs of the teacher candidates on student-teacher communication in semi-structured interview are looked at, if the teacher is authoritative then student would escape from the lecure. Teacher should behave equally to the students. They should not interest with the students, who understand the course. As the differences between the data obtained from the open-ended questions and semi-structured interview; while course trips and portfolio is mentioned in open-ended questions, they mention parents in semi-structured interview. When the data obtained from open-ended questions and semi-structured interview related to innovative instructional strategy-method and techniques are looked at, it is determined that teacher candidates have positive attitudes towards course trips, portfolio, curriculum-syllabus, materials and technological instruments, student-centered education, presentations (individual, group). Moreover, teacher candidates have both positive and negative attitudes towards teacher-centered education, teacher-student communication and parents.

Teacher candidates talk about student-centered education way in open-ended questions and semi-structured interview; however, they cannot give any detailed information about student-centered education and other strategy-techniques (e.g. teaching with discovery) and they cannot also give special examples on the topic related to science and technology teaching. Canbazoğlu [20] also states similarly to these statements as mentioning the names of strategies and techniqeus (drama, play, mind map, etc.) used in science and technology teaching, but it is determined that they cannot mention how these techniques are applied in adequate way and there are confusions about the concepts.

In open-ended questions and semi-structured interview, even though teacher candidates talk about a classroom environment described as the contructivist approach on science lecture, it is determined that teacher candidates' knowledge about the strategy-method and techniques are short and based on memorization. The contructivist approach provides important information in terms of effective education [40].

When the beliefs and attitudes of teacher candidates on assessment and evaluation techniques are looked at, they mention general information of traditional assessment and evaluation, gap-filling and completion, multiple choice tests, verbal and written exams as traditional assessment and evaluation techniques. While most of the teacher candidates dwell on written exams in open-ended questios, they dwell on verbal exams in semi-structured interview. When the beliefs of the teacher candidates on assessment and evaluation with written exams in open-ended questions are looked at, the assessment and evaluation might be inadequate because students may be anxious about their knowledge during written exams. No assessment should be tied to a single test case. When the beliefs of the teacher candidates on assessment and evaluation with verbal exams in semi-structured interview are looked at, it is resulted that verbal exams should be done on the important topics that students have to learn. Differently from the semi-structured interview, teacher candidates mention about the general information related to traditional assessment and evaluation in open-ended questions and when the data from semi-structured interview are investigated, it is determined that they have positive attitudes towards multiple choice tests beliefs. Furthermore, it is resulted that they have both positive and negative attitudes towards

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the beliefs related to written and verbal exams, gap filling and completion, general information of traditional assessment and evaluation.

Teacher candidates mention home works, performance home works, posters, project home works, the general information of supplementary assessment and evaluation, presentations (individual, group) and portfolio as the supplementary assessment and evaluation techniques. While most of the teacher candidates dwell on project home works in open-ended questions, in semi-structured interview they dwell o presentations (individual, group). When the assessment and evaluation beliefs of the teacher candidates on project home works are looked at, students should embody what they think by combining their dreams with both writings and pictures. It is more permanent because of being directed to the application and research. Students comprehend the topic better. When the assessment and evaluation beliefs of the teacher candidates on individual and group presentation in semi-structured interview are looked at, students gain more self-confidence. It is more useful for the students. Teacher assesses individually by their being active situation. While teacher candidates talk about the general information of supplementary assessment and evaluation, performance home works, portfolio and posters in open-ended questions, they talk about the group presentations and home works in semi-structured interview as the differences between the data obtained from open-ended questions and semi-structured interview. When the data from open-ended questions and semi-structured interview related to the supplementary assessment and evaluation are investigated, it is determined that they have positive attitudes towards the beliefs on home works, performance home works, posters, project home works, general information of supplementary assessment and evaluation, presentation (individual, group) and portfolio.

Teacher candidates do not talk about the grading keys, diagnostic tree, structured grid, word association tests, problem solving, mind map, interview, student assessment used frequently in the syllabus. Same as these statements, Canbazoğlu [20] results that science and technology teacher candidates cannot state about the supplementary assessment and evaluation techniques and they cannot explain the features of it.

Teacher candidates talk about the individual differences, assessment tests, experiment, activities-exercises, feedback, responsibility and behaviors in classroom as the innovative assessment and evaluation techniques. Most of the teacher candidates dwell on the experiment in open-ended questions and semi-structured interview. When the assessment and evaluation beliefs of the teacher candidates on the experiment are looked at, teachers should assess the student, who does the experiment, by the understanding situations of all students. It should be repeated if the students do not understand the experiment. As the differences between the data obtained from the open-ended questions and semi-structured interview, while they talk about individual differences, assessment tests and responsibility in open-ended questions, they also talk about the activities and exercises in semi-structured interview. When the data related to supplementary assessment and evaluation of the teacher candidates in open-ended questions and semi-structured interview are investigated, it is determined that they have positive attitudes towards the beliefs on individual differences, assessment tests, activities-exercises, feedback, responsibility and behaviors in classroom. Moreover, it is resulted that they have both positive and negative attitudes towards experiment belief.

As a result of the analysis on the open-ended questions and semi-structured interview, in general teacher should know which teaching method, technique assessments should be used for the student. They state that the individual differences of the students should be taken into consideration for each student by a strategy-method-technique and assessment-evaluation and teacher should use these ways. They also mention that teacher should treat equally and fair to the students during teaching the lesson and they should communicate with all students, not just the students, who understand the lesson. While the teacher teaches the lesson, they should take care of the students, who do not understand the topic, one-to-one and each student in the class should be bring to equal levels. If there is a change on the behavior of the student, they should be aware. Students should know which instructional method and technique assessments should be used. Teacher candidates state about the teacher-parent cooperation and they also mention that if the parent cannot make the students to do home works and cannot be interested in then student cannot advance.

In brief, it is determined that the teacher candidates have different beliefs and attitudes towards the instructional strategy-method-technique and assessment-evaluation. It is established that teacher candidates are confused about the instructional strategy-method ad techniques. It is resulted that some of the teacher candidates' information on the instructional strategy-method-technique and assessment-evaluation are short and based on memorization and they cannot give deeply information and examples and have misconceptions about these.

Suggestions

This research gives an idea about PCK topic of the teacher candidates, who study in Faculty of Education in TRNC. In other words, the ideas of these teacher candidates based on the instructional strategy-method-technique and assessment and evaluation techniques, which is thought to provide them an effective education in Science lessons thinking that it is ready for teaching practice but the obtained data show that teacher candidates do not have enough information about PCK. One of the reasons for this result is the

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practice of the trainers who take part in the teacher training program. For this reason, PCK of the trainers can be examined also for the future researchers.

In terms of new researches, it is also recommended to compare the knowledge and practices of PAB with teachers who are working in different conditions and teacher candidates in different universities and teachers with different years of experience.

CONFLICT OF INTEREST

None

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REFERENCES

[1] Purohit S Baglama B, & Demirok M. [2016] Determination of preservice special education teachers' views on early childhood intervention. *Cypriot Journal of Educational Sciences, 11*(4):213-222. doi: https://doi.org/10.18844/cjes.v11i4.1297

[2] Kanbul S., & Uzunboylu H. [2017] Importance of coding education and robotic applications for achieving 21st-century skills in North Cyprus. *International Journal of Emerging Technologies in Learning*, *12*(1):130-140.

[3] Uzunboylu H, Uluc M, & Ozcan D. [2017] Educational strategies to be acquired by teachers in dealing with attention deficit and hyperactivity disorder students. *Ponte, 73*(8):419-431.

[4] Demirok MS, Baglama B, & Besgul M. [2015] A content analysis of the studies in special education area. *Procedia-Social and Behavioral Sciences*, 197:2459-2467.

[5] Yilmaz N., & Hursen C. [2017] Defining Turkish language teachers' & students' inclination towards reflective thinking. *Ponte*, *73*(7):272-281.

[6] Shulman LS. [1987] Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57(1):1–23. doi: https://doi.org/10.17763/haer.57.1.j463w79r56455411

[7] Shulman LS. [1986] Those who understand knowledge growth in teaching. Educational Researcher. 15:4-14. doi: https://doi.org/10.3102/0013189X015002004

[8] Magnusson S, Krajcik J, & Borko H. [1999] Nature, sources and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome & NG.Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 95-132). Dordrecht, The Netherlands: Kluwer Academic Publisher.

[9] Seferoğlu S. [2004]. Öğretmen yeterlikleri ve mesleki gelişim. *Bilim ve Aklın Aydınlığında Eğitim Dergisi*, 58:40-45. Retrieved from http://yunus.hacettepe.edu.tr/~sadi/yayin/Seferoglu_Ogretmen_Yeterlikleri_BAAE_2004-58.pdf

[10] Şeker H, Deniz S, & Görgen İ. [2004]. Öğretmen yeterlikleri ölçeği. *Milli Eğitim Dergisi*, 164. Retrieved from http://dhgm.meb.gov.tr/yayimlar/dergiler/Milli_Egitim_Dergisi/164/icindekiler.htm

[11] ElDaou B., & Kazan S. [2016]. The effect of ICT training on the science teachers' self-efficacy, attitudes, and students' academic performance in inclusive schools 2015. *World Journal on Educational Technology: Current Issues*, 8(3):148-164. doi: https://doi.org/10.18844/wjet.v8i3.550

[12] Es H. [2016] The effects of the children's university activities to children's views and attitudes towards scientists and scienc. *International Journal of Learning and Teaching*, *8*(2):100-108. doi: https://doi.org/10.18844/ijlt.v8i2.508

[13] Arı E. [2014]. *Temel kavramlar*. In S. B. Filiz (Ed.), *Öğrenme öğretme kuram ve yaklaşımları* (pp. 2-21) (3th ed.). Ankara: Pegem Akademi.

[14] Turgut MF. [1990]. Türkiye'de fen ve matematik programlarını yenileme çalışmaları. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 5*(5): 1-14.

[15] Bahar M, Nartgün Z, Durmuş S., Bıçak B. [2006]. Geleneksel-Alternatif Ölçme ve Değerlendirme Teknikleri Öğretmen El Kitabı. Ankara: Pegem Akademi. pp. 25 – 139.

[16] Korkmaz H. [2004]. Fen ve teknoloji eğitiminde alternatif değerlendirme yaklaşımları. Ankara: Yeryüzü Yayınevi. p. 455.

[17] Virtop SA. [2016]. Challenging paradigms in the continuous training of teachers from curricular area mathematics and science. *Contemporary Educational Researches Journal, 6*(2):41-48. doi: https://doi.org/10.18844/cerj.v6i2.860

[18] Uşak M. [2005] *Fen bilgisi öğretmen adaylarının çiçekli bitkiler konusundaki pedagojik alan bilgileri*. Unpublished doctoral dissertation. Gazi University. Ankara.

[19] Usak M. [2009]. Preservice science and technology teachers' pedagogical content knowledge on cell topics. *Kuram ve Uygulamada Eğitim Bilimleri*, 9(4):2033–2046. Retrieved from https://eric.ed.gov/?id=EJ867376

[20] Canbazoğlu S. [2008]. *Fen bilgisi öğretmen adaylarının maddenin tanecikli yapısı ünitesine ilişkin pedagojik alan bilgilerinin değerlendirilmesi*. Unpublished master's thesis. Gazi University. Ankara.

[21] Özden M. [2008]. The effect of content knowledge on pedagogical content knowledge: The case of teaching phases of matters. *Kuram ve Uygulamada Egitim Bilimleri*, *8*(2):633–645. Retrieved from https://eric.ed.gov/?id=EJ831172

[22] Kaya ON. [2009]. The nature of relationships among the components of pedagogical content knowledge of preservice science teachers: Ozone layer depletion as an example. *International Journal of Science Education*, *31*(7):961-988. doi: https://doi.org/10.1080/09500690801911326

[23] Mıhladız G. [2010]. Fen bilgisi öğretmen adaylarının bbilimin doğası konusundaki pedogojik *alan bilgilerinin araştırılması*. Unpublished doctoral dissertation. Gazi University. Ankara.

[24] Altaylı D., Konyalıoğlu AC, Hızarcı S., & Kaplan, A. [2014]. İlköğretim matematik öğretmen adaylarının üç boyutlu cisimlere ilişkin pedagojik alan bilgilerinin incelenmesi [The investigation of pre-service elementary mathematics teachers' pedagogical content knowledge on three dimensional objects]. *Middle Eastern & African Journal of Educational Research*, 10:4-24. Retrieved from http://www.majersite.org/issue10/181.pdf

[25] Gökkurt B., & Soulu Y. [2016]. Ortaokul Matematik Öğretmenlerinin Pedagojik Alan Bilgilerinin bazı bileşenler açısından İncelenmesi: Koni Örneği [Examination of middle school mathematics teachers' pedagogical content knowledge: The sample of cone] *İlköğretim Online*, 15(3): 946-973. doi: http://dx.doi.org/10.17051/io.2016.14548

[26] Estacioa R, & Martinez DO. [2017]. The use of modified frayer model in developing science vocabulary of senior high school students. *New Trends and Issues Proceedings on Humanities and Social Sciences*, 4(1):36-42. doi: https://doi.org/10.18844/prosoc.v4i1.2049

[27] Veal, WR., Tippins, DJ., & Bell, J. [1999]. The evolution of pedagogical content knowledge in prospective secondary physics teachers. Retrieved from https://eric.ed.gov/?id=ED443719

[28] Halim L., & Meerah, SMM. [2002]. Science Trainee Teachers' Pedagogical Content Knowledge and its Influence on Physics Teaching. *Research in Science & Technological Education, 20*(2):215-225. doi: https://doi.org/10.1080/0263514022000030462

[29] Sarkim T. [2004] Investigating Secondary School Physics Teachers'Pedagogical Content Knowledge: A Case Study, *Post-Script*, 5(1):82–96.
[30] Henze I., van Driel, JH., & Verloop, N. [2008]. Development of Experienced Science Teachers' Pedagogical Content Knowledge of Models of the Solar System and the Universe .*International Journal of Science Education*, 30:1321-1342. doi: https://doi.org/10.1080/09500690802187017
[31] Käpylä, M., Heikkinen, JP., & Asunta, T. [2009]. Influence of Content Knowledge on Pedagogical Content Knowledge: The case of teaching photosynthesis and plant growth. *International Journal of Science Education*, 31(10): 1395-1415. doi: https://doi.org/10.1080/09500690802082168
[32] Yıldırım A, & Şimşek H. [2011]. Sosyal bilimlerde nitel araştırma yöntemleri (8th ed.). Ankara: Seçkin.
[33] murat tezer-IIOABJ-2018-011Hays, PA. [2004]. Case Study Research. In K. de Marrais, & SD Lapan (Eds.). *Foundations for research: Methods of inquiry in education and the social sciences* (pp. 217-234). Mahwah, New Jersey, & London: Lawrence Erlbaum.
[34] Balcı, A. [2013]. Sosyal bilimlerde araştırma: Yöntem, teknik ve ilkeler (10th ed.). Ankara: Pegem.
[35] Karasar N. [2005]. Bilimsel araştırma yöntemi. Ankara: Nobel.
[36] Gözlemsel teknikler. [2011, 23 December]. Retrieved from https://www.pdr.gen.tr/pdr-yazilari/bireyi-tanima-teknikleri/gozlemsel-teknikler
[37] Friedrichsen P, Lankford D, Brown P, Pareja E, Volkmann M, & Abell S. [2007]. *The PCK of future science teachers in an alternative certification program*. Paper presented at the National Association for Research in Science Teaching Annual Conference. Retrieved from http://resmar2t.missouri.edu/papers/narst07.pdf
[38] Canbazoğlu S, Demirelli H, & Kavak N. [2010]. Investigation of the relationship between pre-service science teachers' subject matter knowledge and pedagogical content knowledge regarding the particulate nature of matter. *İlköğretim Online, 9*(1):275-291.
[39] Baştürk S, & Dönmez G. [2011]. Matematik öğretmen adaylarının pedagojik alan bilgilerinin ölçme ve değerlendirme bilgisi bileşeni bağlamında incelenmesi. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi*, *12*(3):17-37. Retrieved from http://dergipark.gov.tr/aeukefd
[40] MEB, Talim ve Terbiye Genel Kurulu Başkanlığı. [2006]. *İlköğretim fen ve teknoloji dersi (6.-7.- 8. Sınıflar) öğretim programı*. Ankara: MEB.