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Analysis of TSKT Questions on Science Teaching in 2013 PPSE According to Reconstructing of Bloom Taxonomy

Mert Kaya[1] and Orhan Karamustafaoğlu[2,*]

[1] Saftekin Gazi High School, Malazgirt, Muş, Turkey
[2] Faculty of Education, Amasya University, Amasya, Turkey

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Abstract

The Ministry of National Education (MoNE) in Turkey hires teachers based on the results of the Public Personnel Selection Examination (PPSE). By 2013, the MoNE has decided to do another examination which is called the Teacher Subject Knowledge Test, in 13 different fields in addition to Educational Science Test. By this decision, prospective teachers have to take 3 different sessions including General Skills Test (GST), General Culture Test (GCT), Educational Science Test (EST), and Teacher Subject Knowledge Test (TSKT). The MoNE has selected teachers based on the results of these PPSE P121 tests. Calculation of PPSE P121 has been made by the following: GST %15, GCT %15, EST %20, and TSKT %50. Science education is one of these 13 different fields. The cognitive levels of questions on TSKT test are related to how ready prospective science teachers are to teach in their subject. The aim of this study is to analyze TSKT questions on science teaching in 2013 PPSS according to reconstructing of Bloom Taxonomy. The requested permission for the analyses of the questions had been taken from the Student Selection and Placement Center (SSPC). The study was conducted using the document analysis method in the framework of qualitative research. At the end of this study; the majority of TSKT questions were found as low cognitive level according to Bloom Taxonomy. Based on the results of this study, some recommendations have been declared for the readers of this study.

Keywords: Public Personnel Selection Examination Questions; Bloom's Revised Taxonomy; Science Teachers

Introduction

Science and Technology curriculum aims to train individuals who research, question, investigate, associate daily life with the topics of science, use the scientific method in solving the problems faced in every aspect of life and see the world from the perspective of a scientist (MEB, 2005). This goal is also emphasized in the science curriculum, which was renewed in 2013. Training individuals in accordance with the requirements of our age and adaptation of individuals to society is directly related to training of teachers. Therefore, the objectives and content of teacher training should be considered in detail (Akçay, 2009). In this context, the preparation for the profession of teaching should focus on, according to Article 43 of The Basic Law of National Education, knowledge and skills in three dimensions: general knowledge, specific subject training and pedagogical formation (DPT, 2000). On the other hand, employment of prospective teachers that have graduated from faculties of education is one of the most significant problems faced by the teacher training system (Bahar, 2011). The

[*]Corresponding Author Phone: +90 358 2526230; Fax: +90 358 2526222

E-mail address: orseka@yahoo.com

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employment of teachers by the Ministry of National Education (MoNE) is based on the results of the Public Personnel Selection Examination (PPSE). MoNE appointed prospective teachers are selected based on their PPSE P10 scores. PPSE P10 was held in two separate sessions and involved three tests; General Skill Test (GST), General Knowledge Test (GKT), Educational Science Test (EST). The PPSE P10 scores were calculated as 30% GST, 30% GKT and 40% EST (OSYM, 2009). With the regulation made in 2013, in order to evaluate the field knowledge of prospective teachers as well, MoNE decided to make appointments in thirteen different fields by taking the results of Teacher Subject Knowledge Test (TSKT) into account in addition to PPSE EST results. With this regulation, MoNE hires prospective teachers based on PPSE P121 scores, held in three separate sessions and consisting of four separate tests: GST, GKT, EST and TSTK. The PPSE P121 scores calculated as 15% GST, 15% GKT, 20% EST and 50% TSTK. In this context, one of the branches that TSTK involves is Science and Technology (OSYM, 2013). Determination of to what degree the students gained the outcomes of Science Teaching TSKT is directly related to the level and scope of questions asked. In this context, there are several classification systems that determine the level of TSKT questions used to evaluate the field knowledge of prospective teachers. The most commonly accepted classification is the cognitive development-level classification, developed by Bloom and known as the Bloom's Taxonomy in the literature (Ralph, 1999). The first three steps of this taxonomy are referred to as low cognitive levels and the last three steps are referred to as high cognitive levels (Wilen, 1991).

With the increase of information in the field of education and the emergence of the structuralist learning theory in curriculums, some shortcomings were found in the original Bloom's Taxonomy. Anderson et al. (2001) made certain additions and adjustments to the original taxonomy in order to eliminate the shortcomings and contradictions in Bloom's Taxonomy, modernize the taxonomy, and named it: "The Revised Bloom's Taxonomy" (Bekdemir ve Selim, 2008). The taxonomy gained a two dimensional structure with this revision; knowledge dimension and cognitive process dimension. The knowledge dimension of the Revised Bloom's Taxonomy consists of four categories from concrete to abstract: Factual Knowledge, Conceptual Knowledge, Procedural Knowledge, Metacognitive Knowledge (Kratwohl, 2002; Anderson, 2005). Anderson et al. (2001) describes the types of knowledge under the knowledge dimension as follows:

- Factual Knowledge: The basic elements that students must know to be acquainted with a discipline or solve problems in it.
- Conceptual Knowledge: The interrelationships among the basic elements within a larger structure that enable them to function together. It is essential to establish relations between concepts.
- Procedural Knowledge: How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.
- Metacognitive Knowledge: Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

Examining the cognitive process dimension of the Revised Bloom's Taxonomy, the first category that we used to know as knowledge, was renamed as "remembering," the second category that we used to know as comprehension was renamed as "understanding," the fifth category that we used to know as "creating" and this category changed places with "evaluating." Anderson et al. (2001) describes the six categories under the cognitive process dimension as follows:

- Remembering: Retrieving relevant knowledge from long-term memory.
- Understanding: Determining the meaning of instructional messages, including oral, written, and graphic communication.
- Applying: Carrying out or using a procedure in a given situation.
- Analyzing: Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.
- Evaluating: Making judgments based on criteria and standards.
- Creating: Putting elements together to form a novel, coherent whole or make an original product.

The main purpose of this study was to analyze 2013 PPSE Science Teaching TSKT questions according to the Revised Bloom's Taxonomy. The fact that there are no studies so far in our country related to the evaluation of the TSKT exam, which was held in 2013 for the first time, constitutes the original value of this work.

Methodology

The study was performed using the document analysis method within the framework of qualitative research. Document analysis is the process of collecting records and documents on the relevant subject and examination by coding them according to a system and certain norms (Chavez, 2009). Documents can be used along with other research methods or constitute the whole data set of a research on their own (Yıldırım and Şimşek, 2011). Within the scope of the study, 2013 PPSE Science Teaching TSKT questions were analyzed according to each category of the six cognitive levels on the basis of the characteristics of revised categories of the Bloom's Taxonomy. As required by the internal validity of the study, the questions were classified independently by three specialists and as a result of the assessment, the data have been found to be consistent at the rate of 86%.

Findings

The questions were examined in two dimensions, the knowledge dimension and the cognitive process dimension, according to the revised taxonomy. Two of 2013 PPSE Science Teaching TSKT questions were shown as an example.

Sample Question:

Light rays bend when they travel from air to glass.

According to this, which of the following conclusions about light rays traveling to glass are correct?

I. Wavelength increases.
II. Average speed decreases.
III. Frequency decreases.

A) Only I B) Only II C) Only III D) I and II E) II and III

Examining the question in the knowledge dimension, the question is at the level of *conceptual knowledge,* as it requires knowledge for classification and establishment of relations between concepts. Examining the question in the cognitive process dimension, the question is at the level of *understanding* as it requires comprehension of the question using

the preliminary information and interpretation and determination of the relationship between the concepts.

Sample Question:

Which of the following attributes of mammals does allow one to conclude the dietary category (herbivore, omnivore, carnivore) of the animal?

I. Tooth type and position,
II. Body size,
III. Ratio of the digestive tract length to body length.

A) Only I B) Only II C) Only III D) I and III E) II and III

Examining the question in the knowledge dimension, the question is at the level of *factual knowledge* as it is aimed at using the information that forms the basic concepts in a subject field. Examining the question in terms of cognitive processes, the question belongs to *analyzing* category as it requires breaking the information into parts and determining the relationship between these parts.

The data obtained in the study is shown in Table 1 by creating a two dimensional taxonomy table.

Table 1. The distribution of PPSE Science Teaching TSKT questions according to categories of the cognitive process and knowledge dimensions of the Bloom's taxonomy

The Knowledge Dimensions	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	**Total**	%
Factual	7	4	0	2	1	0	**14**	**28**
Conceptual	2	9	0	5	1	0	**17**	**34**
Procedural	0	0	17	0	1	0	**18**	**36**
Metacognitive	0	0	0	0	1	0	**1**	**2**
Total	**9**	**13**	**17**	**7**	**4**	**0**	**50**	
%	**18**	**26**	**34**	**14**	**8**	**0**		**100**

As seen in Table 1, 9 of PPSE Science Teaching TSKT questions are related to remembering (18%), 13 are related to understanding (26%), 17 are related to applying (34%) 7 are related to analyzing (14%), and 4 are related to evaluating (8%). According to the knowledge dimension, 14 questions belonged to the factual knowledge category (28%), 17 belonged to the conceptual knowledge category (34%), 18 belonged to the procedural knowledge category (36%) and 1 belonged to the metacognitive knowledge category (2%).

The distribution of the questions according to categories in the cognitive process dimension of the revised Bloom's taxonomy is given in Figure 1.

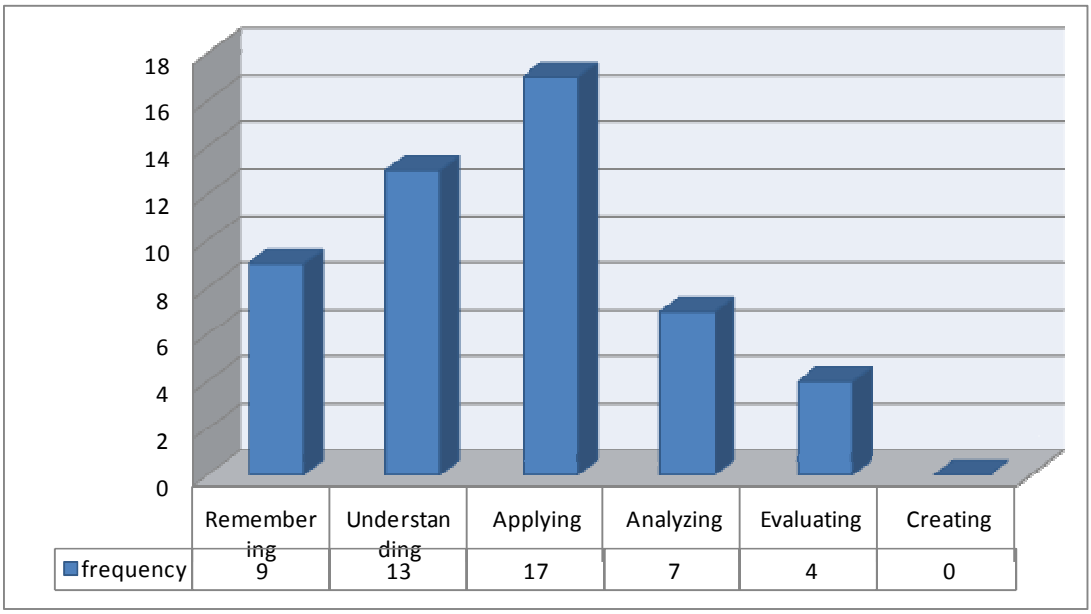

Figure 1. Distribution of the questions according to categories in the cognitive process dimension

Examining Figure 1, it is seen that the majority of the questions are in the applying and understanding category and there are no questions in the creating category. That said, it is seen that the total number of low-level questions (remembering, understanding, applying) is 39 (78%), and the total number of high-level questions (analyzing, evaluating, creating) is 11 (22%). In this context, it was found that the number of low-level questions was quite high compared to high-level questions.

Discussion and Conclusion

The findings of the study show that the vast majority of the TSKT questions are low-level questions, while numbers of high-level questions are limited. Similar results can be seen in the literature (Cansüngü-Koray and Yaman 2002; Çepni, 2003; Çepni, Ayvacı and Keleş, 2001; Rawadieh, 1998; Risner, Nicholson and Webb, 2000; Özmen, 2005; Keskin and Aydın, 2011). In this context, it can be said that the PPSE Science Teaching TSKT questions come short of measuring high-level cognitive processes. Asking students questions containing high level cognitive processes helps them improve their skills, such as: producing knowledge and original products, applying obtained knowledge to new situations, questioning, critical thinking and decision making. Therefore, questions containing high-level cognitive processes are important measuring tools (Saraçoğlu and Tanık, 2011; Yiğit and Akdeniz, 2002). According to findings of the study, there are no questions in the creating category of the cognitive process dimension. This may be due to the fact that TSKT is a multiple-choice exam. In fact, it supports our idea that Poyraz (2005) and Tekin (2000) have indicated that multiple-choice tests are limited tools to measure the high-level skills of students such as creativity.

According to findings of the study, 14 questions belonged to factual knowledge category (28%), 17 belonged to conceptual knowledge category (34%), 18 belonged to procedural knowledge category (36%) and 1 belonged to metacognitive knowledge category (2%). According to this finding, it can be said that the number of questions related to

recognition of the basic concepts, establishment of relations between concepts and methods, techniques and procedures on how to do something are sufficient. 36% of the questions are in the procedural knowledge category, which is a sufficient ratio to develop high level skills. In fact, Ayvacı and Türkdoğan (2010) have reached the conclusion that 19% of the questions were in the procedural knowledge category. They found this ratio to be insufficient and suggested that the procedural knowledge category should have been given more space in order to give students a comprehensive perspective, showing empathy, presenting different perspective and high-level skills, which supports our idea. Only 4% of the questions are in the metacognitive knowledge category, which is an insufficient ratio to measure prospective teachers who are expected to teach with a constructivist approach. Metacognitive knowledge enables one to be aware of his own knowledge and thus gives direction to his knowledge. It can be said that the exam comes short in terms of measuring the metacognitive knowledge of prospective teachers, who are expected to teach students scientific processes such as researching, questioning, problem solving and decision making; and train students with a process-based approach. The fact that we found results similar to those of Eyüp (2012) supports our findings.

Recommendations

- According to the study results, the questions are found to be insufficient in terms of measuring high-level skills. In this context, it should be required to ask questions in all knowledge and cognitive process categories by taking the two dimensional table of the revised Bloom's taxonomy into account.

- It is possible to measure high-level knowledge by giving more space to procedural knowledge and metacognitive knowledge dimensions when preparing questions.

- It should be required that the questions are prepared according to the gains of Science Teaching curriculum and questions should be such as to measure all of these gains.

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