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Examination of 2021 Turkish Central Exam Science Questions in Terms of Science Process Skills

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Abstract: The Central Exam of the High School Entrance System (known as LGS), which has been put into practice in Türkiye since 2018, aims to measure the students' ability to transform the information they have learned into skills rather than simply remembering or memorizing them. In this context, the aim of the study is to analyze each of the 2021 central exam science questions and to evaluate the questions in terms of scientific process skills in Turkish science curriculum. Document analysis, one of the qualitative research methods, was used to analyze the science subtest of the 2021 central exam by four academicians and six science teachers. Within the framework of expert opinions, the compatibility of the questions was evaluated according to the categorical compatibility criterion. According to the findings of the research, it was concluded that the 2021 central exam questions mostly focused on the scientific process skills of "inferring", "interpreting data" and "defining variables". According to this result, it was concluded that the central exam science test was not sufficient in terms of covering scientific process skills. The central exam questions should include more scientific process skills, which is deemed important for science education.

Keywords: Science process skills, LGS, central exam, document analysis

2021 LGS Fen Bilimleri Sorularının Bilimsel Süreç Becerileri Bakımından İncelenmesi

Öz: Türkiye'de 2018 yılından itibaren uygulamaya giren Liselere Geçiş Sistemi merkezi sınavında öğrencilerin öğrendikleri bilgileri salt hatırlama veya ezberleme yönünden ziyade bunları beceriye dönüştürme durumlarının ölçülmesi hedeflenmektedir. Bu bağlamda çalışmanın amacı, MEB tarafından hazırlanan 2021 merkezi sınav fen bilimleri sorularının her birinin analiz edilmesi ve soruların 2018 fen müfredatında yer alan bilimsel süreç becerileri bakımından değerlendirilmesidir. Araştırmada yöntem olarak nitel araştırma yöntemlerinden doküman analizi yöntemi kullanılmıştır. Bu çerçevede 2021 merkezi sınavı fen bilimleri alt testine ait sorular alan uzmanı dört akademisyen ve altı fen bilimleri öğretmeni tarafından incelenmiştir. Uzman görüşleri çerçevesinde soruların uyumu kategorik uyum kriterine göre değerlendirilmiştir. Araştırmanın bulgularına göre 2021 merkezi sınavı sorularının en çok "sonuç çıkarma", "verileri yorumlama" ve "değişkenleri belirleme" bilimsel süreç becerilerinin üzerinde yoğunlaştığı

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sonucuna ulaşılmıştır. Bu sonuca göre merkezi sınav fen bilimleri testinin bilimsel süreç becerilerini kapsaması bakımından yeterli olmadığı sonucuna ulaşılmıştır. Bu bağlamda LGS merkezi sınav sorularında daha fazla sayıda bilimsel süreç beceriye yer verilmesi için çalışmalar yapılması gerektiği düşünülmektedir.

Anahtar kelimeler: Bilimsel süreç becerileri, LGS, merkezi sınav, doküman incelemesi

Introduction

Countries ranked high in terms of science literacy proficiency levels defined in PISA aim to develop inquiry skills, and learn the scientific method instead of use low-level skills such as remembering in science teaching and memorizing information (Harlen, 1999; Organisation for Economic Co-operation and Development [OECD], 2019). The questions in the PISA exam consist of questions that emphasize scientific inquiry. The fact that the questions asked in the central exams in our country are similar to the questions in the PISA exam will increase the habit of our students to qualified questions. Thus, it is thought that our country's success in PISA exams will increase (Ar, 2019). While this situation increases the importance of skill teaching, especially in the development of science-related fields (Çepni & Sarıoğlu, 2021), it points to the need to develop science process skills in students (Chiappetta et al., 2015; Çepni & Çil, 2016; European Skills, Competences, Qualifications and Occupations [ESCO], 2020; Hamarat & Arkan, 2018; Paine, 2020). Therefore, it can be said that science process skills should be included in the science curriculum to achieve the stated goals (Brotherton & Preece, 1995, 1996; Harlen, 1999; Huppert et al., 2002; Rezba et al., 1995; Saat, 2004; Smith, 1995; Tan & Temiz, 2003).

The central exam application, which is named the "Central Examination for Secondary Education Institutions to Admit Students by Examination" officially (known as the central exam or LGS), has been put into practice in Türkiye since 2018, it is aimed to measure the students' ability to transform the information they have learned into skills rather than simply remembering or memorizing them (MoNE, 2018a; Yüzüak & Arslan, 2021). At the same time, science process skills are emphasized in science-specific skills in the science curriculum published and put into practice in 2018. The importance of science process skills is mentioned in the relevant curriculum is as follows:

> "In the process of discovering nature and understanding the relationship between human and environment in the special purposes of the curriculum, adopting science process skills and science research approach and producing solutions to the problems encountered in these areas. To enable the use of science-related knowledge, science process skills and other life skills in solving problems" (Ministry of National Education [MoNE], 2018b).

Smith and Scharmann (1999) also stated that individuals with good science process skills can use appropriate methods in a short time while solving problems in daily life and expressed a justification that is compatible with the specific objectives of the science curriculum. In the related curriculum, science process skills include the skills that scientists use during their studies such as observing, measuring, classifying, recording data, constructing hypotheses, using data and creating a model, changing and controlling variables, and experimenting. In the curriculum, emphasis is given to transferring science processes to the learning environment (MoNE, 2018b). Therefore, in the measurement part, the necessity of carrying out a process in harmony with the curriculum content emerges. In this respect, it is thought that it is important to examine the exams in terms of science process skills. There is no common definition of science process skills accepted by all scientists. However, when classifying skills, it is seen that many scientists classify them as common

skills. While some scientists classify science process skills as basic, causal, and experimental, most scientists classify them as basic and high-level skills (Burns et al., 1985; Carey et al., 1989; Clock, 2004; Germann, 1994; National Research Council, 1996; Rubin et al., 1992). Therefore, it can be said that science process skills have flexible definitions and classifications under the same roof and main idea. Different science process skills classifications made by various researchers are shown in Table 1.

Table 1

Classification of Science Process Skills

(Padilla, 1990)	(Rezba et al., 1995)	(Smith, 1995)	(Çepni et al., 1997)	(Chiappetta et al., 2015)
Observing	Observing	Observing	Observing	Observing
Inferring	Inferring	Classifying	Measuring	Inferring
Communicating	Communicating	Measuring	Classifying	Space and time relations
Measuring	Measuring	Inferring	Recording data	Communicating
Classifying	Classifying	Predicting	Forming space-number relations	Measuring
Predicting	Predicting	Communicating	Predicting	Predicting
Controlling variables	Defining variables	Space and time relations	Defining variables	Using numbers
Defining operationally	Constructing a table of data	Defining operationally	Interpreting data	Defining a term operationally
Formulating hypotheses	Constructing a graph	Formulating hypotheses	Inferring	Formulating models
Interpreting data	Describing relationships between variables	Experimenting	Constructing hypotheses	Controlling variables
Experimenting	Recording and processing data	Defining variables	Formulating models using data	Interpreting data
Formulating models	Analyzing investigations	Interpreting data	Experimenting	Hypothesizing
	Constructing hypotheses	Formulating models	Changing and controlling variables	Experimenting
	Defining variables operationally		Making decisions	
	Designing investigations			
	Experimenting			

Of these various classifications in the literature on science process skills, we decided that it would be most appropriate to use the one that the Turkish science curriculum (MoNE, 2018b) mentions, which was theorized by Çepni et al. (1997). Appropriate measurement and evaluation tools are needed to measure the skills in the curriculum. Those skills are explained below:

1. Basic processes

a. Observing: Observing the environment using the sense organs.

b. Measuring: Expressing the properties of objects or substances numerically in terms of unit systems.

c. Classifying: Grouping events, objects, and ideas according to their common characteristics.

d. Recording data: Grouping and recording of observation and examination results.

e. Forming space-number relations: Perceiving and detecting properties such as shape, time, speed, distance of objects and events.

2. Causal processes

a. Predicting: arriving at a conclusion about the subject to be studied before conducting an experiment.

b. Defining variables: Identifying the factors affecting the investigated event and situation.

c. Interpreting data: Expressing an opinion on aggregated or tabulated data.

d. Inferring: Coming to a conclusion about an event or situation.

3. Experimental processes

a. Constructing hypotheses: making tentative generalizations about the event or situation being studied based on preliminary observation and experimentation.

b. Formulating models using data: from ideas derived using data to arrive at mathematical expressions and designs.

c. Experimenting: probing hypotheses by checking for independent variables and examining their effects on dependent variables.

d. Changing and controlling variables: determining what effect it has on results by changing one of the factors that affect an event or situation while keeping the others constant.

e. Making decisions: making a judgment or judgment using science process skills (Çepni et al., 1997).

As those skills are aimed to teach, assessing and using these skills in questions becomes essential. In line with the aim of MoNE (2018a), exams started to become more demanding of process skills of students. Especially from the science test aspect, science process skills are used in the solutions of the so-called skill-based questions. A question of an experimental process in science test may or may not contain one or more of science process skills (Çepni, 2016). While solving a problem or answering a question, students may need to use their science process skills and one process skill may not be enough and more than one skill can be used. Central exam aims to make inferences about the transformation of the information learned by the students into skills. There are a small number of studies in the literature examining the central exam questions in terms of science process skills. Çolak (2017) examined eight central exams held twice a year between 2013 and 2017 in terms of scientific process skills. A total of 160 questions constituting the science test of these 8 exams were examined together with their choices and antecedents. The items were analyzed by two independent researchers. While examining the questions, 18 scientific process skills were determined, and these skills were grouped under three categories. These categories are Planning and Initiation, Implementation and Analysis, and Conclusion.

Arıkan and Kırındı (2020), on the other hand, examined the central exams between 2005 and 2015 in order to find an answer to the question "Are the central exam science test questions prepared in a way that supports SPS and critical thinking skills?" While analyzing these exams, scientific process skills determined according to Aydoğdu (2009) were taken as basis. As a result of the research, it was deduced that the questions supported all scientific process skills. However, it was also added that among these skills, there were mostly questions involving the skills of "observing" and "inferring". It was concluded that one of the sparsely included steps in the questions was 'making a hypothesis' from higher-order thinking skills and 'measuring' from basic skills. Another study in the literature in relation to the subject, there is a study conducted by Polat and Bilen (2022). Accordingly, the questions in the central exams (TEOG and LGS) applied in our country between 2013 and 2021 were examined according to the renewed bloom taxonomy. As a result of the research, it was determined that the questions were insufficient to measure high-level skills and the distribution of questions was not proportional. In the international basis, Çepni (2016), Karslı et al. (2019) and Arslan (2019) examined the PISA implementation in terms of science process skills. As mentioned in OECD (2019), science process skills are an important aspect of assessment in terms of real-life transfer of knowledge. With this study, we aimed to analyze whether the questions in the central exam science test include science process skills, and if so, which of these skills they contain. In this context, the aim is to analyze each of the 2021 central exam science questions prepared by the Ministry of National Education and to evaluate the questions in terms of science process skills in the 2018 science curriculum. When the literature was scanned, no study was found that carried out a detailed analysis of the science questions of the 2021 central exam in terms of science process skills. In this respect, we think that our study will contribute to the literature and that the data to be obtained as a result of this study will contribute to the elimination of the deficiencies of the central exam questions, if any, to make them more suitable for the curriculum. Thus, we believe that the central exam can become a more appropriate measurement tool for the vision of the curriculum.

Methods

Research Design

In the research, the document analysis method, one of the qualitative research methods, was used. Document analysis is a scientific research method that can be defined as the collection, examination, and analysis of various documents as the primary source of research data. Although this method is often used as a complement to other research methods in the literature, it can also be used as a stand-alone method (Sak et al., 2021). In this context, the questions of the 2021 central exam science subtest were examined through document analysis on the google form sent to them by four academicians and six science teachers, who experts in the field are, and who have studied science process skills. The scientific skills that the questions contain and that should be used in their solution were revealed and the results were expressed with descriptive methods. The document in the study is Booklet A containing LGS 2021 questions. The relevant questions were sent to experts via google forms and experts were provided to analyze the relevant document. Therefore, document analysis method was preferred in the study.

Data collection and analysis

The science process skills examined in this study are observing, classifying, measuring, recording data, forming space-number relations, predicting, defining variables, interpreting data,

inferring, constructing hypotheses, using data, and considering the classifications of various scientists and the curriculum. and model building, making decisions, changing and controlling variables, and experimenting (Çepni, 2004; Çepni et al., 1997; MoNE, 2005, 2018b). Since there is no universal and exact classification by scientists and the existence of different approaches that can be used in solving questions, the calculation of consistency from the ideas of different researchers gives a more reliable result (Cohen, 1960). In this context, a conclusion was reached by calculating the compatibility of central exam 2021 science questions analyzed separately and classified according to their science process skills by four academicians and six science teachers, who are experts in the field.

For example, question number 15 of the booklet A of 2021 central exam science test, 9 of 10 experts stated opinions and one abstained. For each question and skill they have stated, experts are also required to reason and justify their choices. A screenshot of google analysis and sample of expert opinions are available in Appendix 1.

Within the framework of expert opinions, the compatibility of the questions was evaluated according to the categorical compatibility criterion. The categorical agreement criterion provides an indication of agreement by evaluating the agreement between the standards and the evaluations of the evaluators in terms of content (Traynor et al., 2020; Webb, 2005). The percentage of matches between experts was examined by determining the science process skills of the experts in the questions (Akbulut & Çepni, 2013). As a result of this examination process, the agreement between science process skills and scale items higher than 0.60 can be interpreted as the criterion being met (Webb, 1997, 2007). Since the opinions of 10 experts were taken in the research data, the first acceptable value higher than the threshold value was found to be 0.63, and values between 0.63 and 0.80 were interpreted as agreeable and values higher than 0.80 as highly compatible (Viera & Garrett, 2005).

Findings

The table showing the compatibility of the skills found in each question and the question as a result of the examination of the questions by four expert academicians and six science teachers is given in Table 2 below. In this table, the agreement indices are indicated with different colors and their explanation is given under the table. Compliance of 0.63 and above, which is considered appropriate, is colored green. The squares that are not painted with any color are an indication that everyone accepts that there is no skill in that question. For example, it can be said that there is a classification skill in the first question because there is a correlation of 0.88 among the experts. In other words, 7 of the 8 experts who answered this question stated that they had classification skills in this question. On the contrary, there is no measurement skill since no expert has stated the existence of the skill. Since the agreement is calculated as the agreement of the respondents within themselves, different rates are obtained for each question. For example, when one of the experts skipped a question without answering, the agreement was calculated among nine people, not ten.

Table 2

The percentage of agreement among experts in terms of science process skills of the questions

Science process skills / Question numbers (booklet A)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Observing	0.25	0.10		0.20		0.20	0.10	0.14		0.10			0.20	0.11	0.11		0.44	0.13		
Measuring		0.10	0.11	0.20			0.10					0.10	0.40	0.44	0.22		0.11		0.30	0.11
Classifying	0.88	0.30	0.22	0.20		0.20			0.56	0.20	0.50	0.10	0.30	0.11		0.78	0.11	0.38	0.30	0.22
Recording data		0.40	0.11	0.20	0.13	0.10	0.10				0.13	0.20	0.50	0.11	0.11				0.10	
Forming space-number relations	0.13	0.10	0.33			0.20	0.30					0.20	0.20	0.44	0.78					0.11
Predicting		0.40	0.22	0.20	0.13	0.10	0.10		0.33	0.40		0.20		0.44	0.56					
Defining variables		0.40	0.33	0.70	0.13		0.30			0.50		0.90	0.80	0.33	0.44				0.90	0.11
Interpreting data	0.38	0.60	0.67	0.80	0.63	0.70	0.90	0.14	0.11	0.50	0.13	0.30	0.60	0.67	0.78	0.11	0.56	0.50	0.30	0.89
Inferring	0.38	0.60	0.67	0.50	0.63	0.60	0.70	1.00	0.44	0.80	0.63	0.4	0.60	0.89	0.78	0.22	1.00	0.88	0.30	0.67
Constructing hypotheses				0.40			0.20			0.10		0.20	0.20	0.11					0.20	
Formulating models using data				0.10		0.10									0.56					
Making decisions	0.38	0.40	0.11	0.70	0.38	0.20	0.40	0.29	0.22	0.40	0.13	0.20	0.70	0.11	0.67	0.33	0.22	0.13	0.60	0.33
Changing and controlling variables		0.40	0.11	0.50	0.13							0.10	0.50	0.11	0.22		0.33		0.80	
Experimenting		0.10		0.50									0.20	0.11	0.11				0.50	

80% or more

63-80%

50-63%

50% or less

Based on the data in Table 2, the table of science process skills with 0.63 or more consistency in each question is presented in Table 3 below.

Table 3

Expression of Skills Consistent Above 0.63 According to Questions

N	Science process skill and the consistency	N	Science process skill and the consistency
1	Classifying (0.88)	**11**	Inferring (0.63)
2	-	**12**	Defining variables (0.90)
3	Interpreting data (0.67) Inferring (0.67)	**13**	Defining variables (0.80) Making decisions (0.70)
4	Defining variables (0.70) Interpreting data (0.80) Making decisions (0.70)	**14**	Inferring (0.89) Interpreting data (0.67)
5	Interpreting data (0.63) Inferring (0.63)	**15**	Forming space-number relations (0.78) Interpreting data (0.78) Inferring (0.78) Making decisions (0.67)
6	Interpreting data (0.70)	**16**	Classifying (0.78)
7	Interpreting data (0.90) Inferring (0.70)	**17**	Inferring (1.00)
8	Inferring (1.00)	**18**	Inferring (0.88)
9	-	**19**	Defining variables (0.90) Changing and controlling variables (0.80)
10	Inferring (0.80)	**20**	Inferring (0.67)

In Table 3, among the skills that are thought to be used in each question, those with 80% or more agreement among experts are painted in dark green, and those between 63% and 80% are painted in light green. As can be seen from the table, according to the answers given by the experts, the highest agreement was determined as the inferring skill in the 8th and 17th questions. However, in questions 2 and 9, no science process skills were found above the acceptable rate of 0.63. As can be seen from Table 2, the highest agreement was 0.60 in the second question, data interpretation and inference skills, and in the 9th question, the classification skills were 0.56. However, since these compliance rates are below the compliance threshold, it is interpreted that there is no science process skill measured in these questions.

Table 4 shows the distribution of the skills consistent above 0.63 according to the questions.

Table 4

Distribution of the Skills With at least 0.63 Agreement According to the Questions

Skill	Number of questions that include the skill	Questions that include the skill
Inferring	11	3, 5, 7, 8, 10, 11, 14, 15, 17, 18, 20
Interpreting data	8	3, 4, 5, 6, 7, 14, 15, 20
Defining variables	4	4, 12, 13, 19
Making decisions	3	4, 13, 15
Classifying	2	1, 16
Forming space-number relations	1	15
Changing and controlling variables	1	19
Observing	0	-
Measuring	0	-
Recording data	0	-
Predicting	0	-
Constructing hypotheses	0	-
Formulating models using data	0	-
Experimenting	0	-

When Table 4 is examined, it is seen that the most used science process skill according to the accepted agreement of 63% and above is the skill of inferring. This skill was used in 11 different questions. This skill is followed by the skill of "interpreting the data". This skill was used in 8 different questions. In addition, the skill of "defining variables" is in 4 different questions; "making decisions" skill in three different questions; "classification" skill in two different questions. The skills of "forming space-number relations" and "changing and controlling variables" were used in 1 different question. On the other hand, the skills of observing, measuring, recording data, predicting, constructing hypotheses, using data and creating a model, and experimenting could not provide a agreement of more than 63% in any of the questions.

When the tables are examined, it can be seen that the question in which science process skills are used the most is the 15th question. Four skills were used in this question. These skills, used together in the same question, are forming space-number relations, interpreting data, inferring and making decisions. In the 4th question following this, it is seen that three science process skills, namely defining variables, interpreting data and making decisions, are used together.

Discussion and Conclusions

According to the findings of the research, it was concluded that the 2021 central exam questions mostly focused on the science process skills of "inferring", "interpreting data" and "defining variables". However, as a result of the document analysis, the science process skills of "observing", "measurement", "recording data", "predicting", "constructing hypotheses", "using data and creating a model" and "experimenting" in the science questions of the 2021 central exam were not covered enough. It is thought that the hardiness of producing questions to measure the nature of these skills and the limitation in the number of questions may be the reason for obtaining these results since the questions are multiple-choice. In addition, it is thought that high-level science processes such as "experimenting", which are among these rarely used skills, can be evaluated in environments where students are more active. The fact that the exam questions are only multiple-choice causes the evaluation of students' basic science process skills to be at the forefront.

With the exam change made in the Turkish education system, it is aimed to increase the success of an exam that measures various skills at the international level (MoNE, 2018a). In recent years, the increase in the number of questions prepared for science process skills in science questions in the central exam draws attention. However, it is seen that the science questions in the central exam do not adequately cover the science process skills. As a result of the study, it was determined that the questions did not fully measure the science process skills in the curriculum, the questions were generally aimed at basic science process skills, and there were not enough questions about skills of integrated or experimental levels. In addition, a question for a learning outcome may address more than one skill due to the nature of scientific process skills. Therefore, scientific process skills are interrelated skills (Aslan et al., 2016). Questions that include integrated science process skills can also address basic skills. For example, Abruscato (2000, as cited in Aydogdu, 2016) stated that a hypothesis cannot be completely separate from observations and inferences. In this context, it is considered normal to see more than one scientific process skill in a question. In this respect, the importance of questions that address integrated science process skills emerges.

Despite the lack of different studies examining science process skills in the context of the central exam in the literature, comparisons and evaluations related to studies that deal with central exam science questions in the context of the renewed Bloom's taxonomy and SOLO have been conducted. Iz (2021), examining the questions in the secondary education entrance exams according to the MoNE achievements, PISA proficiency levels, and the revised Bloom taxonomy, determined that the questions were at the low-level cognitive level and analysis steps. It has been observed that science questions mostly measure low-level thinking skills and concentrate especially on the comprehension level (Polat & Bilen, 2022).

Akyürek (2019) determined that TEOG and central exam questions were insufficient to measure High-Level Thinking skills, clutter was at low-level knowledge and cognitive steps, and Sezer (2018) found that there were no TEOG questions corresponding to the evaluation and creation steps. In addition, it was concluded that the questions were clustered in the "understanding" level according to the revised Bloom's taxonomy and that they overlapped with "level 1" and "level 2" according to Webb's depth of knowledge levels (Ormancı, 2022). İnci (2014) determined that TEOG questions concentrate on low-level cognitive steps. Çakır (2019), in his study comparing the TEOG, central exam and PISA questions according to the revised Bloom taxonomy, drew attention to the fact that there are no high-level cognitive step questions such as

the creation step in other exams other than the PISA exam. As Polat & Bilen (2022) cites, Arıkan & Kırındı, 2020; Dalak, 2015; Dindar & Demir, 2006; Ermurat et al., 2011; Gökulu, 2015; Güven & Aydın, 2017; Kaşıkçı, 2018; Özel, 2010; Tanık & Saraçoğlu, 2011; Taşkın et al., 2019 and Tolan, 2011 support the results of the study.

Ormancı (2022) concluded that the questions were not distributed homogeneously in the context of PISA science literacy and TIMSS, and each question measures at least one achievement in the science curriculum, but all the achievements in the science curriculum and the experiments and activities in the science textbooks did not meet the questions sufficiently. This result shows similarities with the results of this study. The reason for this is that the central exam requires students to associate their existing knowledge with daily life and interpret them from different perspectives, as well as internalize their science process skills. It is thought that this situation will contribute to the permanence of knowledge in students and that each student gains the 21st-century skills indicated in the curriculum to solve the situations they encounter in their daily lives by using their science process skills. Ar (2019) also stated that scientific inquiry is given importance in the questions in PISA exams. In this context, the fact that the questions in the central exams in Turkey are in the PISA logic will enable students to gain experience in such questions. This situation will have a positive effect on the PISA exam scores of Turkey. It is clear that the central exam is highly selective since science questions do not only cover reading comprehension questions but also require using science process skills. In this context, central exam science questions should include science process skills in a balanced way for scientific inquiry. With the exam change in the Turkish education system in 2018, an international level exam approach that tests various skills was adopted (MoNE, 2018a). However, according to the results of this study, it was concluded that the exam in 2021 did not include a sufficient level of integrated science process skills despite the passage of three years. Considering the importance that developed countries attach to science literacy (Bell & Lederman, 2003; Norris & Phillips, 2003) and the connection between science literacy and scientific process skills (Anagün, 2008; Duruk, 2012), the importance of research on scientific process skills becomes clear.

Suggestions

The suggestions based on the findings are as follows: It has been determined that most of the exam questions focus on the science process skills of "inferring", "interpreting data" and "defining variables", which are in low-level cognitive steps. The quality and level of the questions that students encounter in assessment activities are an integral part of the education system and are very important for the development of students. In this context, it would be beneficial to increase the number of questions measuring the science process skills of "constructing hypotheses", "using data and creating a model" and "experimenting" by reducing the number of questions that measure the skills of "inferring" and "interpreting data" by the central exam question preparation commissions. According to these results, it is recommended to prepare questions about national and international evaluation frameworks and science process skills in the curriculum so that we can achieve our educational goals. It would be beneficial to plan, and present trainings focused on this direction to central exam question preparation commissions and science teachers.

In line with the vision of the Turkish science curriculum, studies should be carried out to include both high-level and basic cognitive process skills in the central exam questions, which are the transition practice from primary to secondary education. It is thought that the central exam question format and styles should be arranged in a way that can include high-level cognitive processes.

Thus, in the education given in primary education, more importance needs to be given to improving the science process skills of students. For future research, researchers may be suggested to examine the questions in the education system of countries that are successful in international exams such as PISA in comparison with the questions in our country. In these comparative examinations, attention can be paid to different dimensions besides science process skills.

Implications

The results of this study have significant ramifications for Turkish scientific education and assessment. The findings imply that the questions on the current central exam do not completely cover the entire spectrum of science process abilities specified in the curriculum. This raises questions about the exam's ability to test students' grasp and use of scientific thinking and skills. A wider range of science process skills, including those at the integrated and experimental levels, must thus be assessed by altering the test questions to ensure that they more closely fit with the objectives of the science curriculum. These issues may be addressed in order to improve science education and evaluation in Turkey and better equip students to meet the demands of the 21st century.

Limitations

The results of this study are important to see where we are in the current situation and to consider the necessary changes. However, this study is limited to the exam questions in 2021. Investigations to be conducted in the following years in terms of similar and different skills will provide deeper contributions to the literature. Also, while this study provides conclusions on specific science process skills, other skills measured or necessary to succeed in central exams such as 21st century skills, engineering design or life skills are out of the scope of this study.

Ethics Committee Report: This study is a document analysis, and ethical committee decision was not required since no data were obtained from any living thing in the scope of the study.

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Geniş Türkçe Özet

Giriş

Türkiye'de 2018 yılından itibaren uygulamaya giren Liselere Geçiş Sistemi (LGS) sınavında öğrencilerin öğrendikleri bilgileri salt hatırlama veya ezberleme yönünden ziyade bunları beceriye dönüştürme durumlarının ölçülmesi hedeflenmektedir. Aynı zamanda 2018 yılında yayımlanan ve uygulamaya giren fen bilimleri dersi öğretim programında da fen alanına özgü becerilerde bilimsel süreç becerilerine vurgu yapılmaktadır. İlgili öğretim programında bilimsel süreç becerileri gözlem yapma, ölçme, sınıflama, verileri kaydetme, hipotez kurma, verileri kullanma ve model oluşturma, değişkenleri değiştirme ve kontrol etme, deney yapma gibi bilim insanlarının çalışmaları sırasında kullandıkları becerileri kapsamaktadır. Programda bilimsel süreçlerin öğrenme ortamına aktarılmasına önem verilmektedir (Millî Eğitim Bakanlığı [MEB], 2018). Programda yer alan becerilerin ölçülmesi için uygun ölçme ve değerlendirme araçlarına ihtiyaç duyulmaktadır. 2018 yılından itibaren uygulanmaya başlayan LGS bu ihtiyaca yönelik olarak yapılmaya başlanmıştır. Böylece öğrencilerin öğrendikleri bilgilerin beceriye dönüşmesi ile ilgili çıkarımda bulunulmak istenmektedir. Bu çalışma ile LGS sınavında yer alan soruların bilimsel süreç becerilerini içerip içermediği, eğer içeriyorsa da bu becerilerinin hangilerini içerdiği analiz edilecektir. Bu bağlamda amaç, MEB tarafından hazırlanan 2021 LGS fen bilimleri sorularının her birinin analiz edilmesi ve soruların 2018 fen öğretim programında yer alan bilimsel süreç becerileri bakımından değerlendirilmesidir. Alanyazın tarandığında 2021 yılı LGS fen bilimleri sorularının bilimsel süreç becerileri bakımından detaylı analizi yapılan bir çalışmaya rastlanmamıştır. Bu bakımdan çalışmamızın alan yazına katkıda bulunacağını, ayrıca bu çalışma sonucu elde edilecek veriler ile LGS sorularının varsa eksikliklerinin giderilerek programa daha uygun düzeye gelmesine katkıda bulunabileceğini düşünmekteyiz.

Yöntem

Araştırmada nitel araştırma yöntemlerinden doküman analizi yöntemi kullanılmıştır. Bu çerçevede 2021 LGS fen bilimleri alt testine ait sorular doküman incelemesi yapılarak bilimsel süreç becerileri konusunda çalışmaları bulunan alan uzmanı dört akademisyen ve altı fen bilimleri öğretmeni tarafından incelenmiştir.

Verilerin toplanması ve analizi

Alan uzmanı dört akademisyen ve altı fen bilimleri öğretmeninin ayrı ayrı inceleyip bilimsel süreç becerilerine göre sınıflandırdığı LGS 2021 fen bilimleri sorularının inceleyenler arasındaki uyumu hesaplanmıştır. Uzman görüşleri çerçevesinde soruların uyumu kategorik uyum kriterine göre değerlendirilmiştir. Araştırma verilerinde on uzman görüşü alındığından, eşik değerden yüksek ilk kabul edilebilir değer 0.63 olarak bulunmuş ve 0.63 ile 0.80 arasındaki değerler uyumlu, 0.80'den daha yüksek değerler ise yüksek uyumlu olacak şekilde yorumlanmıştır.

Bulgular

LGS 2021 soruları incelendiğinde, birinci soruda uzmanlar arasındaki uyum düzeyi 0.88 olduğundan, soruda baskın olarak bulunan bilimsel süreç becerisinin sınıflama becerisinin olduğu söylenebilir. Uzmanların verdiği cevaplara göre en yüksek uyum sekiz ve 17. sorularda sonuç çıkarma becerisi olarak belirlenmiştir. Bununla birlikte iki ve dokuzuncu sorularda kabul edilebilir oran olan 0.63 üzerinde herhangi bir bilimsel süreç becerisine rastlanılmamıştır. ikinci soruda en

yüksek uyumlar 0.60 ile verileri yorumlama ve sonuç çıkarma; dokuzuncu soruda ise 0.56 ile sınıflama becerilerine aittir. Ancak bu uyum oranları uyum eşik değerinin altında kaldığı için bu sorularda ölçülen bir bilimsel süreç becerisi bulunmadığı şeklinde yorumlanmaktadır. Kabul edilen %63 ve üzeri uyuma göre en çok kullanılan bilimsel süreç becerisinin "sonuç çıkarma" becerisi olduğu görülmektedir. Bu beceri on bir farklı soruda kullanılmıştır. Bu beceriyi "verileri yorumlama" becerisi takip etmektedir. Bu beceri sekiz farklı soruda kullanılmıştır. Ayrıca "değişkenleri belirleme" becerisi dört farklı soruda; "karar verme" becerisi üç farklı soruda; "sınıflama" becerisi iki farklı soruda; "sayı uzay ilişkileri kurma" ve "değişkenleri değiştirme ve kontrol etme" becerileri ise 1'er farklı soruda kullanılmıştır. Bununla birlikte gözlem yapma, ölçme, verileri kaydetme, önceden kestirme, hipotez kurma, verileri kullanma ve model oluşturma, deney yapma becerileri hiçbir soruda %63 üzeri uyumu sağlayamamıştır. En çok bilimsel süreç becerisi kullanılan sorunun 15. soru olduğu görülebilmektedir. Bu soruda dört tane beceri kullanılmıştır.

Tartışma ve Sonuç

Araştırmanın bulgularına göre 2021 LGS sorularının en çok "sonuç çıkarma", "verileri yorumlama" ve "değişkenleri belirleme" bilimsel süreç becerilerinin üzerinde yoğunlaştığı sonucuna ulaşılmıştır. Bununla birlikte doküman incelemesi sonucunda 2021 LGS fen bilimleri sorularında "gözlem yapma", "ölçme", "verileri kaydetme", "önceden kestirme", "hipotez kurma", "verileri kullanma ve model oluşturma" ve "deney yapma" bilimsel süreç becerilerine yeterince yer verilmediği ortaya çıkmıştır. Bu sonuçların elde edilmesinde soruların çoktan seçmeli olmasından dolayı becerinin doğasına çok uygun soru üretilememesinin ve soru sayısındaki sınırlılığın sebep olabileceği düşünülmektedir. Ayrıca az kullanılan bu becerilerden "deney yapma" gibi üst düzey bilimsel süreçlerin daha çok öğrencinin aktif olduğu ortamlarda değerlendirilebileceği düşünülmektedir.

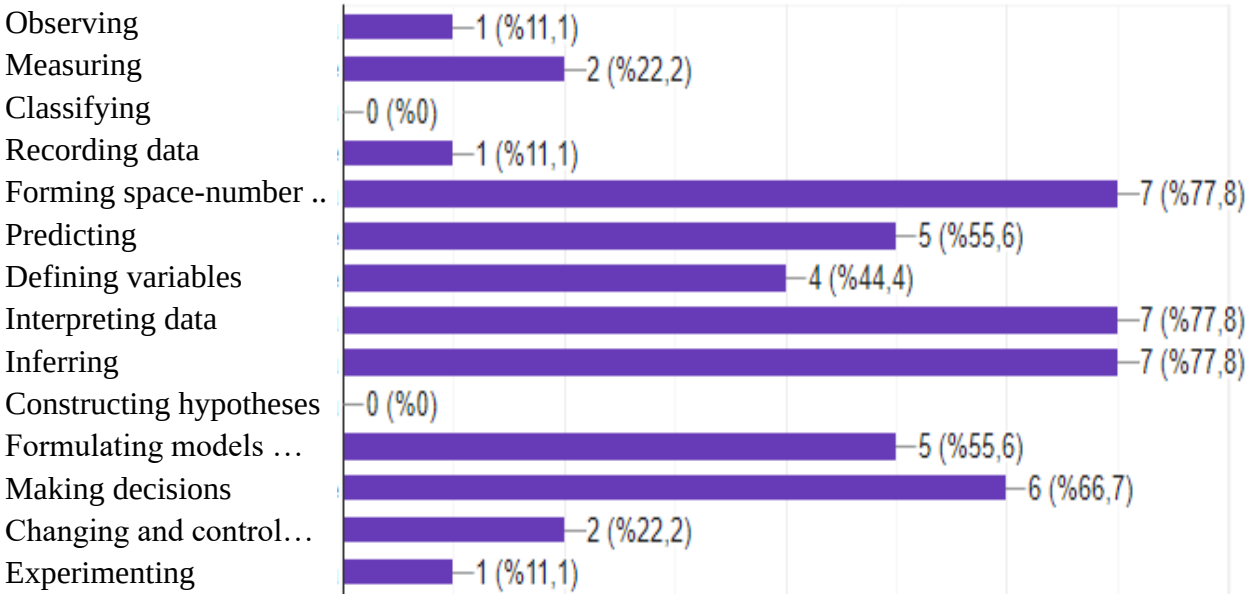
Çalışma sonucunda soruların programda yer alan bilimsel süreç becerilerini tam olarak ölçer nitelikte olmadığı, soruların genellikle az sayıdaki becerilere yönelik olduğu ve tüm düzeylere ilişkin becerilere dair yeterince soru olmadığı belirlenmiştir. LGS fen soruları yalnızca okuduğunu anlama sorularını kapsamayıp bilimsel süreç becerilerini kullanmayı gerektirdiğinden seçiciliği yüksek bir sınav olduğu çok açıktır. Bu bağlamda LGS fen sorularının bilimsel süreç becerilerini dengeli bir şekilde içeriyor olması gerekmektedir.

Öneriler

Öğrencilerin değerlendirme etkinliklerinde karşılaştıkları soruların kalitesi ve düzeyi, eğitim sisteminin ayrılmaz bir parçasıdır ve öğrencilerin gelişimi için çok önemlidir. Bu bağlamda merkezi sınav soru hazırlama komisyonları tarafından öğrencilerin "sonuç çıkarma", "verileri yorumlama" becerilerini ölçen soru sayısı azaltılarak "hipotez kurma", "verileri kullanma ve model oluşturma" ve "deney yapma" bilimsel süreç becerilerini ölçen soru sayısının yeterli düzeyde artırılması yararlı olabilir. Bu sonuçlara göre eğitim hedeflerimizi gerçekleştirebilmemiz için ulusal ve uluslararası değerlendirme çerçeveleri ile programda yer alan bilimsel süreç becerilerine yönelik sorular hazırlanması önerilmektedir.

Appendix 1. Analysis Sample of SPS Expert Opinions

Sample SPS of Question 15.



Sample Expert Opinion on Question 15.

> *"In the question here, many experiments can be made using different numbers and every result can be revealed. Therefore, there is a measurement process, the data as a result of the measurement must be recorded, number space relations are used in these processes, situations can be predicted, and after determining, changing and controlling the variables, the obtained data is interpreted and a conclusion is reached and the decision-making process for the right choice begins. Here the student goes through the process of performing an artificial experiment on paper and in his mind."*
>
> *"By applying different variables sequentially, the situations that will arise can be predicted and after determining, changing and controlling the variables, the data obtained is interpreted and a conclusion is reached and a decision is required for the right option."*

Note: For the above question, the experts marked the BSBs in the given options and the graph mentioned above was created. 9 experts provided feedback to this question sent to 10 experts. For example, there were 7 experts who argued that the ability to interpret data was in this question. Thus, 7 out of 9 experts (77.8%) were accepted as compatible and shown as 0.78 in the table in the study.