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MATHEMATICS LITERACY CURRICULUM DESIGN BASED ON QUESTION WRITING[1]

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ABSTRACT

The purpose of this study is to design, test and evaluate mathematics literacy curriculum based on a constructivist approach towards pre-service teachers. This study is conducted on primary school mathematics pre-service teachers. Data for the main elements of the curriculum are obtained from document analysis in related mathematics literacy teaching. Data for testing and the development of a curriculum template are obtained from semi-structured forms obtained from classes in the application process. The data for the evaluation of the curriculum are obtained from the pre-test, interviews, and the post-test. Obtained findings show that pre-service teachers attended activities with interest and in an active way relating daily life with teaching and preferred to work with groups. These findings show that the constructivist approach in mathematics literacy curriculum is suitable to serve as a basis. At the end of teaching, it is observed that the pre-service teachers gained competencies such as knowing basic concepts of mathematics literacy, selecting among current problems used in this field and develop new problems to be used in this field. Additionally, opportunities and challenges faced by pre-service teachers in the new problem development process are identified. According to those included in the critical category of teaching content show that the number of question transformation activities should be increased under the scope of the curriculum. Accordingly, it is believed that it is beneficial to include mathematics literacy curriculum in the undergraduate programs.

Keywords: Mathematics literacy curriculum, PISA, pre-service teachers, question writing.

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INTRODUCTION

Raising individuals with "mathematics literacy" is one of the main issues of mathematics education. This issue is noticed by education stakeholders and the middle school mathematics curriculum applied in Turkey between 2013-2018 included the literacy concept and in the purpose section, "gaining mathematical information and skills that may be necessary in daily life" (Ministry of National Education [MEB], 2013) is included. The general purpose of middle school mathematics curriculum applied in 2018 also included "individuals can develop and effectively use mathematics literacy skills" (MEB, 2018: 9). Mathematics literacy is defined as the capacity to formulate, apply and interpret mathematics in living spaces in diverse manners (Organisation for Economic Co-Operation and Development [OECD], 2013, 2016). Mathematics literacy evaluation under the Program of International Student Assessment (PISA) measures what can individuals do with learned information in real life and at what level does this information effects participation of an individual to real life rather than what is taught in schools (Berberoğlu & Kalender, 2005: 26). PISA makes this measurement to add to the questions about life situation in order to ask these questions within a context (Altun, 2016: 136). With this structure, the PISA evaluation has been one of the most important references to guide the education policies for various countries (Breakspear, 2012).

After reports prepared by Tomlinson (2004) and Smith (2004), mathematics literacy has been the main objective in schools of certain countries. It is stated that the priority of mathematics curriculum should be mathematics literacy (Burkhardt, 2008). The goals of middle school mathematics curriculum applied in Turkey since 2013 have similarities with such expressions in terms of content. Despite these similarities, the low results of Turkey in the PISA application (MEB, 2016: 37) show that this curriculum fails to reach its goal. One of the main reasons behind this is insufficient inclusion of mathematics literacy in the teaching process.

Uysal and Yenilmez (2011) stated that to increase the mathematics literacy of eight grade students that are level two or below, they frequently need to face the problems shown in PISA in their learning environment. Altun and Bozkurt (2017) stated that discussing life-related texts with mathematics content in the learning environment is needed to familiarise students with this type of texts. Additional contextual questions and texts with mathematical content to mathematics teaching and asking questions related with these may prevent this problem by creating discussions. Widjaja (2011) stated that in terms of gaining experience about the power of mathematics in a real-life context, PISA questions are important for pre-service teachers and mathematics teacher training programs should support developing mathematics literacy. In the literature, it was emphasized that mathematical literacy questions should be included in the teaching process. This emphasis showed that studies on two subjects are needed. The first is how to teach mathematics literacy. The second is how to gain the competence to select and write questions to be used in teaching mathematics literacy to teachers or prospective teachers.

In literature, there are results obtained from studies conducted in mathematics literacy fields regarding the quality of the teacher and teaching. Saenz (2009) found that Spanish pre-service teachers struggled more in contextual questions compared to conceptual and operational questions. Leikin and Levav-Waynberg (2007) stated that middle school teachers struggle matching subjects with real life situations, therefore, preferred abstract examples. This preference may be caused by lack of experience. In another study (Altun & Akkaya, 2014: 34), teachers expressed a lack of relating teaching with real life situations as an issue. Özgen (2013) stated that mathematics pre-service teachers struggle matching mathematics with life. Based on these results related with mathematics teaching process and lack of contextual questions in measurement and evaluation, scope of this study should include contextual question selection and writing.

Problem writing activities should be included in mathematics education and it is recommended that students write their own problems, using their experience arising from other problems they have previously solved (National Council of Teachers of Mathematics [NCTM], 1991; 2000). Math teachers should be able to pose problems that their students will struggle in order to encourage their students to think mathematically (Crespo, 2003) and to gain in-depth knowledge of their understanding of mathematics (Vacc, 1993; Cai & Hwang, 2002; Goldenberg & Walter, 2003). Kohar, Zulkardi and Darmawijoyo (2014) suggest encouraging teachers and students to design PISA-based teaching and assessment tools. These tools must include mathematical literacy questions. Therefore, writing questions becomes an important part of teachers' work and has an important place in mathematics education (Patáková, 2013). According to Silber and Cai (2017) pre-service mathematics teachers represent a unique group of individuals who engage in mathematical thinking. On the one hand, these are learners of mathematics developing a deeper understanding of mathematical concepts and ideas, thus problem posing gives them an opportunity to experience mathematics with a new activity. On the other hand, these are individuals training to teach mathematics to children in schools, thus trying to write question makes them think about how they could pose mathematical problems for their students.

Because of low scores in PISA and studies in the literature, studies to help mathematics pre-service teachers to be competent individuals are needed. Such an initiative may significantly reduce issues related with raising mathematically literate individuals. This study is planned to tackle this problem and the purpose is to design, test and develop mathematics literacy curriculum towards mathematics pre-service teachers.

Most of mathematics literacy studies in the literature are based on PISA data. Therefore, it may be beneficial to evaluate results obtained by Turkey in the mathematics literacy field of PISA as this data is the primary data source.

Evaluation of PISA Results

PISA is applied once in every three years since the year 2000. In these applications, 15-year-old students are evaluated in three main fields, namely mathematics, science and reading. In each application, one of these

three fields are emphasised. Under the scope of this study, 2003 and 2012 applications with mathematics emphasis (2006 and 2015 science, 2009 and 2018 reading) is considered for evaluation. Mathematics literacy average scores of OECD countries in this application were calculated as 500 and 494 respectively and average scores of Turkey were calculated as 423 and 448. The competence level is classified between a category of 1 to 6 and these scores correspond to a second competence level. The second level is regarded as students recently showing skills to use mathematics effectively and as a base line for mathematical competence (İskenderoğlu & Baki, 2011: 291).

Content and Structure of Mathematics Literacy Curriculum

The general purpose of the mathematics literacy curriculum is to help pre-service teachers to gain skills such as knowing the main concepts of mathematics literacy, selecting related activities and problems within the current mathematics teaching process and developing new ones.

In designed curriculum, the main concepts regarding mathematics literacy are presented in detail. After the main concepts, the purpose for the pre-service mathematics teachers are to gain skills such as:

- selecting problems to be used in mathematics literacy within current mathematics problems,
- transforming current mathematics problems to problems that can be used in these situations,
- developing new problems to be used in this field.

Therefore, activities regarding how pre-service mathematics teachers can obtain mathematics literacy questions are frequently included in teaching. To present an example, one of these activities is presented in Appendix 1.

Brown and Schäfer (2006) stated that in mathematics literacy teaching, the constructive approach is an effective model. In constructivist curriculum, learning content is linked with real life and it is unique, learners actively generate information that will be used throughout life in a democratic class environment by solving the complexities of daily life (Karadağ & Korkmaz, 2007). Learning is organised for the context of individuals rather than pre-determined topics (Marlowe & Page, 1998). This information regarding the properties of constructivist learning is in line with the definition of mathematics literacy and the structure of question writing activities conducted in this study. In these activities, pre-service teachers have active roles. Additionally, due to the nature of the definition, mathematics literacy emphasises the active use of gained mathematical information and skills in daily life. Therefore, mathematics literacy teaching designed under the scope of this study considered the constructive approach as the basis.

Teaching plan framework (titles) in this study should meet the learning process based on constructivist teaching. Accordingly, related literature is reviewed and the teaching plan with these properties are selected (Sönmez, 2007: 181). The teaching program is planned for each class based on this selection. A sample teaching plan for fifth week is given in Appendix 1.

Purpose

The low national performance in PISA and results of studies related with quality of teachers and teaching show that question writing based mathematics literacy teaching is necessary for pre-service mathematics teachers. Therefore, the purpose of this study is to design a mathematics literacy curriculum based on question writing.

The lack of mathematics literacy applications and studies to prepare these applications in Turkey (Demir, 2015) means we must educate individuals who know the main concepts about mathematics literacy, can select problems and develop new problems as a priority.

Teachers are a component of teaching, and therefore, pre-service teachers are an effective power. If pre-service teachers have the competency to select and develop the mathematics literacy application, this gap can be narrowed. In this sense, the sub-problems of this study can be expressed as follows.

1. What is the readiness level of pre-service mathematics teachers regarding the main concepts of mathematics literacy?
2. At what level do pre-service mathematics teachers gain the main mathematics literacy concepts with an applied mathematics literacy curriculum?
3. At what level does the applied mathematics literacy curriculum template provide skills to select problems that could be used in mathematics literacy field among current mathematics problems and create new problems to pre-service mathematics teachers?
4. What are opportunities and challenges faced by pre-service mathematics teachers for selecting and writing mathematics literacy questions?

Design, test and development of curriculum that provides solution of these problems, the introduction of main mathematics literacy concepts, question selection, question transformation, and obtaining context and question writing activities is necessary. With this teaching, pre-service mathematics teachers will know the main mathematics literacy concepts and develop question selection, transformation and writing skills in the mathematics literacy field.

The purpose of this study is to transform the serial actions (Demir & Altun, 2018) in the literature into a draft curriculum based on the constructivist approach, and to try, evaluate and develop it. The curriculum applied in this study has three main differences in terms of the mathematics literacy teaching in the literature. First, the mathematics literacy curriculum is programmed and applied to create class content for one term rather than a unit within the mathematics literacy teaching process. Second, the purpose and activities for “transforming current mathematical problems into problems that can be used in the mathematics literacy field” will be added to the curriculum content. Third, a unique method is used to estimate whether a question is a mathematical literacy question. Also, this study is unique since it is conducted on a group who will become teachers of students that participate in PISA evaluations. This way, this curriculum can be beneficial in teacher trainings

and in-service seminars organised for teachers. From this perspective, it is believed that this will have a widespread impact on the mathematics field.

METHOD

The purpose of this study is to develop a curriculum template for mathematics literacy classes towards elementary pre-service mathematics teachers. To reach this purpose, mixed method is used. Method of this study is presented in Table 1.

Table 1. Study Method

	MIXED METHOD				
Pattern	Stage	Purpose	Model	Method	Technique
Action Research	1	Structuring main elements of curriculum template	Survey	Qualitative	Document Analysis
	2	Identification of readiness of participants regarding main concepts of mathematics literacy	Survey	Quantitative	Descriptive
	3	Test, evaluation and development of curriculum template (Application)	Trial	Qualitative	Observation
	4	Evaluation of curriculum template over participant interviews	Trial	Qualitative	Interview, Audio-Visual Records, Content Analysis
	5	Evaluation of effects of curriculum template over three variables	Trial	Quantitative	Single Group Pre-test/Post-test

The first stage contains structuring of the main elements in a curriculum template (Demirel, 2012; Yüksel & Sağlam, 2012) which are (i) purposes, (ii) content, techniques and activities that will be applied in (iii) learning teaching processes and (iv) evaluation. The second stage contains a quantitative pre-test whose purpose is identification of the readiness level towards main mathematics literacy concepts. The third stage (application stage) contains observing courses and testing, evaluation and development of curriculum template. The fourth stage contains the evaluation curriculum template by using interviews to collect opinions of pre-service mathematics teachers after teaching. The fifth stage contains measurement of effects of the newly applied curriculum template on (i) mathematics literacy main concepts, (ii) question selection and (iii) question writing skills. Ethical rules were followed at all stages of the method.

For this study, the mixed method is considered. The mixed method contains qualitative (open-ended) and quantitative (close-ended) data collection for research questions or hypothesis and analysing both types of data (Creswell, 2013: 217). It is seen that these properties of mixed method match the methods of this study. Also, in effort to understand the work environment/topic by the researcher, the goal to make a change or find a solution to existing conditions is emphasised. This effort and goal shows that this study can be classified as action research (Yıldırım & Şimşek, 2008: 78). Action researchers are commonly used in-class teaching

applications and by teacher-teaching researchers. Therefore, action researchers try to contribute to the development of problems by cooperating with individuals in the environment rather than isolating themselves from the social environment or generating solutions for certain problems (Norton, 2009; transferred by Karaman & Apaydın, 2014: 381). This property matches the action research part of this study. In this case, this study can be characterised as action research with a mixed method.

Study Group

The study group consisted of 12 students in 2nd grade of a mathematics teaching undergraduate program in a state university in the Aegean region. Applications were conducted in a 3-hour elective course in the spring semester of the 2016-2017 academic year. Although there were other teaching programs, a study group among pre-service elementary teachers was selected due to participation of 7, 8, 9 and 10th grade students in PISA projects and the elementary pre-service mathematics teachers will work with 7th and 8th grades. Waiting until 9th or 10th grade to introduce mathematics literacy concept to students may be too late.

Data Collection Tool and Collection of Data

When method of this study was considered, the first step included structuring four main elements of the curriculum template. For this purpose, the mathematics literacy literature and PISA reports published by OECD were analysed. These resources were subjected to document analysis and (i) purposes, (ii) content, (iii) learning teaching process and (iv) evaluation elements were structured.

In the second stage of this method, the process to identify the readiness level of the pre-service teachers regarding the main mathematics literacy concepts is considered. For this purpose, the pre-test was evaluated by expert views and consisted of a total of 10 questions with 2 multiple choice, 4 close-ended and 4 open-ended questions were used. Test is a criterion-based measurement tool. It is known that these types of measurement tools are used for comparing pre-determined mastery or success levels of student performances, focusing on narrow and sharp skill sets, and summarising mastery levels in these criteria. Therefore, these tools are beneficial for program planning and monitoring development (McLoughlin & Lewis, 1997). The purpose of this study and properties of criterion-based measurement tools match. Therefore, this pre-test where validity and reliability study was conducted for suggested criterion based measurement tools was applied.

At the third stage, test, evaluation and development of mathematics literacy curriculum template was included. For this purpose, classes were monitored with the semi-structured observation form obtained from the literature (Sönmez, 2007: 219). For purpose of validity, the observer was selected as a mathematics teacher experienced in measurement evaluation and has studied in the mathematics literacy field. For qualitative observations, the expertise of observer in the observed field is important to increase validity (Karasar, 2009: 164). After the class, by using the forms, purpose and content of the related class, the applied learning teaching process and what level of validity was achieved on evaluation activities were discussed with

the observer. This way, the content of the main elements of the curriculum were adjusted. Accordingly, the curriculum had a final form for the related week.

The fourth stage contains the evaluation of the curriculum's effects based on participant pre-service teachers' opinions. For this purpose, semi-structured interviews were adopted. The interview was conducted on the 13th week. Participants were asked "can you select questions suitable for the mathematics literacy among current mathematics questions and can you write appropriate questions in this field". After that, depending on answers of the participants, reasons were asked to participants who gave negative answers and opportunities to ask the participant who gave positive answers were given. This way, opportunities and challenges faced by the pre-service mathematics teachers in the problem selection and new problem generation in mathematics literacy.

Validity and reliability of interview questions: Interviews were recorded with a video camera by the researcher and a measurement evaluation expert who has competence in content and process. To provide scope validity, the literature was reviewed, and expert opinions were collected to determine the interview questions. During the interview, in addition to "Did you learn selection and development of problems in mathematics literacy? Please state openly and sincerely.", additional questions are used to receive the opinions of participants. A sincere and trustful environment during the interview process is important to increase the possibility to obtain real data (Çepni, 2012: 163).

The fifth stage contains the measurement of effects of the newly applied curriculum template on (i) mathematics literacy main concepts and (ii) problem selection and new problem development skills. The criterion based interim test and post-test was used which has questions reviewed by experts and selected from the literature. Including pre-test in the second stage, information regarding content and application time of quantitative data collection tools are given in Table 2.

Table 2. Information Related with Test Content

	Number of Questions		
Measured	Pre-test	Interim Test	Post-test
Main Concepts	10	8	-
Selecting from Current Mathematics Problem*	-	12	-
Developing New Problem**	-	Questions until interim test	Questions from interim test to post-test
Application Time (Week)	1st Week	8th Week	From 9th Week to 14th Week

* In related problem conditions, these are the questions that can be considered as mathematics literacy. Whether pre-service teachers could select problem conditions among others.
** Pre-service teachers were asked to develop at least 4 new problems.

It is known that the development of new problems is a hard process and a skill that can be improved over time (Demir & Altun, 2018). Including tests and interviews, data collection lasted for 14 weeks and repetitive

measurements were conducted. The purpose of these repetitive measurements was to increase the validity of data and therefore, results obtained from this data.

Application

Mathematics literacy is appropriate for the constructivist approach (Brown & Schäfer, 2006). Therefore, teaching was designed based on principles of this approach. In this sense, all activities were structured as a group based on contexts faced by participants daily within the active learning teaching processes.

With observation forms, objective, content and learning teaching process for each class was monitored, evaluated and developed. Based on these processes, the general purpose and gains of the obtained curriculum template are listed below. Additionally, each gain is matched with the contributing component(s) and the scope validity of gains towards general purpose are presented in Table 3 (table of specification).

The general purpose is to help pre-service teachers to gain skills such as (i) knowing the main concepts of mathematics literacy, (ii) selecting related activities and problems within the current mathematics teaching process and (iii) developing new ones.

Table 3. Table of Specifications Regarding Gains

		Components of General Purpose		
	Gains	*i*	*ii*	*iii*
K1	Writes a problem concept definition.	x		
K2	Classifies problems.	x		
K3	Notices the importance of solution process in a problem.	x		
K4	Knows PISA and defines Mathematics Literacy (ML).	x		
K5	Discovers the correspondence of expression in ML definition in application.	x		
K6	Knows the scope of formulating situations and problems in mathematical terms.	x		
K7	Knows the scope of using mathematical concepts, realities, methods and reasoning process.	x		
K8	Knows the scope of interpreting, applying and evaluating mathematical outputs.	x		
K9	Knows how mathematical processes work in the solutions of ML problems.	x		
K10	Knows the scope of context properties and context types.	x	x	
K11	Knows how to add ML question property to relationships between mathematical processes and context.	x	x	
K12	Knows categories and the scopes of mathematical content information in the ML field.	x		
K13	Knows the general ML evaluation framework.	x		
K14	Knows criterion to be used to decide whether a question has properties to measure ML.		x	
K15	Selects questions that can measure ML among given questions.		x	
K16	Applies transforming exercise questions to ML questions.			x
K17	Develops awareness for events that can emerge within context.			x
K18	Evaluates how a final problem obtained after transformation can serve towards the mathematics literate measurement purpose.			x
K19	Writes a ML question based on faced and noted contexts.			x
K20	Evaluates at what level does this question serve the measurement of ML.			x
K21	Matches written or selected ML questions with gains in the 7th, 8th, 9th, and 10th grade mathematics curriculum.		x	x

To provide samples, teaching content regarding selected classes are given in the appendix 1. Other classes were conducted based on this sample class. Additionally, a few sample questions written by pre-service teachers are added in appendix 2.

Data Analysis

For data collection tools, a score of over 100 was determined for each participant based on data obtained from the pre-test related with the main concepts of mathematics literacy.

In testing, evaluation and development of curriculum template semi-structured observation forms filled by observers in the classroom were analysed to reflect the related updates for objectives, content and learning teaching process for each class.

While evaluating the effects of the curriculum template on participant optinions, audio and video recordings obtained during the interview were transcribed first and these texts were subjected to content analysis to reflect opportunities and challenges faced by the pre-service mathematics candidates in the problem selection and the new problem development processes. In this study, positive opinions of pre-service teachers during the interviews are considered as opportunities and negative opinions are considered as challenges. Strauss and Corbin (1990) stated that the coded-based content analysis is necessary if there is no theory to form a basis for analysed phenomenon. In this study, the coded-based content analysis was conducted on data collected during interviews and "opportunity-challenge coding for pre-determined concepts" (Çepni, 2012: 174) was applied. For reliability, the original statement-concept matching during the analysis process is analysed by a second expert. Differences between the researcher and the measurement evaluation expert were discussed and reconciliated. Additionally, the original statements of participants were matched with codes (opportunities-challenges) with a descriptive approach (Le Compte & Goetz, 1982).

While evaluating the effects of teaching on three variables (main concepts, selection, writing), the scores of participants from the related sections of the tests given in Table 2 were analysed as follows:

1) The "Main Concepts" section scores of pre-test and interim tests were compared for participants. The goal here was to determine the gain in the main mathematics literacy concept level of participants. The distribution of pre-test scores were tested with the Kolmogorov-Smirnov test and it was shown that there was no normal distribution ($p=0.002<0.05$). Therefore, Wilcoxon test was applied for comparison (Büyüköztürk, 2011: 162).

2) The "Selecting Among Current Mathematics Problems" section of the interim test consisted of 12 questions with 4 suitable for mathematics literacy and 8 unsuitable questions. Participants were asked to select suitable options for mathematics literacy. Scores obtained by pre-service teachers over 100 were calculated as

$$\left[\left(\frac{\text{Number of Questions Correctly Chosen by the Participant}}{4} - \frac{\text{Number of Questions Wrongly Chosen by the Participant}}{8}\right).100\right]$$

3) In the question writing section, questions written by pre-service teachers were evaluated for (i) whether these questions are literacy questions, (ii) uniqueness and (iii) clarity.

i. For the first (i) item, the evaluation of written questions is a prerequisite. This evaluation is based on analysing context, mathematical processes while solving these questions and testing functionality of the obtained products at the end of this process. Formulas/models, mathematical outputs and processes for context and solution process of each question are tested for conditions given in Table 4.

Table 4. Tests Applied to Evaluate the Suitability of Selected or Written Questions to Mathematics Literacy

	Testing	Results		
		Yes	No	Absent*
1	Does question have context?			
2	Is data presented in the question real or can be real?			
3	*If any,* are the assumptions in question text functional?			
4	*If any,* are the limitations in the question text functional?			
5	Does the question have at least one acceptable solution?			
6	If the solution of the question has a formulising process, does the mathematical formula/model obtained during or at the end of the solution enable one to form an argument for variables or limitations in the given life situation?			
7	If solution of the question has a formulising process, does the mathematical formula/model obtained during or at the end of the solution enable a functional interpretation for variables or limitations in the given life situation?			
8	Do mathematical operations in the solution provide a functional result for a given life situation? Or do these operations provide an approximation of functional results? (Here, there should be uncertainty regarding lack of qualitative or quantitative data related with a life situation and these operations should be tested whether they have a functional property of a life situation.)			
9	Do mathematical outputs formula/model obtained during or at the end of the solution enable to functional interpretation or forming argument for variables in a given life situation?			

* This column is not marked for questions that does not have "if " condition (questions 1, 2, 5, 8 and 9).

If test results for written question are:

for 1	"Yes"
for 2	"Yes"
for 3	"Yes" or "Absent"
for 4	"Yes" or "Absent"
for 5	"Yes"
for any of 6, 7, 8, 9	"Yes", this question passed evaluation step.

For remaining conditions, this question failed to pass an evaluation stage and the question writer is given related feedback based on the test items with the "No" answer. If the writer could revise the question based on feedback, this question is retested in a final form. Questions that passed this stage were given 30 points.

ii. The uniqueness of the question was evaluated with over 40 points based on uncommon nature, novelty and originality of the question:

- ✓ Uncommon nature (5p.): Routine problems were scored with 0 and non-routine problems were scored with 5.
- ✓ Novelty (10p.): Life conditions in the question:
  a. was given 5 if the question interesting and 0 for other conditions.
  b. was given 5 points if interest is raised for the solution or result and 0 for other conditions.
- ✓ Originality (25p.):
  a. If this question is the same as another mathematics literacy or obtained from re-organisation of the content, (-35) points was given,
  b. If this question was obtained because of a unique writing process, 25 points was given.

iii. Clarity was evaluated over 30 full points. In these evaluations:

- ✓ Unclear and unsolvable questions due to missing text, shape or data were given 0.
- ✓ Questions that can be clarified with minor changes on the test, shape or data were given 15.
- ✓ Questions that can be understood and solved as they were, were given 30 points.

Evaluations (i, ii and iii) were conducted by a researcher and mathematics teacher measurement evaluation expert. Arithmetic average of both evaluators was considered.

This way, all questions written by pre-service mathematics teachers were evaluated with 30 points for mathematics literacy, 40 points for uniqueness and 30 points for clarity. This way, a score over 100 points was obtained for each question written by the pre-service teachers. During the teaching process and in the examination, pre-service mathematics teachers wrote multiple questions. A participant's writing points were determined as follows: based on evaluations explained above, highest scoring question of the pre-service teacher was determined and score of this question was evaluated as the score "to develop a new problem".

The combined score for "problem selection or new problem development" of pre-service teachers were calculated based on the arithmetic average of the post-test score and the sections of interim test except the "Main Concept" section.

After all these calculation, the (i) main concepts and (ii) selection and new problem development score was identified for each teacher of over 100 points. The scores of pre-service teachers are presented to show achieving gains in a percentage format.

FINDINGS AND COMMENTS

Below, the findings of this study are presented based on the sub-problem order. The first sub-problem was about identification of the readiness of pre-service mathematics teachers in terms of main concepts of mathematics literacy. The pre-test results before teaching are presented in Table 5.

As seen from Table 5, the data obtained from the pre-test showed that the readiness level of pre-service teachers in terms of main mathematics literacy concepts was 2.8 over 100. This showed that including general information and definitions regarding mathematics literacy concepts in designed curriculum is necessary.

The second sub-problem of this study required identification of gains of pre-service teachers in terms of main mathematics literacy concepts. The results obtained from the "main concepts" section of the interim test are presented in Table 5. To provide opportunities for comparison, the pre-test results of the groups are given on same table.

Table 5. Main Concept Test Results Over 100 Full Points

N	Pre-test		Interim Test	
	$\bar{X}$	ss	$\bar{X}$	Ss
12	2.80	1.99	56.25	20.45

When Table 5 is considered, it is seen that the study group significantly gained in mathematics literacy main concepts and gains exceeded 56%. Additionally, the statistical significance of this difference before and after teaching was determined. For this purpose, the pre-test scores and the "main concepts" section scores of interim tests were compared. Since these scores of the dependent sample had a non-normal distribution, a Wilcoxon signed rank test was applied and results are shown on Table 6.

Table 6. Comparison of Awareness Scores

Interim test- Pre-test	N	Rank Average	Rank Total	z	p
Negative Rank	-				
Positive Rank	12	6.50	78.00	3.06	.002
Equal	-				

* On a positive rank basis

Analysis results showed that gains of pre-service teachers in the study group for mathematics literacy main concepts increased in a statistically significant way ($z = 3.06$, $p < 0.05$).

The third sub-problem of this study analysed the level of the applied mathematics literacy curriculum template to provide skills to select problems that could be used in the mathematics literacy field among current mathematics problems and to create new problems for pre-service mathematics teachers

In this study, it was assumed that knowing the main concepts in the mathematics literacy field is prerequisite to selecting problems and new problem development skills. Therefore, by considering the low pre-test scores of

participants, there was no need to measure mathematics literacy problem selection and new problem development skills before teaching.

Score distribution, average and standard deviation of participants are given in Figure 1.

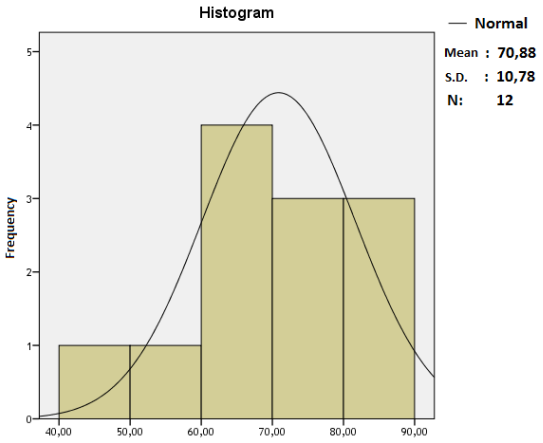

Figure 1. Combined Score Distribution for Problem Selection and New Problem Development

When Figure 1 is analysed, it is seen that 70.88% of study group gained these two skills.

The fourth sub-problem was to identify opportunities and challenges faced by pre-service mathematics teachers while selecting mathematics literacy problems and developing new problems. Content analysis was applied to the opinions of pre-service mathematics teachers. Explanation of participants and related classification is given in Table 7. Each sentence given in the findings column of the table are original expressions of teachers.

Table 7. Classification of Pre-service Teacher Opinions for Study Purpose

No	Finding	Evaluation
1	Thinking what will come from where. It is good for me (thinking on something). (Other) classes are boring to me. This, because I can make it. I think on what I look at. We can write a question like while putting chairs here (to sit down), how much can we fit and how can we fit them. I see everything like that, as my other friends say, I see like there is context everywhere. While walking on the road, I am trying to see what I can make up from trees, flowers, bugs. I am thinking what I can do to turn them into questions. It is good and all that to think about context. It is good for me to learn something like that. I added something beautiful to my life.	Opportunity
5	Well, after doing it for the first time, you gain self-confidence. You can think like that more.	Opportunity
6	If our friends can write like this, it will be fun for them. If they can get couple of things...	Opportunity
7	While I am studying, when I get bored I think of a question, I mean it is fun to think like this. Thinking of a question is like a puzzle.	Opportunity
22	When I am forced to think of a certain thing (on a context or topic to act as source to these questions), I cannot do it.	Opportunity
23	(In class) we were having fun, I mean let's find a context, let's do that, let's do this, we were a group, it was like that.	Opportunity
24	Seing a different mathematics question type, looking at mathematics from this perspective (life relationship) is good for me.	Opportunity
25	Let this be a confession. For me mathematics was about numbers on paper. They were saying that you will use it in the economy, daily life etc. I cannot solve problems, so I cannot see them. But in this class, I really learned that I can use mathematics in the surrounding. It was a science for me, but from now on, I started using, I mean, I must say that.	Opportunity

26	It is good to show PISA at the beginning because I had the idea that these are used in exams like PISA, and it works globally. For me, it is good for you to say PISA first. We saw what it was used for (mathematics literacy).	Opportunity
27	We said we should keep transformation (questions) longer, but I think it is the opposite. Transforming is boring for me. The thing is, I am forced to follow that path, I cannot think widely. When I think about it on my own, since I can think of everything, since I start the question I will write. For me, it is good to directly start the question. Transforming is boring for me. It is better to keep it short.	Opportunity
28	But now I am looking everywhere for context.	Opportunity
29	I am thinking about it when I am in the market.	Opportunity
30	Although we tour, we always think about context.	Opportunity
31	Now, I am better. We talked about you even on our Bursa trip. We try to find as much as we can.	Opportunity
32	We had it in us, finding context I mean.	Opportunity
33	There (while transforming context into a question), having a group is advantageous for me. We have three people, they are supportive.	Opportunity
2	It was hard at first, now it is not that hard.	Challenge
3	But writing is harder (compared to selecting).	Challenge
4	First, when it comes to question writing, I was stressed, first, then it is more enjoyable I mean since we constantly write examples.	Challenge
8	This is a skill because I try to be creative, but I mean I cannot.	Challenge
9	If I don't experience it, I cannot turn it into question.	Challenge
10	I first, look at the problems in my normal life. What do I have? I notice I don't have any problem. I mean in terms of context. Then, I can't write it. Since I can't find context, I don't have question.	Challenge
11	Because I can't think. (lack of interest)	Challenge
12	I know what mathematics literacy is, I really learned it, but I can't find context.	Challenge
13	I think I can't think differently. Context is always the same. Since I live in the village, I think of the village.	Challenge
14	I don't have options, I cannot select. I couldn't diversify it. I mean a newspaper question, magazine question, survey question, I cannot think of them. If I find a question, I cannot find the solution. How will I solve it? I have trouble with statistics and probability, I just erased them from my head. I cannot write questions like that.	Challenge
15	Okay, I think of all those contexts and all but I lack like the problem or something like that (worker, pool, age, mixture etc.).	Challenge
16	Like he said, I mean there are problem topics (age ...), what we write are like them but like context from real life. Since I cannot do them, it is not solution oriented. I memorise in mathematics, if they give me rule, I can make it.	Challenge
17	Context, I was able to find but my context was always in a profit-loss direction.	Challenge
18	Once I found context, I can't write question in a creative way, I mean in an uncommon way. For example, we have one question, I cannot go beyond it, I am always trying to write based on it.	Challenge
19	I find context, but I find it challenging to write that context as a question.	Challenge
20	It was hard for me to transfer (context) into a mathematics questions.	Challenge
21	Which one will I take (context-event). How will I transform it into mathematics literacy? This is hard.	Challenge
34	We selected questions after explaining the class content, if we started transforming non-mathematics literacy questions, that would be easier. Then, we can take PISA questions as examples. To write at a higher level for example, we first learn, we learn how to write. To go one step higher, we take PISA questions as a basis. This type of transition can happen.	Challenge
35	Similarly, I believe having a longer transformation process before the question writing process could be better for us, there can be personal differences.	Challenge
36	I actually struggle in writing. Suddenly shortly after learning we started writing.	Challenge
37	Instead of PISA, where how and in what way can we use mathematics literacy, rather than PISA if we used this in informative way, later we could come to this class in more accepted and entertained way. Starting directly from PISA, and after that selecting mathematics literacy question and transforming and question writing, I couldn't match relationship of these with PISA. And I was like what happened from the things we started with until now.	Challenge

Statements 1, 28, 29, 30, 31 and 32 are evaluated as opportunities show the importance of observing daily events and developing a context based on these events to write mathematics literacy questions. These statements at the same time show that the "can I make a mathematics literacy question from there" thought was internalised by pre-service teachers.

Again, in statements 5, 6 and 7 that are considered as opportunities, it is shown that writing questions is fun and succeeding in this task caused teachers to be more interested in the process. Statements 24 and 25 showed that the perspectives of participants towards mathematics has been positively changed. Statement 22 shows that not being limited by context or subject. Statements 23 and 33 show that group work is considered as an opportunity.

Statements 2 and 4 show that question writing is a skill that develops over time; statement 3 showed that question writing is hard; statements 19, 20 and 21 showed that participants struggled how to transfer context into a mathematics literacy question; statements 9, 10, 12 and 21 showed that participants struggled in finding or identifying context. Again, statements 8, 16 and 18, which were evaluated as challenges, showed that the issue is about a lack of creative thought. Similarly, statements 13, 14 and 17 showed that the same contexts are considered and there is lack of internalisation. Statement 11 showed the lack of interest of participants. Statements 15 and 16 showed that participants felt insufficient about certain mathematics topics.

Other than these, statements 34, 35, 36 and 37 show that explaining topics in a teaching content is considered as a challenge. Statements 26 and 27 showed that this ranking is considered as an opportunity.

DISCUSSION, RESULTS AND RECOMMENDATIONS

It is emphasised that the mathematics literacy level of pre-service teachers is below the expected level (Demir, 2015; Kabael & Barak, 2016). In addition to literature, that was seen to be true in the current study, and necessity and importance of teaching was proved with pre-test data of this study. Conducting similar studies can contribute to the development of pre-service teachers' literacy skills.

In this study, at the beginning of the teaching, explaining the following issues in detail about mathematics literacy was evaluated by pre-service teachers as an opportunity.

1. Mathematical literacy is measured worldwide by PISA applications organized by OECD.
2. The results are considered at a level to guide the education policies of the countries.
3. Mathematics literacy helps students to realize the relationship between mathematics and everyday life.

This result shows that its widespread impact and relevance to everyday life are two factors that increase the interest of pre-service teachers on mathematics literacy. It can be said that these factors provide two benefits together. First, pre-service teachers' motivation for learning mathematical literacy increased. Second, pre-service teachers regarded "writing mathematics literacy questions" as a valuable task.

Widjaja (2011) showed that in terms of experiencing the power of mathematics under real world contexts, mathematics teacher training programs must be supported in terms of mathematics literacy development. Demir and Altun (2018) provided question selection and writing skills to pre-service teachers with mathematics literacy teaching. Mathematics literacy teaching in this study is used as a resource in this study, based on recommendations in literature. Content and structure was developed and adapted as "question writing based

mathematics literacy curriculum template". This newly developed and applied program enabled pre-service teachers to gain skills for mathematics literacy main concepts, selecting problems among current problems and developing new problems. Compliant results of these two studies prove the reliability of teaching. This way, a reliable curriculum template that will support teacher teaching in mathematics literacy field is presented. The implementation of this curriculum can reduce the difficulties (Leikin & Levav-Waynberg, 2007; Özgen, 2013) that pre-service teachers and teachers face in associating mathematics with life.

In this study, a curriculum template has been developed for the mathematics literacy course, which many researchers (Güneş & Gökçek, 2013; Özgen & Kutluca, 2013; Özgen, 2015; Kabael & Barak, 2016; Machaba & Mwakapenda, 2017) recommend adding to teacher training programs. In addition, it is stated that teachers should use the mathematics literacy problems involving real world contexts in the teaching process (Bansilal, 2011; Dewantara, Zulkardi & Darmawijoyo, 2015). The focus of this curriculum template is on question writing. Thus, pre-service teachers are also supported in writing mathematical literacy problems that they will need during the teaching process. Based on these points, it can be said that this curriculum template will have practical contributions to the literature.

In the constructivist approach, life-filled learning is organised in the environment of the individual rather than pre-determined topics (Marlowe & Page, 1998: 53). In this study, it is found that it is important to observe daily life and develop context from this while writing mathematics literacy questions. Question writing is fun and succeeding in the question writing increases interest. It is also found that transforming events into questions is fun. The interest level is increased when question writing is related with life and pre-service teachers are actively involved in the mathematics literacy teaching process. These results show that by the nature of mathematics literacy question writing, this activity is an interesting activity for pre-service teachers. This could be presented as an opportunity to enable active participation of pre-service teachers while developing new problems. It is shown that in the closeness to life and active participation as given above, the constructivist approach of mathematics literacy curriculum should be the basis. This result supports Brown and Schäfer's (2006) conclusion.

Demir and Altun (2018) stated that mathematics literacy teaching has the scope to form the content of a class in one term and recommended "question writing over time". Based on these recommendations, this study was conducted for one academic term and it is found that pre-service teachers viewed surrounding events as "can I make mathematics literacy question from this" and internalised this. This is an important and positive result regarding the effect level of teaching and it is believed that since pre-service teachers worked on these actions for one term, this was effective to internalise actions. So that question writing in this field is a skill that develops over time and it is a challenging process. This way, to realise question writing, a class period where pre-service teachers can see life events from this perspective was provided.

Knowledge about how the problem writing process works is still limited (Silber & Cai, 2017). The results of the research on question writing can also contribute to the curriculum developed within the scope of this study. For example, Demir's (2019) research on the pre-service teachers' actions that they frequently carry out during the question writing process and how these actions are ranked can contribute to this issue. Studies that can guide prospective teachers in the process of writing questions can enrich the curriculum in terms of the methods used in the teaching and learning process.

In this study, it is found that more time should be allocated to the question transformation process before starting the question writing activity. This result validated including question transforming activities in the curriculum. Additionally, it is shown that question transformation activities in mathematics literacy teaching should be included more than given in this study. This situation shows that the need for the development of new activities still continues. In other words, more research is needed on how teacher candidates will be prepared for mathematics literacy teaching (Colwell & Enderson, 2016).

It can be said that question writing allows prospective teachers to think deeply about what mathematics literacy is. An important finding of this study is while pre-service mathematics teachers regarded mathematics as a science consisting of numbers on paper, with mathematics literacy teaching, they realised they can use it around them and started to use it around students. This result shows that mathematics literacy is defined by formulising, application and interpretation of mathematics in certain life environments (OECD, 2013; 2016) can be given with teaching. At the same time, this result supports Silber and Cai's (2017) statement that question writing activities offer them the opportunity to experience mathematics with a new activity.

Recommendations

The main output of this study is question writing based mathematics literacy curriculum template that shows the efficiency of qualitative and quantitative data. The curriculum can be used in in-service trainings as well as mathematics teaching undergraduate and graduate programs. This way, in education and learning, more competent individuals can be provided in this field.

Another result of this study is that pre-service teachers with insufficiencies in certain mathematics topics are struggling to develop new problems. This result is supported by Ellerton (1986) that reflects “a well-planned problem writing activity is the property of mathematics students with high performance”. Therefore, in studies that especially and only have the purpose to create new questions (mathematics or mathematics literacy field), this should be considered while selecting a sample.

It is found that participants struggle to transfer daily events to questions in terms of context. Qualitative studies that investigate the source of such an issue and how to overcome this issue can be recommended.

In this study, pre-service teachers were asked to use four categories (personal, occupational, social, scientific) determined by PISA while generating context for questions and give examples of possible real-life events. Subjects that contain limitations were not included. Some of the participants regarded not being limited with daily life topics as challenges while other regarded this as opportunities. Based on this fact, experimental or qualitative studies can be conducted to identify which event or which samples are perceived as opportunities or challenges.

Another result of this study is questions generated by pre-service mathematics teachers. Projects to subject these to the necessary question development processes (OECD, 2005: 21) can be applied. In this sense, it is expected that this study will serve as a database for future studies. Additionally, these questions can be used during teaching or measurement evaluation activities. This way, the solution to problems such as lack of forming connections between teaching and life (Altun & Akkaya 2014: 34) and lack of insufficient problem-solving activities regarding mathematics literacy in elementary second level mathematics and science books (Dede & Yaman, 2005) can be contributed.

Relevance to everyday life is one of the main principles of teaching (Bransford, Sherwood, Vye, Rieser, 1986). Considering this principle within the teaching process is a necessity in mathematics as well as other fields. Based on this fact, in addition to mathematics literacy, science literacy, reading skills and social science field studies can be conducted in terms of teacher training.

ETHICAL TEXT

In this article, journal writing rules, publishing principles, research and publishing ethics rules, journal ethics rules are followed. Responsibility belongs to the author (s) for any violations related to the article.

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APPENDIX 1. STUDY GROUP 5. COURSE

Name Of Subject: Mathematics Literacy

Week: 5

Topic: Selecting and Transforming Mathematics Literacy Question

Duration: 45 + 45 + 45 min

Purposes

K15. Selects questions that can measure mathematics literacy among given questions.

K16. Applies transforming exercise questions to mathematics literacy questions.

K17. Develops awareness for events that can emerge within context.

Content

Importance of Differences in Selecting, Transforming, Context Obtaining in Mathematics Literacy Questions

Learning and Teaching Process

Methods and Techniques: Expression, Question-Answer, Presentation, Brain Storming

Tools: Mathematics Literacy Question Selection Exercise, Question Transformation Sample, Projection

Introduction

A mathematics literacy question selection exercise is given to students. By working as groups of two-three people, students are asked to select mathematics literacy questions among 18 questions in the test. During selection operation, testing should be completed based on given table (see also Table 4: 12).

Results of this testing:

for 1	"Yes"
for 2	"Yes"
for 3	"Yes" or "Absent"
for 4	"Yes" or "Absent"
for 5	"Yes"
for any of 6, 7, 8, 9	is "Yes", it is stated that this question has desired quality.

Evaluation: Class responsible expresses how to distinguish mathematics literacy questions among other questions at the end of this class. Additionally, responsible states that they will learn methods to transform a regular exercise question into a mathematics literacy question.

Transition to class: 10 minutes time is given for selection. The numbers of the questions selected by each group is written on the board. Groups that made different decisions for the same question are asked to discuss and convince each other. This process is managed by the instructor until all groups have a common ground for each question. At the end of the process, questions with such qualities are determined.

Development Section

Each one of 4 problems obtained from an exercise question and transformation of that question is given to one group to solve. Groups are given time to solve these questions. At the beginning, the group only sees their own problem and do not see questions of the other groups. Questions are given below.

1) What can be the maximum field area in terms of square meters of a field with a circumference of 1338 meters?

2) How many people can fit to a field with a 140000m2 area?

3) How many people can fit to a field with 1338-meter circumference?

4) Rally: Elections are approaching, and an aerial photograph of a rally field is given on the side. According to news on CTV there are 700.000 people and according to ETV there are 150.000 people in the field. It is stated that general intensity is like this and the field is about 140.000m. Accordingly, which one of the TV channels is reflecting the truth? Explain mathematically.

5) How many people were there? Elections are approaching, and an aerial photograph of a rally field is given on the side. According to news on CTV there are 700.000 people and according to ETV there are 150.000 people in the field. It is stated that general intensity is like this and 1338-metre-long security band was used to cover around the field. Accordingly, which one of the TV channels is reflecting the truth? Explain mathematically.

After groups completed the solution, representatives of groups that have problems 1, 3 and 5 are called to solve the problem on the board. At that time, papers that have all these five questions are given to the groups. Now, all groups can see all questions. Here, while solving each of these problems, the differences in mathematical process of each problem are compared to precious problems and are stated on the solutions of students on the board. It is stated that the first question transformed into the third and the third question transformed into the fifth. It is stated that the purpose is to obtain mathematics literacy.

At the first stage of transformation (from 1 to 3), the operation is about answering a “why should I calculate this area?” question. Adding how many people will fit this area to the first problem requires a calculation of area and adding functionality to this calculation. However, third problem has no context. To provide this, the

second step of transformation is applied (from 3 to 5) and operation to answer, "why should I calculate the number of people that can fit in this area?" question is conducted. For this purpose, this field can be described as a rally field and the different television channels broadcast a different number of people in the rally. This way, the problem has a context and necessity (functionality) to evaluate the mathematical results within context is provided.

Similarly, it is stated that the first question is transformed to the second and that one is transformed into the fourth.

Abstract: With context, it is stated that operations and the results for the solution of any problem, real life relating is achieved. This way, operations and results for a final problem solution gain meaning and this is a quality required in mathematics literacy questions.

Transition: Students are asked to determine one or two questions for the transformation operation among 58 (40+18) given questions in the previous weeks and this week. Students are asked to work in groups of three or four people. 7-8 minutes time is given for the question selection. Students are asked to transform these questions into mathematics literacy questions. Students are asked to ask, "why should I do this modelling or operation in the solution? How should I find this result?" questions to their own problem like in the "rally" question transformation exercise. When determined problems transform into a sensitive form to answer these questions, it is stated that they will achieve a mathematics literacy question.

After this explanation, groups are given time for the transformation process. The instructor pays attention to each group. Guidance and counsellor feedback and clues are given. Groups are encouraged to discuss the suitability of obtaining questions after transformation in terms of mathematics literacy.

Result Section

Last Abstract: Groups that complete the transformation operation after discussion are evaluated with final problems, these problems are shared with the class and feedback is provided. Groups that cannot complete this process are asked to present their transformation next week.

Re-motivation: Students are asked to view experienced events, news, texts, photographs, videos (on newspaper, social media etc.) by asking "can I create mathematics literacy question from these" perspective until next class (for one week.) Because it is stated that the starting point and critical point for writing mathematics literacy question is context, the strongest contexts can be achieved with association. Association can only be achieved by keeping abovementioned though alive in the mind while seeing surrounding events. Students are asked to note these contexts associated with this awareness and in a suitable thinking environment, transform these contexts into mathematics literacy questions with individual or group work.

Closure: Students are asked to come next class by noting one or two contexts obtained with this perspective.

Evaluation Section

The scores of the students obtained from the selection test are evaluated. There are 5 questions that should be selected in this test with desired properties.

The level of application of transformation can be identified for each group. For this purpose, (i) asking the correct question, (ii) identifying transformation steps and (iii) the suitability of final problems to mathematics literacy can be evaluated while applying the transformation process to selected problems.

APPENDIX 2. QUESTION SAMPLES WRITTEN BY PRE-SERVICE TEACHERS

Sample 1:

To prevent water pollution, the metropolitan municipality decided to deploy a large net consisting of equal squares to cover the coastline of Porsuk river from end to end and plans to tie the net as seen in the picture above. This way, it will be easier to ***collect waste*** and the awareness of people will be increased.

Before applying the net, waste accumulated in Porsuk River is collected. The most common waste and measurements of these wastes are given. Accordingly, what should be the maximum side length of each square on the net in terms of cm? Please write your solution.

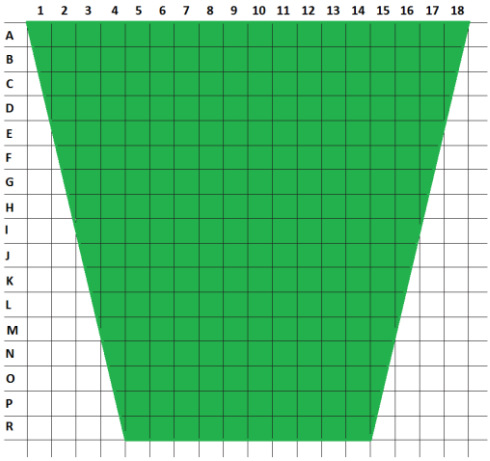
Sample 2:

A textile merchant asks his apprentice to make a bar with 50 cm length to easily measure the textile. The merchant will measure ***the length and width*** of the textile with this bar and calculate textile prices ***by square meter***.

The merchant sells by measuring with this bar, but he realised that this bar is 47 cm long. The textile merchant who completed all these sales on account is relieved. Because he has not yet received the money from customers. He only wrote the amount of money to be collected.

What should the textile merchant that wants to correct his mistake do to calculate correctly? Suggest a discount formula to organise all incorrect calculations.

Sample 3:



The coloured section in the picture is the plan of a field that will be afforested. The side of each square on the plan represents a length of 2 meters.

On this area, 3 rotating water jets will be placed. Water jets I and II can spray water up to 8 meters away from where they are placed, and water jet III can spray up to 12 meters.

What is ***the most efficient*** way to place the water jets inside this area without spraying water outside the area? Mark 3 points on the plan to place water jets I, II and III.

APPENDIX 3.

T. C.
KÜTAHYA DUMLUPINAR ÜNİVERSİTESİ REKTÖRLÜĞÜ
Fen ve Mühendislik Bilimleri Bilimsel Araştırma ve Yayın Etik Kurulu

TOPLANTI TUTANAĞI

Toplantı Tarihi: 21.04.2020
Toplantı Sayısı: 2020/01

GÜNDEM 2: Üniversitemiz Eğitim Fakültesi Dekanlığı'nın 17.04.2020 tarih ve E-15416 sayılı yazısı gereğince; Dr. Öğretim Üyesi Furkan DEMİR'in ***"Matematik Okuryazarlığı Öğretim Programı Tasarımı"*** çalışması için ilkokul, ortaokul, lise ve üniversite öğrencileri ile görüşme ve anket yapma talebinin etik açıdan uygunluğu üzerine görüşme.

KARAR 2 : Üniversitemiz Eğitim Fakültesi Dekanlığı'nın 17.04.2020 tarih ve E-15416 sayılı yazısı gereğince; Dr. Öğretim Üyesi Furkan DEMİR'in ***"Matematik Okuryazarlığı Öğretim Programı Tasarımı"*** çalışması için ilkokul, ortaokul, lise ve üniversite öğrencileri ile görüşme ve anket yapma talebinin etik açıdan uygunluğu üzerine görüşüldü.

Yapılan görüşmeler ve değerlendirmeler sonucunda, çalışma kapsamında uygulanacak olan görüşme, ölçek ve anket sorularının, ilgili kurumlardan izin alınmak kaydıyla, fikri, hukuki ve telif hakları bakımından sorumluluğu başvurucuya ait olmak üzere etik açıdan uygun olduğuna oy birliği ile karar verildi.

Prof.Dr. İrfan TERZİ
Başkan

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