Educational Research and Reviews

Academic Journals

ABOUT ERR

Educational Research and Reviews (ISSN 1990-3839) is published bi-monthly (one volume per year) by Academic Journals.

Educational Research and Reviews (ERR) is an open access journal that publishes high-quality solicited and unsolicited articles, in English, in all areas of education including education policies and management such as Educational experiences and mental health, the effect of land tenure system on resource management, Visualization skills and their incorporation into school curriculum, Gender, education and child labour etc. All articles published in ERR are peer-reviewed.

Educational Research and Reviews

ARTICLES

Full Length Research Paper

The problems posed and models employed by primary school teachers in subtraction with fractions

Tuba Aydoğdu İskenderoğlu

Karadeniz Technical University, Turkey.

Students have difficulties in solving problems of fractions in almost all levels, and in problem posing. Problem posing skills influence the process of development of the behaviors observed at the level of comprehension. That is why it is very crucial for teachers to develop activities for student to have conceptual comprehension of fractions and operations involving fractions. The achievement of such conceptual comprehension can be accelerated through the use of mathematical models. For this, the aim of the study is to identify the errors in the problems posed by primary school teachers with respect to subtractions with fractions, and the models they employ to solve these problems. The present study employs both quantitative and qualitative methods together. This study was carried out with 31 primary school teachers. The teachers involved in the study were selected through random sampling. The study employs the "Problem Posing Test" comprising four items of subtractions with fractions. The test drawn up with reference to the operation of subtraction with fractions includes one item for each: subtracting a proper fraction from another proper fraction, and subtracting a mixed fraction from another mixed fraction. First of all, the answers provided by the teachers were categorized as problem, not-a-problem, or blank. Following such a classification is an analysis of the errors observed in the responses provided in the problem category. At the end, the study reveals that the rate of correct responses offered in the problem category falls as one progresses from item, one where both the minuend and the subtrahend are proper fractions, towards item four where a mixed fraction is subtracted from another mixed fraction. The fact that nine distinct types of errors were observed in the study reveals that the teachers have significant shortcomings when posing problems regarding subtraction with fractions.

Key words: Fractions, subtraction, primary school teachers, problem posing, modeling.

INTRODUCTION

The studies reviewing the qualifications of teachers are often constructions built on the grounds laid by Shulman (1987). Shulman (1987) noted that various types of field

knowledge a teacher is expected to have involve references to basic concepts and principles regarding that field, the curriculum, and the relationships between

these.

Furthermore, the teachers' behavior in the classroom and their practices during the activities are also shaped by their content knowledge (Ball and Bass, 2000). That is why content knowledge plays a major role in shaping the process of education in the classroom (Baki and Çelik, 2005; Ball et al., 2001; Çakan, 2004; Dursun and Dede, 2004; Seferoğlu, 2001). The knowledge to be provided and the means to provide that knowledge is important, for the effectiveness of the teacher is among the major factors that affect learning (Romberg and Carpenter, 1986). Fractions, in turn, are among the topics deemed necessary to teach and learn.

Fractions

It is important to realize the conceptual understanding of fractions and operations for fractions, which present numerous problems during learning. Because mathematically, rich fractions have an important place in the learning of algebraic subjects, one of the areas of advanced learning (Redmond, 2009; Smith, 2002). However, fractions are one of the subjects that are difficult to teach because they are cognitively complex (Smith, 2002). The difficulties observed during the learning of fractions have been covered by numerous studies (Haser and Ubuz, 2002; Aksu, 1997; Başgün and Ersoy, 2000; Ersoy and Ardahan, 2003; Hanson, 1995; Wu, 1999). When looking at the literature reveals that students have some difficulties with respect to solving problems regarding fractions at almost all levels (Kocaoğlu and Yenilmez, 2010), and hence in problem posing (Işık et al., 2011).

Problem posing

One of the main purpose of primary school mathematics classes is to instill the skills of problem posing. Problem posing can be used not only to determine the mathematical knowledge and skill levels of the students, pre-service teachers, or teachers (Işık and Kar, 2012a; Kılıç, 2013; McAllister and Beaver, 2012) but also influence the problem solving skills.

Problem posing skills provide a distinct perspective regarding the problem solving process, and therefore, help with the comprehension of the relationships the problem entails. That is why teachers and therefore pre-service teachers would benefit from a high level of problem posing skills in mathematics.

For instance, problems provided in text books may be insufficient, incompatible with the current proficiency levels of students, or unrelated with their interests or needs. In such cases, the teacher may be required to pose additional problems regarding the topic at hand, in order to for the purpose of the course (Albayrak, 2000; Korkmaz and Gür, 2006).

Furthermore, problem posing skills influence the process of development of the behaviors observed at the level of comprehension. That is why it is very crucial for teachers to develop activities for student to have conceptual understanding of fractions and operations involving fractions (Işıksal, 2006; Mack, 1990; Mok et al., 2008; Rule and Hallagan, 2006; Utley and Redmond, 2008). The achievement of such conceptual understanding, in turn, can be accelerated through the use of mathematical models.

Modeling

Mathematics exhibits an inherently more abstract structure compared to other sciences. Direct presentation is not deemed a suitable means to ensure that students can imagine or visualize a mathematics concept (van de Walle, 2004).

The leading factor posing a problem in terms of primary school students' understanding of mathematics is the insufficient level of abstract thinking abilities on their part. Researchers consider materialization of the concepts through generalization as one of the ways to overcome this issue (Çelik and Çiltaş, 2015).

In this context, models with some certain physical and mental actions can be presented in order to construct mathematical conceptualization among students. A picture, drawing, symbol, or a concrete means entailing the relationship conveyed by a mathematical concept could be the model of that mathematical concept. Models can be employed for three distinct purposes, namely enabling students develop new concepts and relationships in their minds, helping students establish the relationships between concepts and symbols, and assessing the level of comprehension in students' mind (Olkun and Toluk Uçar, 2012). There are a number of models used for the teaching of fractions based on these objectives.

Some studies reveal the importance of using fraction models. The use of applicable and different models would expand and deepen the understanding of fractions in the minds of students as well as teachers. Three distinct models are employed for the teaching of fractions: region/area, length/measurement, and set (van de Walle, 2004). Region/area models help materialize the fraction as a portion of the region, while length models allow comparison of lengths and measurements instead of regions. The number line model, an example of length models, presents the fraction as a real number.

In the set model, on the other hand, a portion of the objects included in the set are represented with reference to the fraction. In other words, a given set of objects refers to the whole, and a sub-set of those objects represents the fraction (Olkun and Toluk Uçar, 2012; van de Walle, 2004). For the teachers to be able to employ suitable models in the process of teaching concepts,

they should be aware of such models.

Purpose of the study

In recent years, studies on the teaching of mathematics tend to focus on the characteristics of knowledge the teacher would need to have (Newton, 2008). Hill et al. (2005) stated that the mathematical knowledge the teachers need to have should enable them to provide explanations to students, and to analyze their responses in turn.

On the other hand, studies investigating the pedagogical content knowledge of teachers and pre-service teachers (Chick and Baker, 2005; Işık, 2011; Newton, 2008; Özmantar and Bingölbali, 2009; Toluk Uçar, 2009; Ward and Thomas; 2007) reveal that they experience numerous problems in terms of identifying the errors of students, explaining reasons, and planning teaching with a view to eliminating errors.

Difficulties in learning fractions have been the subject of many researches (Haser and Ubuz, 2002; Aksu, 1997; Başgün and Ersoy, 2000; Ersoy and Ardahan, 2003; Hanson, 1995; Wu, 1999); and it can be seen that at almost all levels, the students have encountered some difficulties in solving problems about fractions (Kocaoğlu and Yenilmez, 2010).

Soylu and Soylu (2005) note that students have major learning difficulties regarding ordering, addition, subtraction, multiplication and division with fractions. Research shows that on the topic of difficulties not only students but also teachers and pre-service teachers have with the concept of fractions, and the operation of division with fractions (Ball, 1990; Borko et al., 1992; Carraher, 1996; Işıksal, 2006; Ma, 1999; Mok et al., 2008; Post et al., 1991; Redmond, 2009; Sharp and Adams, 2002; Tirosh, 2000; Toluk-Uçar, 2009; Yim, 2010; Zembat, 2007; Şiap and Duru, 2004; Seyhan and Gür, 2004; Soylu and Soylu, 2005).

While teachers trying to develop the conceptual meaning of fractions by students, they also have difficulties in making interpretation and making meaning with division of fractions by themselves (Utley and Redmond, 2008). That is why problem posing occupies a central position in terms of associating fractions and operations involving fractions, with real life cases (Abu-Elwan, 2002).

The studies so far focus on multiplication and division with fractions and the solution of verbal problems requiring division with fractions (Işık et al., 2011; Işık and Kar, 2012a); and often focus on pre-service teachers and students. On the other hand, the studies performed on problem posing show that the level of competence in problem posing skills leaves much to be desired (Işık et al., 2011; Işık and Kar, 2012b).

McAllister and Beaver (2012) have analyzed the errors pre-service primary school teachers had with the problems they posed with respect to operations with fractions. Işık and Kar (2012c) on the other hand, analyzed the errors committed in the problems posed with respect to additions with fractions, in a study involving seventh year students in primary education. It is evident that the limited number of studies carried out with respect to problem posing involving addition and subtraction with fractions were more often than not executed with teachers, students, or pre-service teachers, with particular reference to addition with fractions (Kar and Işık, 2014).

Kar and Işık (2014) investigated the types of errors seventh year secondary school students had in terms of problem posing involving subtractions with fractions. Kar and Işık (2015) shed some light also on secondary school mathematics teachers' problem posing skills regarding subtractions with fractions. On the other hand, no study investigating the types of errors primary school teachers had with subtractions with fractions was observed. Yet, Primary Schools Mathematics Courses (1st, 2nd, 3rd, and 4th years) Curriculum mentions the learning outcome "Ability to solve problems requiring additions and subtractions with fractions" (Ministry of Education (MEB), 2015). Taking into account the fact that Primary Schools Mathematics Courses (1st, 2nd, 3rd, and 4th years) Curriculum envisages a learning outcome regarding problem solving with subtraction, it is clear that the analysis of the problems posed by the teachers and the identification of the models they employ with respect to the solution of the problems would enable the development of deep insights regarding potential conceptual shortcomings of teachers.

No studies investigating primary school teachers' – direct practitioners– problem posing skills regarding subtraction with fractions, and problem solving methods by modeling such problems, were observed. The present study, in turn, is crucial with a view to understanding the errors in the problems posed by the teachers, and the models they employ, with the overall objective of identifying any shortcomings on this topic. Such an endeavor would not only shed light on the efforts to eliminate any shortcomings in this context, but also contribute to teacher training. In this vein, the objective of the present study is to identify the errors in the problems posed by primary school teachers with respect to subtractions with fractions, and the models they employ to solve these problems.

METHODOLOGY

The present study employs quantitative and qualitative methods in conjunction. In this context, the errors primary school teachers had in terms of the problems they posed with respect to subtractions with fractions were identified through qualitative analyses of the responses provided to four open-ended items. The distribution of error categories and models with respect to each of the four items in the Problem Posing Test, in turn, was investigated through a quantitative analysis.

Table 1. Subtraction related items of the problem posing test, and their characteristics.

Items	Characteristics
$\frac{5}{8} - \frac{2}{8} = ?$	Subtraction of a proper fraction from another
$1\frac{1}{3} - \frac{2}{3} = ?$	Subtraction of a proper fraction from a mixed fraction, to produce a proper fraction
$2\frac{4}{9} - \frac{7}{9} = ?$	Subtraction of a proper fraction from a mixed fraction, to produce a mixed fraction
$3\frac{1}{4} - 1\frac{2}{4} = ?$	Subtraction of a mixed fraction from another

Sample

This study was carried out in spring 2015 to 2016, with 31 (18 female, 13 male) primary school teachers assigned to a number of schools in 3 district centers of Trabzon. The teachers involved in the study were selected through random sampling. The study was conducted with volunteers from selected teachers with random sampling. Each teacher who voluntarily agreed to take part in the study was assigned a code in the range T1 ... T31, with T standing for teacher. One of the teachers had an experience of 1-5 years; 10 had 6-10 years; 9 had 11-15; 6 had 16-20; 2 had 21-25; 1 had 26-30; and 2 had more than 30 years of experience in service.

Primary schools mathematics courses (1st, 2nd, 3rd, and 4th years) curriculum was updated in 2015, and started to be applied in schools since 2016 to 2017 education year. The teachers in the study group perform the teaching of operations with fractions and fractions in line with the achievements in the 4th grade "performs additions and subtractions with fractions of matching denominators" and "solves problems requiring addition and subtraction with fractions" under the "operations with fractions" category of the curriculum (MEB, 2015).

Data collection tools and the collection of data

The study employs the "problem posing test" comprising four items regarding subtractions with fractions, as the data collecting tool. The "problem posing test" is offered to each pre-service teacher in written form. There is a total of 4 operations that require only subtraction operation with fraction to be performed in the problem posing test.

The test drawn up with reference to the operation of subtraction with fractions includes one item for each: subtracting a proper fraction from another proper fraction, and subtracting a mixed fraction from another mixed fraction, as was the case with the study by Kar and Işık (2014). These are coupled with two more items regarding the subtraction of a proper fraction from a mixed fraction. One of these latter two items produces a proper fraction while the other produces a mixed one (Table 1).

In contrast to the study by Kar and Işık (2014), however, the operations included in the "Problem Posing Test" entail fractions with matching denominator, for primary school curriculum includes operations with fractions with matching denominator.

A number of researchers employed similar questions when investigating operations with fractions (McAllister and Beaver, 2012; Toluk-Uçar, 2009). Firstly, the test prepared by the researcher was examined by an expert in doctoral dissertation in elementary mathematics education. After the necessary changes were made, the pilot study was applied to the three primary school teachers who were not involved in the actual study. As a result of the pilot study, the items in the test were given the final shape in line with

the opinions of the primary school teachers.

The test prepared in the process of collecting the data was given in written form to the teachers. At the beginning of the test, there are questions to determine the gender of teachers and to determine how many years they were working as a teacher. Then, the operations of fractions are numbered and each of them are written as one item. Appropriate gaps were left under each item in the test for teachers to work. After test being distributed to the teachers, it is required to write a verbal problem statement in the solution to the given process, which is related only to the daily life situations that can be used for that process. The respondents were told that they were required to pose appropriate problems suitable for the primary school students' level, and were recommended to leave the question unanswered, if they felt unable to pose a proper problem.

Then, they are asked to solve each problem by modeling the problems they had pose for each of these items. No time limitations have been made to the teachers in this whole process. Teachers were warned not to use any device such as calculator, computer, or phone in this process because there is only one operation in each question. Also, it is stated that the teachers do not influence each other when responding to the test and that each teacher should do it herself/himself.

Data analysis

First of all, the answers provided by the teachers were categorized as problem, not-a-problem, or blank. Such a categorization was employed in previous research as well (Işık and Kar, 2012b; Kar and Işık, 2014; Leung, 2013; Silver and Cai, 2005).

This approach aimed to discern answers which cannot be associated with daily life, or which do not contain a question phrase. The not-a-problem category contains the responses where only a description was provided in one or more sentences, which do not contain a question form, and which cannot be associated with elements of daily life. The discussion based on the examples of responses provided for the not-a-problem category is presented in the findings section. Also, those who found a solution were described as "problem".

The ones that the teacher has typed as a problem are re-analyzed. This was done in order to determine the errors that teachers made in the problems they had established. Thus, the analysis of the errors in the answers in the problem category was made and classified. The classification of the primary school students' errors in posing problems with subtraction with fractions was based on 12 types of errors.

Kar and Işık (2014) identified the problems in seventh year primary school students posed with reference to subtractions with fractions. Kar and Işık (2014) identified the following types of errors: expressing the subtrahend fraction over the remainder of whole (Error 1(E1)), not being able to establish part-whole relationship

Table 2. Problem states.

Items	Problem		No problem		Blank		Total
	N	Percentage	N	Percentage	N	Percentage	N
Item 1	30	96.7	1	3.3	-	-	31
Item 2	28	90.3	2	6.4	1	3.3	31
Item 3	28	90.3	1	3.3	2	6.4	31
Item 4	25	80.8	3	9.6	3	9.6	31
Total	111	89.6	7	5.6	6	4.8	124

(E2), attributing natural number meaning to the result of the operation (E3), confusion about units (E4), attributing natural number meaning to the fractions (E5), failure in expressing the operation in the question root (E6), not being able to express whole parts of mixed fractions (E7), representing the mixed fraction as numerator and denominator (E8), attributing a value to the whole (E9), expressing the subtrahend fraction as a certain amount of minuend fraction (E10), logical error (E11), and expressing the fractions over the different wholes (E12). The statements regarding such error types are presented in the findings section.

The problems posed by the primary school teachers were analyzed using the qualitative descriptive analysis method, with reference to the problem types categories identified by Kar and Işık (2014). Each problem sentence posed by primary school teachers was read and reviewed carefully, and a classification was sought by coding the sentences.

Coding of data was carried out by an expert in doctoral dissertation of elementary mathematics education and the researcher. The doctoral student was trained by the researcher. To examine the inter-rater reliability, the researcher coded all primary school teachers' responses and then an expert in doctoral dissertation of elementary mathematics education independently coded them. The rate of agreement on the coding of the responses was 92%. Then, by comparing the analyses, the same error categories were taken directly and a common decision was reached by discussing different ones. As a result, the category of each problem has been determined. These categories are included in the findings section. In the problems teachers set up, more than one type of error can be found at the same time. The distributions of error categories for each of the four items in the problem building test were formed by quantitative analyzes.

In this process, the percentage and frequency tables were formed taking into account the number of faults in each problem setting item. As a result of the analysis, the determined categories are detailed in the findings together with the frequency and percentage table. Thereafter, the analyses by the author and the researcher were compared. The responses on which the disagreement occurred were reread, and an agreement was reached. As a result, the category of each problem has been determined. These categories are included in the findings section. The problems posed by the teachers can present more than one error type simultaneously. The distribution of error categories with respect to each of the four items in the Problem Posing Test, in turn, was developed through quantitative analyses.

In this process, the number of errors regarding each problem posing item was used in developing the percentage and frequency tables. As a result of the analysis, the determined categories are detailed in the findings together with the frequency and percentage table.

The models used in fraction teaching are considered in the process of determining the models that teachers use to solve the problems they have posed. For this reason, the models teachers employ when solving problems they posed are categorized as region/area, length, set, concrete model, or blank. The region/area models were further classified using the sub-categories of square, rectangle, circle, and triangle. The models used by the teachers were analyzed by two distinct researchers, followed by a comparison of their assessments. The ones where they concurred were included directly, whereas further reconciliation was sought for the ones that differed. In conclusion, percentile and frequency tables were drawn up, taking into account the numbers of models used to solve each problem.

RESULTS

The answers primary school teachers enrolled in the study provided with respect to four basic operations entailing subtraction with fractions were categorized as problem, not-a-problem, or blank. The findings regarding the categorization are provided in Table 2.

Table 2 reveals that 111 (89.6%) of all 124 responses provided by primary school teachers were problems, while 7 (5.6%) were not, and 6 (4.8%) were blanks. Furthermore, in the problem category, the largest group of responses entailed the first item, where a proper fraction was subtracted from another proper fraction, whereas the smallest group of responses entailed the fourth item, where a mixed fraction was subtracted from another mixed fraction, to produce yet another mixed fraction. Against this background, one can argue that the teachers' level of success in providing responses in the problem category decreases as they proceed from the first item to the fourth one.

Seven (5.6%) responses provided by the teachers were categorized in the not-a-problem category. For instance, the response provided by T30 for item 1 reads "Ali spent a part of $\frac{5}{8}$ of his cash. The amount he spent is equal to $\frac{2}{8}$ of his cash." In his response, the teacher attempted to express the fractions verbally, but failed to reflect the subtraction operation in the question form. The response provided by T3 for item 4, on the other hand, reads "I paint $1\frac{2}{4}$ of the fraction $3\frac{1}{4}$ to blue. Please depict the not-blue section using a model employing operations." Again, the response provided by the teacher coded T3 does not contain a question form. For item 3, T3 again responded with the phrase "What is $\frac{7}{9}$ less than fraction $2\frac{4}{9}$?", asking the calculation of an operation's result, rather than

Table 3. Classification of the problems posed by the teachers, with reference to the types of errors.

Errors	Item 1 $(\frac{5}{8} - \frac{2}{8})$		Item 2 $(1\frac{1}{3} - \frac{2}{3})$		Item 3 $(2\frac{4}{9} - \frac{7}{9})$		Item 4 $(3\frac{1}{4} - 1\frac{2}{4})$		Total	
	N	%	N	%	N	%	N	%	N	%
E1	1	2.3	-	-	-	-	-	-	1	0.4
E2	-	-	8	15.7	10	17.2	9	18.4	27	13.4
E3	1	2.3	-	-	1	1.7	1	2	3	1.5
E4	-	-	-	-	-	-	-	-	-	-
E5	-	-	-	-	-	-	-	-	-	-
E6	18	41.9	18	35.3	17	29.4	14	28.7	67	33.4
E7	-	-	-	-	-	-	-	-	-	-
E8	-	-	-	-	7	12.1	3	6.1	10	5
E9	5	11.6	4	7.8	4	6.8	3	6.1	16	8
E10	17	39.6	21	41.2	18	31.1	16	32.7	72	35.9
E11	1	2.3	-	-	1	1.7	1	2	3	1.5
E12	-	-	-	-	-	-	2	4	2	0.9
Total	43	100	51	100	58	100	49	100	201	100

formulating a problem that can be associated with daily life.

89.6% of the responses provided by the teachers can be categorized as problems; however these problems have also their share of certain types of errors. The findings regarding the distribution of such error categories are provided in Table 3.

A glance at Table 3 reveals that the teachers committed the largest number of errors when responding to item 3 where a mixed fraction was produced when a proper fraction was subtracted from a mixed one (58), followed by item 2 where a proper fraction was produced when a proper fraction was subtracted from a mixed one (51). These are followed by item 4 entailing the subtraction of a mixed fraction from another mixed fraction (49 errors), and item 1 entailing the subtraction of a proper fraction from another (43 errors). The most frequent error committed by the teachers was E10 (35.9%). It is followed by E6 (33.4%), E2 (13.4%), E9 (8%), and E8 (5%). E1, E3, E11 and E12, on the other hand, were committed very rarely. Furthermore, the teachers who took part in the study did not commit E4, E5, and E7 at all.

Item 1

A total of 43 errors were observed in 30 responses considered problems pertaining to the operation $\frac{5}{8} - \frac{2}{8} =?$ entailing the subtraction of a proper fraction from another one. The average number of errors committed per problem is 1.4. Among all errors, the most common ones

were E6, E10, and E9, while E1, E3, and E11 were rarest. E2, E4, E5, E7, E8 and E12, on the other hand, were not observed at all. Among these, E7 and E8 were not observed in this item as they characteristically pertain to mixed fractions.

For item 1, T4 posed the problem "*Ayşe keeps $\frac{5}{8}$ of her allowance unspent. She saves $\frac{2}{8}$ of the unspent amount in her piggy bank. How much money Ayşe has left out of her unused allowance?*" The problem posed by the teacher is marred by a failure in expressing the operation in the question root (E6). The problem asks for the calculation of $\frac{2}{8}$ of $\frac{5}{8}$, thus, requires multiplication. Therefore, the subtraction was not reflected on the question root in the problem posed. Moreover, the fraction produced in the problem thus posed is expressing the subtrahend fraction as a certain amount of minuend fraction, hence contains a E10 type error as well.

One of the errors committed in item 1 is E9. T31 posed the problem "*Ayşe ate $\frac{5}{8}$ of 40 walnuts. Hasan ate $\frac{2}{8}$ of 40 walnuts. What is the difference between the amount of walnuts they have consumed?*" Even though the teachers were asked to pose a problem which can be solved with the operation specified, some attributed a value to the whole and considered the fractions involved in the operation, certain amount of that whole.

Among the teachers who took part in the study, only T14 committed the error E1 when posing a problem. That problem reads "*An automobile covered $\frac{5}{8}$ of a distance in the morning. In the afternoon, it covered $\frac{2}{8}$ of the remaining

remaining distance. What is the difference between the distances the automobile covered in the morning and in the afternoon?" In that problem, the teacher assigned the term road covered in the morning to $\frac{5}{8}$, while noting that $\frac{2}{8}$ of the remainder was covered in the afternoon. In the problem, the teacher presented the fraction with reference to the remaining amount of distance rather than the initial distance involved.

Item 2

A total of 51 errors were observed in the 28 answers provided in the problem category with reference to the operation $1\frac{1}{2} - \frac{2}{3} = ?$ entailing a proper fraction produced by subtracting a proper fraction from a mixed fraction. The average number of errors committed per problem is 1.8. Among all errors, the most common ones were E10, E6, and E2. Error types E1, E3, E4, E5, E7, E8, E11, and E12, on the other hand, were not observed at all in this item. The rarest type of error observed with this problem posing item, on the other hand, is E9. The problem posed by T22 for item 2 entailed an error in E10 category. The problem formulated by the teacher reads "Nur ate $\frac{2}{3}$ of a $1\frac{1}{3}$ pizza. What is the proportion of *the remaining pizza?*", where the teacher expressed the subtrahend fraction as a certain amount of minuend fraction, rather than of the whole. This constitutes a E10 error on part of the teacher. This also posed an obstacle in terms of expressing the operation in the problem root, hence led to an H6 error as well.

Another type of error committed with the problems posed with reference to item 2 was E2 where a failure to establish the link between the part-whole exists. The problem posed by teacher T12 also exhibits E2 error. The problem reads "$\frac{2}{3}$ *out of* $1\frac{1}{3}$ *of a plot is left to fallow. What is the size of the cultivated section?*" E2 error refers to problems which were posed in ignorance of the fact that the fractions involved in the operation or the fraction produced as a result of the operation was larger than the whole. In this problem, even though we have only a single plot, the question refers to a $1\frac{1}{3}$ portion. Furthermore, E10 error is also present as the fraction produced in this problem is expressed a certain amount of minuend fraction, not to mention E6 due to the failure to express the operation in the problem root.

Item 3

A total of 58 errors were observed in 28 responses considered problems pertaining to the operation $2\frac{4}{9} - \frac{7}{9} = ?$ entailing the subtraction of a proper fraction from a mixed fraction, to produce another mixed fraction. The average number of errors committed per problem is 2.07.

Among all errors, the most common ones were E10, E6, E2, E8, and E9, while E3 and E11 were rarest. Error types E1, E4, E5, E7, and E12, on the other hand, were not observed at all.

One of the errors committed under this item is E2. For instance, the problem posed by teacher T21 reads "*How much of the melon would remain after eating $\frac{7}{9}$ of the melon $2\frac{4}{9}$ of which had remained?*" entails such a error. In this problem, the melon stipulated by the teacher is larger than a whole.

When posing a problem with respect to item 3, T16 committed the error E8. The problem posed by the teacher reads "*Assuming that we have painted 2 walls of equal size at the school, and $\frac{7}{9}$ of a wall which is equal to its $\frac{4}{9}$, what portion of the walls would remain without paint?*" The result of the operation to solve the problem is $1\frac{6}{9}$. However, the problem form tried to present the mixed fraction with the phrase "what portion of the walls would remain without paint". The phrase "what portion" would be acceptable in case of proper fractions, but not so with mixed ones, taking into consideration its reference to the relationship between the whole and its parts. That is why it is a E8 error to refer to the mixed fraction produced through the operation, using the phrase "what portion".

Item 4

A total of 49 errors were observed in the 25 answers provided in the problem category with reference to the operation $3\frac{1}{4} - 1\frac{2}{4} = ?$ entailing a mixed fraction produced by subtracting a mixed fraction from a mixed fraction. The average number of errors committed per problem is 1.9. Among all errors, the most common ones were E10, E6, and E2. Error types E1, E4, E5, and E7, on the other hand, were not observed at all with this item. The rarest types of error observed with this problem posing item, on the other hand, are E3, E11, and E12.

Another error committed with item 4, entailing the subtraction of a mixed fraction from another mixed fraction is E3, which refers to attributing natural number meaning to the result of the operation. T19's problem with a E3 error was posed as "*A student who read $3\frac{1}{4}$ of her books prepared summaries of $1\frac{2}{4}$ of the books she read. How many books remain without a summary?*" Even though the result of the operation was a mixed fraction, T19 formulated the question as if the result would be a natural number.

T7, on the other hand, committed E11 error with a logical error when posing a problem for the operation provided. The problem posed by T7 reads "*I drank $1\frac{2}{4}$L out of $3\frac{1}{4}$L milk. How much water do I have left?*" The problem mentions milk in the part presenting the data,

Table 4. Models employed by teachers for each item.

Items	Area model					Number Line	Blank	Total
	Square	Rectangle	Circle	Triangel	Concrete model			
Item 1	2	23	5	-	-	-	1	31
Item 2	4	16	6	1	1	1	2	31
Item 3	5	22	1	-	1	1	1	31
Item 4	6	13	10	-	-	1	1	31
Total	17	74	22	1	2	3	5	124

and refers to water when asking the question. Therefore, the data presented and the result asked are not compatible.

The problem posed by T23 for item 4 entails a E12 error. The problem posed by the teacher reads "*Ahmet used $3\frac{1}{4}$ plates for the roof of his home, while Mehmet used $1\frac{1}{4}$. What is the amount of plates Ahmet used in excess of the amount used by Mehmet?*" This error type refers to the problems where the fractions involved in subtraction were represented over unequal wholes. The problem posed by T23, in this context, mentions the roofs of different houses.

The teachers were asked to employ models for solving the problems they posed. Table 4 presents the models the teachers employed for each item. The teachers have resorted to modeling for each item, even though they did not pose a problem. Table 4 presents the models employed by the teachers for the items provided. Teachers left 5 out of a total of 124 items blank, without employing any models at all.

Furthermore, in 116 cases, the teachers employed the area model. When employing the area model, the teachers used a number of distinct geometric shapes and images of concrete models. In this process, 17 items were posed with squares, 74 with rectangles, 22 with circles, and 1 with triangles. Two items, in turn saw the use of concrete models.

Among the two, one employed the area model with a torus, and the other with a bottle drawing. Just 3 items saw the use of number lines, whereas none of the teachers who took part in the study employed the set model to represent the fractions.

Figure 1 below presents the area models provided by teachers for items 1, 2, and 4. Teachers T1 and T26 employed geometric shapes in the area model, whereas T9 opted with the use of a concrete model. T1 used a rectangle, T29 a circle, and T9 a torus.

Figure 2 depicts the number line model T12 used for item 3. The teacher first presented the subtracted fraction by converting it to an improper fraction over number line, followed by the conversion of the subtracted fraction to an improper fraction. Then, the teacher referred to the difference between the two.

DISCUSSION

Posing a problem is one of the alternative assessment tools used to identify conceptual understanding skills, misconceptions or errors (Ticha and Hospesova, 2009). The primary school teachers who took part in the study were presented with four operations entailing subtraction with fractions. The teachers were then asked to pose verbal problems regarding these operations, and to solve the problem thus posed, through modeling. The responses provided by the majority of the teachers involved in the study, with respect to the operations provided, meet the criteria for problems.

The study reveals that the rate of correct responses offered in the problem category falls as one progresses from item one where both the minuend and the subtrahend are proper fractions, towards item four where a mixed fraction is subtracted from another mixed fraction; a result confirming the findings of Kar and Işık (2014). One of the reasons for this may be the difficulties teachers have with mixed fractions.

In this context, one could argue that the increase in the number of mixed fractions involved in the operation regarding which a problem is to be posed have a negative impact on the teachers' ability to pose correct problems (Kar and Işık, 2014). Even though most of the given answers have problem property, the verbal problems posed by the teachers entail certain errors.

Kar and Işık (2014) identified 12 types of errors seventh year secondary school students had in terms of problem posing involving subtractions with fractions. However, the present study observed just 9 of these. The types of errors identified in the present study are E1, E2, E3, E6, E8, E9, E10, E11 and E12. On the other hand, in contrast to what Kar and Işık (2014) found, the present study did not come across error types E4, E5, and E7. Error types E1, E4, E10, E11, and E12 observed in this study are comparable to what Kar and Işık (2015) found with secondary school mathematics teachers, while error types E8, E9, E10, E11, and E12 are similar to the types of errors McAllister and Beaver (2012) observed in the problems pre-service primary school teachers posed with respect to the subtraction operations.

The fact that nine distinct types of errors were observed
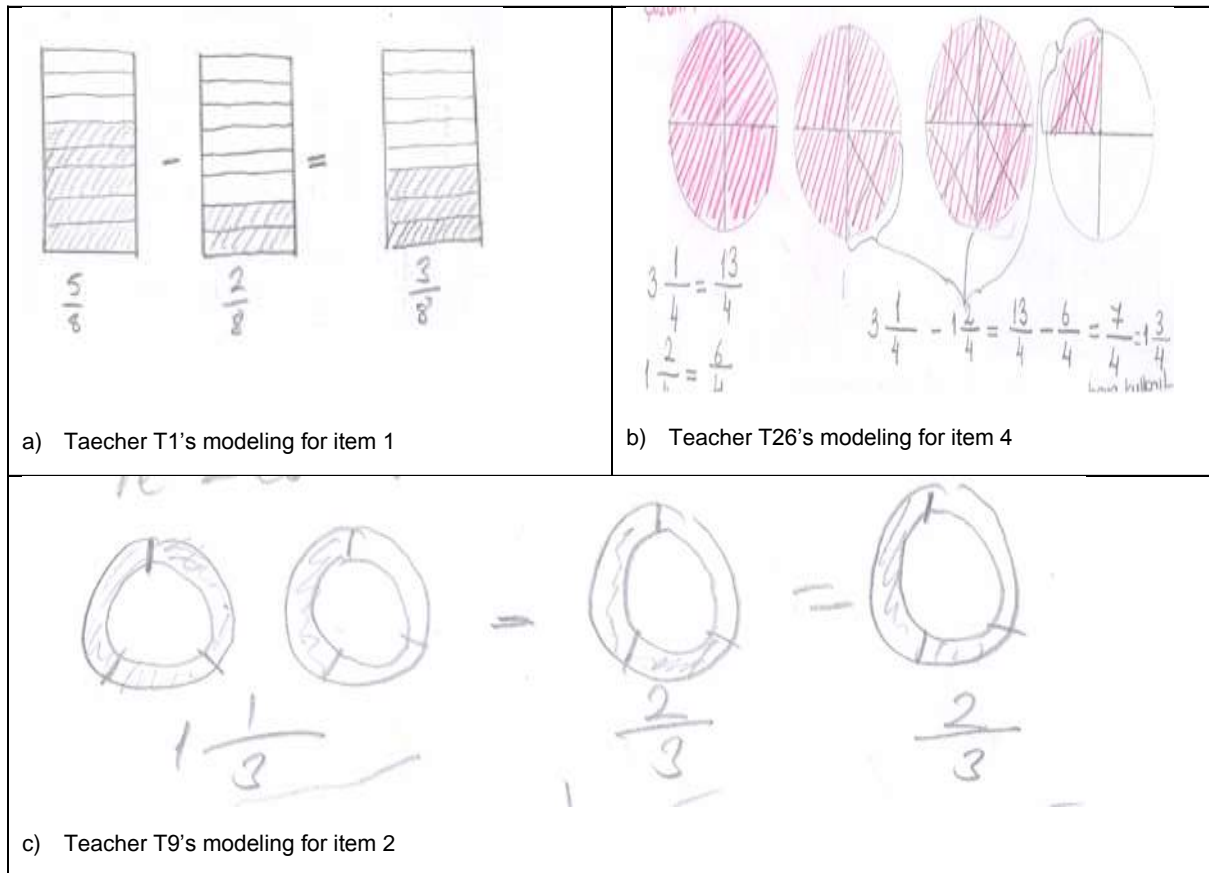
Figure 1. Area models employed by the teachers.
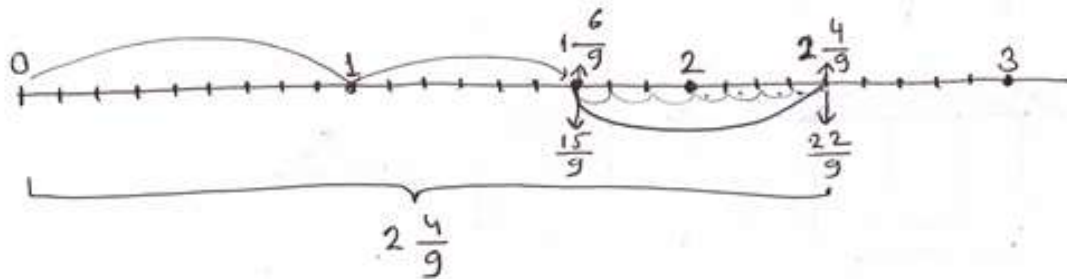
Figure 2. T12's modeling for item 3.

in the study reveals that the teachers have significant shortcomings when posing problems regarding subtraction with fractions. Kar and Işık (2015) through an analysis of the types of errors and the statements provided, noted three issues in the heart of the errors. These issues are

1. Difficulties in terms of language
2. Difficulties in terms of conceptualization, and
3. Difficulties caused by the teachers' habits regarding

the teaching process (Kar and Işık, 2015).

These issues may lie at the core of the errors committed by the primary school teachers involved in the present study. The failure to grasp the relationship between the part and the whole, the inability to use relevant units with the fractions, and the statement of fractions with reference to different wholes are but a few of the errors which may be caused by the conceptual difficulties teachers have with the concept of fractions. Such errors

observed at the conceptual level regarding the operations with fractions have roots extending back to the fractions concept (Charalambous et al., 2010).

The conceptual shortcomings observed in teaching of subtraction with fractions can have negative connotations regarding the education processes themselves as well. For content, knowledge is one of the most significant determinants of teaching of mathematics (Ball et al., 2008; Ball et al., 2001).

One of the important reasons for the errors in the problems that teachers posed in this research might be the difficulties in the linguistic dimension. Because, in the study conducted by Kar and Isik (2015), the teachers stated that they had difficulties in expressing their thoughts while posing problems during the focus group interviews. On the other hand, expressing the resulting fraction with reference to the remainder of the whole, or as a certain portion of the minuend, the failure to reflect the subtraction to the question root, assignment of a value to the whole, logical fallacies, and the use of "what portion" phrase with reference to mixed fractions may have something to do with the difficulties experienced at a conceptual level, as well as deficiencies in verbal language skills (Kar and Işık, 2014).

Besides, it is seen that the difficulties experienced in the linguistic dimension are more frequent in the items in which at least one of the mixed fractions is minuend or subtrahend. Another important reason for the errors in the posed problems is the routines of the teachers in the teaching process. Teachers, although they all know that wholes have to be equal but they do not give expressions about this situation in their problems. Problems that teachers pose such as providing opportunities for students to learn can also lead to misconceptions (Isik and Kar, 2012b; Kar and Işık, 2015).

Therefore, such deficiencies in teachers can be seen as an important reason for the misconceptions of students at the conceptual level. For example, if the teachers do not emphasize enough that all of wholes have to be equal, that may cause the students to do operations on fractional numbers which contain non-equal wholes (Kar and Işık, 2015).

The most common types of error observed with the problems posed by the primary school teachers who took part in the study are expressing the subtrahend fraction as a certain amount of minuend fraction (E10), failure in expressing the operation in the question root (E6), and not being able to establish part-whole relationship (E2), in the respective order.

These results are parallel to the study of Kar and Işık (2014). But Kar and Işık (2015) study with secondary school mathematics teachers, in contrast, express the fractions over the different wholes (E12), logical error (E11), and unit confusion (E7) as the most common errors. Among these, only H10 is specific to subtractions with fractions. Existing studies (Işık and Kar, 2012c; McAllister and Beaver, 2012) suggest that unit confusion,

attributing natural number meaning to the result of the operation, not being able to establish part-whole relationship and failure in expressing the operation in the question root as highlighted by the present study, are more common in the problems posed with reference to fraction operations, compared to others. This is perhaps due to the teachers having more difficulty in these error types, and the roots of such errors lying in the shortcomings regarding the concept of fractions. The most common error the teachers committed with respect to E6, in turn, was to pose the problems as representations of a*b, rather than a-b. In this error type, the teachers considered the subtrahend of the fraction as a certain part of the minuend of the fraction, rather than that of the whole.

The average number of errors the problems provided by primary school teachers in response to each item of the problem posing test entails is greater than one. It is clear that the teachers have significant difficulties in terms of their problem posing skills. This finding is in parallel to those of Kar and Işık (2014). Taking into account the average number of errors regarding each problem posing item, the lowest average number of errors (1.4) was observed with item one, where both the minuend and the subtrahend were proper fractions.

On the other hand, the average number of errors rises to 2.07 with item three, where, particularly the result of subtracting a proper fraction from a mixed fraction was to be another mixed fraction. In other words, on average, each problem posed contains more than two errors. This may be due to the teachers' less than stellar abilities regarding posing problems related with daily life, with reference to subtraction with fractions.

Herman et al. (2004) stated that elementary school students can explain the addition operation with fraction process with symbolic representations, while a few can create descriptions or stories about the process of addition operation with fractions. The results of this study also show that the students have a lower chance of posing problems related to daily life situations for subtraction operation with fractions.

The teachers have resorted to modeling for each item. Teachers left only a few items blank, without employing any models at all. Furthermore, the majority of the teachers employed the area model, and while doing so, made use of the images of various geometric shapes and concrete models. The most widely used geometric shapes were squares, rectangles, and circles. Tabak et al. (2010) found that 4 and 5th year primary school students had substantial success in using the area model for expressing fractions. They concluded, with reference to the students' ability to interpret fractions using various geometric shapes (squares, rectangles, triangles, parallelograms, circles, and right trapeziums under the area model, that they had been highly successful with circles, rectangles, circles, and parallelograms (Tabak et al., 2010).

The primary school teachers employed the number line only with a few items; the set model, on the other hand, was not used at all. The teachers' preference for the area model may stem primarily from the fact that they would be dealing with years 1 to 4. For the students in such years are yet capable almost only of concrete thought; the use of the area model may be an easier route for the teachers to explain. The lack of use of the set concept, in turn, may be explained by the lack of reference to that topic at the primary school level. On the other hand, the teachers may be simply experiencing difficulties with the use of number lines and set models. Tabak et al. (2010) found in this context, that the students had only minor success with the number line model.

CONCLUSION AND RECOMMENDATIONS

The present study was based on four items developed with reference to subtraction with fractions. The fractions used in these items were chosen to common denominators, as the study group was primary school teachers. As a means to build on this study, similar ventures can be tried on operations involving fractions with different denominators, as well as on different operations involving fractions. The study was carried out with 31 teachers employed at three schools. In this context, similar studies can be executed with ever larger samples. This would help improve the generalization ability of the results, through nothing but access to wider audiences.

The present study gathered data through the problem posing test developed for the study. Future studies may employ interviews as well, with a view to obtaining in-depth insights into the errors committed by the teachers. Moreover, the types of errors identified in the present study suggest roles played by difficulties experienced on the language front, problems regarding conceptualization, and issues with the teachers' habits regarding the teaching process. The interviews may help identify the causes of the types of errors committed by the teachers, and eliminate them through workshops and in-service trainings etc. Moreover, it is interesting that the teachers who took part in the study mostly made use of the area model. The interviews may try and investigate why the area model had been thus dominant.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

Abu-Elwan R (2002). Effectiveness of problem posing strategies on prospective mathematics teachers' problem solving performance. J. Sci. Math. Educ. S.E. Asia 25(1):56-69.

Aksu M (1997). Student performance in dealing with fractions. J. Educ. Res. 90(6):375-380.

Albayrak M (2000). İlköğretimde Matematik ve Öğretimi. 2. baskı, Ankara: Aşık Matbaası.

Baki A, Çelik D (2005). Grafik hesap makinelerinin matematik derslerine adaptasyonu ile ilgili matematik öğretmenlerinin görüşleri. Turk. Online J. Educ. Technol. 4(4):146-162.

Ball DL (1990). Pre-service elementary and secondary teachers' understanding of division. J. Res. Math. Educ. 21(2):132-144.

Ball DL, Bass H (2000). Interweaving content and pedagogy in teaching and learning to teach: Knowing and using mathematics. In Jo Boaler (Ed.), Multiple Perspectives on Teaching and Learning. Westport, CT: Ablex Publishing. pp. 83-104.

Ball DL, Lubienski S, Mewborn DS (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. In V. Richardson (Ed.), Handbook of Research on Teaching, 4:433-456. Washington, DC: American Educational Research Association.

Ball DL, Thames MH, Phelps G (2008). Content knowledge for teaching what makes it special?. J.Teacher Educ. 59(5):389-407.

Başgün M, Ersoy Y (2000). Sayılar ve Aritmeatik I: Kesir ve Ondalık Sayıların Öğretilmesinde Bazı Güçlükler ve Yanılgılar, IV. Fen Bilimleri Eğitimi Kongresi Bildiri Kitabı: MEB Yayınları, Ankara 604-608.

Borko H, Eisenhart M, Brown C, Underhill R, Jones D, Agard PC (1992). Learning to teach hard mathematics: Do novices and their instructors give up too easily?. J. Res. Mathe. Educ. 23(3):194-222.

Carraher DW (1996). Learning about fractions. In L. P. Steffe, P. Nesher, P. Cobb & B. Greer (Eds.), Theories of Mathematical Learning (pp. 241-266). Hillsdale, NJ: Erlbaum.

Charalambous CY, Delaney S, Hsu HY, Mesa V (2010). A comparative analysis of the addition and subtraction of fractions in textbooks from three countries. Mathe. Thinking Learn. 12:117-151.

Chick HL, Baker MK (2005). Investigating teacher's responses to student misconceptions. In H. L. Chick & J. L. Vincent (Eds.). Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education Melbourne, Victoria, Australia: PME. 2:249-256.

Çakan M (2004). Assessment-Evaluation Applications of Teachers and their Qualification Levels: Primary and Secondary Education. Ankara University J. Educ. Sci. 37:99-114.

Çelik B, Çiltaş A (2015). Beşinci sınıf kesirler konusunun öğretim sürecinin matematiksel modeller açısından incelenmesi. Bayburt Üniversitesi Eğitim Fakültesi Dergisi 1:10.

Dursun Ş, Dede Y (2004). Öğrencilerin matematikte başarısını etkileyen faktörler: matematik öğretmenlerinin görüşleri bakımından. Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi 24(2):217-230.

Ersoy Y, Ardahan H (2003). İlköğretim okullarında kesirlerin öğretimi II: Tanıya yönelik etkinlikler düzenleme, http://www.matder.org.tr/bilim /ioko 2tyed. asp?ID=49, Download:27.04.2015.

Hanson D (1995). Understanding Fractions (Grades 5 to 8). http://mathcentral.uregina.ca/RR/database/RR.09.95/hanson4.html

Haser Ç, Ubuz B (2002). Kesirlerde kavramsal ve işlemsel performans. Eğitim ve Bilim 27(126):53-61.

Herman J, Ilucova L, Kremsova V, Pribyl J, Ruppeldtova J, Simpson A, Stehlikova N, Sulista M, Ulrychova M (2004). "Images of fractions as process and images of fractions in processes". Proceedings of the 28th Conference of the International Group of the Psychology of Mathematics Education, Bergen.

Hill HC, Rowan B, Ball DL (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. Am. Educ. Res. J. 42(2):371-406.

Işık C (2011). İlköğretim matematik öğretmeni adaylarının kesirlerde çarpma ve bölmeye yönelik kurdukları problemlerin kavramsal analizi. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 41:231-243.

Işık C, Kar T (2012a). İlköğretim matematik öğretmeni adaylarının kesirlerde bölmeye yönelik kurdukları problemlerde hata analizi. Kuram ve Uygulamada Eğitim Bilimleri (KUYEB) 12(3):2289-2309.

Işık C, Kar T (2012b). Sınıf öğretmeni adaylarının problem kurma becerileri. Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi 23:190-214.

Işık C, Kar T (2012c). 7. sınıf öğrencilerinin kesirlerde toplama işlemine kurdukları problemlerin analizi. İlköğretim Online 11(4):1021-1035.

Işık C, Işık A, Kar T (2011). Analysis of the problems related to verbal and visual representations posed by pre-service mathematics teachers. Pamukkale University J. Educ. 30(2):39-49.

Işıksal M (2006). A study on pre-service elementary mathematics teachers' subject matter knowledge and pedagogical content knowledge regarding the multiplication and division of fractions. Unpublished doctoral dissertation, Middle East Technical University, Turkey.

Kar T, Işık C (2014). Analyzing problems posed by seventh grade middle school students for subtraction operation with fractions. Elem. Educ. Online 13(4):1223-1239.

Kar T, Işık C (2015). The Investigation of Elementary Mathematics Teachers' Views about Problems Posed by Students: Addition Operation with Fractions. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. J. Educ.) 30(1):122-136.

Kılıç Ç (2013). Determining the performances of pre-service primary school teachers in problem posing situations. Educational Sciences: Theory Pract. 13(2):1195-1211.

Kocaoğlu T, Yenilmez K (2010). Beşinci sınıf öğrencilerinin kesir problemlerinde yaptıkları hatalar ve kavram yanılgıları. Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi 14:71-85.

Korkmaz E, Gür H (2006). Determining of prospective teachers' problem posing skills. Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi 8(1):64-74.

Leung SS (2013). Teachers implementing mathematical problem posing in the classroom: challenges and strategies. Educ. Stud. Mathe. 1-14.

Olkun S, Toluk Uçar Z (2012). İlköğretimde etkinlik temelli matematik öğretimi. Ankara, Anı yayıncılık.

Ma L (1999). Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States, Erlbaum: Mahwah, NJ.

Mack NK (1990). Learning fractions with understanding building on informal knowledge. J. Res. Math. Educ. 21(1):16-32.

McAllister CJ, Beaver C (2012). Identification of error types in preservice teachers' attempts to create fraction story problems for specified operations. School Sci. Math. 112(2):88-98.

Milli Eğitim Bakanlığı, Talim, Terbiye Kurulu Başkanlığı (MEB) (2015). İlkokul Matematik Dersi (1, 2, 3 ve 4. Sınıflar) Öğretim Programı. Ankara.

Mok IAC, Cai J, Fung ATF (2008). Missing learning opportunities in classroom instruction: Evidence from an analysis of a well-structured lesson on comparing fractions. Math. Educator 11(1/2):111-126.

Newton KJ (2008). An extensive analysis of pre-service elementary teachers' knowledge of fractions. Am. Educ. Res. J. 45(4):1080-1110.

Özmantar MF, Bingölbali E (2009). Sınıf öğretmenleri ve matematiksel zorlukları. Gaziantep Üniversitesi Sosyal Bilimler Dergisi 8(2):401-427.

Post TR., Harel G, Behr MJ, Lesh R (1991). Intermediate teachers' knowledge of rational number concepts. In E. Fennema, T.P. Carpenter & S.J. Lamon (Eds.), Integrating research on teaching and learning mathematics (177–198). Albany: State University of New York Press.

Redmond A (2009). Prospective elementary teachers' division of fractions understanding: A mixed methods study. Unpublished doctoral dissertation, Oklahoma State University.

Romberg TA, Carpenter TP (1986). Research on teaching and learning mathematics: Two disciplines of scientific inquiry. In M. C. Witrock (Ed.), Handbook of Research on Teaching, New York: Macmillan, 850-873.

Rule AC, Hallagan JE (2006). Preservice elementary teachers use drawings and make sets of materials to explain multiplication and division by fractions. Paper presented at the 2nd Annual Preparing Mathematicians to Educate Teachers (PMET) Conference at Oswego, New York.

Seferoğlu SS (2001). Elementary school teachers perceptions of professional development. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 20:117-125.

Seyhan G, Gür H (2004). İlköğretim 7. ve 8. sınıf öğrencilerinin ondalık sayılar konusundaki hataları ve kavram yanılgıları. Matematikçiler Derneği. www.matder.org.tr

Shulman LS (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educ. Rev. 57:1-22.

Silver EA, Cai J (2005). Assessing students' mathematical problem posing. Teach. Children Math. 12(3):129-135.

Smith JP (2002). The Development of Students' Knowledge of Fractions and Ratios. In B. Litwiller and G. Bright (eds.), Making Sense of Fractions, Ratios, and Proportions, Reston, Virginia, NCTM, pp. 3-17.

Soylu Y, Soylu C (2005). İlköğretim besinci sınıf öğrencilerinin kesirler konusundaki öğrenme güçlükleri: Kesirlerde sıralama, toplama, çıkarma, çarpma ve kesirlerle ilgili problemler. Erzincan Eğitim Fakültesi Dergisi, 7(2):101-117.

Sharp J, Adams B (2002). Children's constructions of knowledge for feaction division after solving realistic problems. J. Educ. Res. 95(6):333-347.

Şiap İ, Duru A (2004). Kesirlerde geometriksel modelleri kullanabilme becerisi. Gazi Üniversitesi Kastamonu Eğitim Dergisi, 12(1):89-96.

Tabak H, Ahi B, Bozdemir H, Sarı MH (2010). İlköğretim 4. ve 5. sınıf öğrencilerinin matematik dersinde kesirleri modelleme becerileri. e-J. New World Sci. Acad. Educ. Sci. 5(4):1513-1522.

Ticha M, Hospesova A (2009). Problem posing and development of pedagogical content knowledge in pre-service teacher training. Paper presented at the meeting of CERME 6, Lyon.

Tirosh D (2000). Enhancing pre-service teachers' knowledge of children's conceptions: The case of division of fractions. J. Res. Math. Educ. 31(1):5-25.

Toluk-Uçar Z (2009). Developing pre-service teachers understanding of fractions through problem posing. Teach. Teacher Educ. 25:166-175.

Utley J, Redmond A (2008). Prospective elementary teachers attitudes towards and knowledge of the division of fractions. Paper presented at the annual meeting of the Research Council on Mathematics Learning, Oklahoma City, OK.

Van de Walle JA (2004). Elementary and middle school mathematics: teaching developmentally (5th ed.). Boston, MA: Pearson.

Ward J, Thomas G (2007). What do teachers know about fractions? In Findings from the New Zealand Numeracy Development Projects Wellington, New Zealand: Learning Media. pp. 128-138.

Wu H (1999). Some remarks on the teaching of fractions in elementary school. Available at: http://math.berkeley.edu/~wu/fractions2.pdf

Yim J (2010). Children's strategies for division by fractions in the context of the area of a rectangle. Educ. Stud. Math. 73:105-120.

Zembat İÖ (2007). Working on the same problem-concepts; with the usual subjects pre-service elementary teachers. Elem. Educ. Online 6(2):305-312.

Educational Research and Reviews

Full Length Research Paper

The effects of green schooling knowledge level and intensity of parental guidance on the environmental awareness of the early age student

Sihadi Darmo Wihardjo[1]*, Sofia Hartati[1], Yuliani Nurani[1] and Agus Sujarwanta[2]

[1]Faculty of Education Science, State University of Jakarta, Indonesia.
[2]Post Graduate Program Muhammadiyah University of Metro, Metro Lampung, Indonesia.

This study was conducted to determine the effect of green schooling knowledge and parents guidance on the environmental awareness of the students. This study used a quantitative approach with the ex-post facto method. This study was conducted in Muhammadiyah 41 elementary school in East Jakarta at July to December on the 2nd semester of the academic year of 2014/2015. The data were collected from a sample which consisted of four third grade elementary school students drawn randomly. The data were analyzed using two ways ANOVA. The results showed that: 1). There were significant differences of green schooling knowledge level on the student's environmental awareness; 2).There were significant differences in the intensity of parental guidance on the environment to the student's environmental awareness, and 3). There were significant differences in green schooling knowledge level and the intensity of parental guidance on the environment to the student's environmental awareness. Both variables might be considered to improve the student's environmental awareness.

Key words: Green schooling knowledge, intensity of parental guidance, environmental awareness.

INTRODUCTION

Environmental awareness as a part of education could not be ignored by the school. The educational institution as the primary stakeholder is obliged to improve the environmental awareness of students since they were on early stage in the school. The patterns of human consumption was affected by continuously growing of modern life, also affecting the environment, because exploiting the natural resources is the only way to fulfill the human subsistence that grows massively, in the other side also disrupting the environment sustainability.

The decrease of environmental carrying capacity is indicated by the number of natural disasters which is caused by human behavior. Forest fires, floods and landslides that occurred in Indonesia are the evidence of environmental awareness crisis. To prevent further damage, it is necessary to do an early anticipation through environmental education in the schools since an early age.

From the viewing point of science, awareness is a part of social psychology which adopts the cognitive domain.

Awareness is generated through feelings and actions which influence each other. Awareness could be observed from the attitude and behavioral changes after getting various information. Environmental awareness is influenced by the personality and the value system where they live, therefore: 1). Every individual is a part of the environment, so that, its existence and sustainability are affected by the environment they live; 2). Human beings must become active agents who act as the ecosystem advisers in managing natural resources, and 3). Every individual reserve the right to enjoy the good and healthy environment, preserve the good and healthy environment, and also obliged to prevent the damage and pollution to the environment.

Concerns about the environment are very important for today's life, or in the future. Nowadays, the lack of environmental awareness among us has caused many environmental damages. There is still hope of fixing it by improving environmental awareness among young children. Schools have an important role to play in teaching the children on the concept of environment. It seems like impacting on them knowledge on the green environmental concept (green schooling). The value system is adopted by the family, in this case, the student's parents, could be urged to provide guidance to students, and, it could complete the behavioral construction function, which is performed at school. Both factors became important in providing environmental education in order to improve environmental awareness of the students at an early stage.

According to Anderson (1972: 34), awareness is a conscious mental process due to a dominant and obtrusive impulse or stimuli. Another opinion expressed that the human's awareness is not a value, but rather as a domain or complementary values. Awareness, in this case, assign a value of the environment, not to the people, so the main point of human awareness is the domain, where all the individuals and cultures complement and holds the value to each other (Gilmour and Duck, 1980: 14).

According to Bennett (1997: 145), there is environmental awareness on the individual knowledge, feelings and tendencies. The comprehension of environmental awareness is determined by the amount of experience and emotional connection acquired from learning, whether formal, non-formal, and informal.

According to Miller (1993: 335), environmental awareness is a human way to conserve nature in order not to be bothered or harassed by others, who are not responsible. The concept of the environmental awareness originated from the changes in society's view of the environment. This point of view recognized as a new paradigm, that assumes 1). The supply of natural resources that provided by the earth are not infinite; 2). Humans and nature must be connected harmoniously; 3). Each individual has a responsibility for solving environmental problems; 4). Humans are the part of nature, not the master of nature, because of that, when humans destroy nature they also destroy themselves.

To instill the values of this new paradigm, we need an environmental education whose its implementation could be done by giving the green knowledge schooling. The main purpose of environmental education is to instill: 1). Personal or social groups awareness and sensitivity to the environment; 2). Understanding and comprehension of the environment and its problems; 3). Awareness of the environment and emerge the desire to contribute to environmental protection; 4). The benefits of the expertise in identifying and resolving the environmental problems; and 5). The opportunity for participating in the environmental problems solving (Michael, 1990: 272-273) show in Figure 1. The environmental awareness model that could explain how the information could trigger the environmental positive attitude and behavior could be explained as follows:

This model illustrates that the information and knowledge of a person or a group will determine whether a person has a concern or otherwise does not care for the environment. Furthermore, a high level of environmental awareness will most likely push the individual into portraying positive behavior that could support environmental sustainability. On the contrary, if a person's concern for the environment is at a low level, it is difficult to expect he could be prosecuted for positive behavior towards the environment.

Environmental awareness, in the context of this study, is influenced by knowledge of green schooling and parental guidance. According to Suriasumantri (2005: 104), knowledge is everything that we know about a particular object which is directly or indirectly and act as mental repertoire which enriches human cognition. The contents of knowledge itself was mentioned by Davenport and Prusak (1999: 1), as a collection of human experiences, values and related information which bind to the object which is used as fundamental to receive new information and experiences, to evaluate information and experiences which furthermore are applied in a person's minds. As described by Thio (1994: 4), the benefits of knowledge covering a wide range of purposes: decision-making, valuation, imagination, problem-solving, classification and consideration, and all the above mentioned are a mental process.

All aspects of life that could be reached by the human senses, could be considered as an object of knowledge. Everything that is known as knowledge does not occur accidentally, but it is obtained through the process and methods which are developed by humans according to their necessity. As stated by McKnight (2011: 5), human being must have two basic concepts in order to interact with each other, namely: knowledge and mental skills. Knowledge is comprehension of the object through the mind consciousness. Meanwhile, the brain skills are the
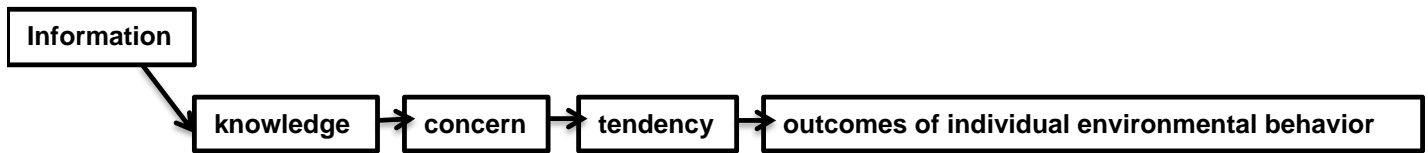
```
┌──────────────┐
│ Information  │
└──────┬───────┘
       │
       ▼
┌───────────┐   ┌──────────┐   ┌──────────┐   ┌─────────────────────────────────────────────┐
│ knowledge │──▶│ concern  │──▶│ tendency │──▶│ outcomes of individual environmental behavior │
└───────────┘   └──────────┘   └──────────┘   └─────────────────────────────────────────────┘
```

Figure 1. Model of environmental awareness.

ability of a person to be able to influence others in the organizational structure. Skill is also the manifestation of knowledge, and as a form in the implementation process. According to Bloom et al. (1984: 62-67), knowledge is included in the cognitive domain and it has nine aspects: facts, rules, relations between objects, methodologies, classifications, principles, generalizations, theories and structures.

It has been tested by human experience that information in the knowledge could be used to solve specific problems. Therefore, knowledge is also known as a source of answers to the questions that are found in life and could be used as a tool to solve various problems. Knowledge as a form of human mind power wealth which is is very important and useful. Not only to answer the question that always comes into the human minds, but it also helps people to solve their problems.

Parents' guidance factors are related to early childhood period, in the view of Ki Hadjar Dewantara, where children included in the age range of 0-7 years were specified into Windu I category. Children included in this period are called childhood or garden child. The most suitable education for them is giving example and habituation. The parent's guidance to their children is more general. This counseling intends to instill the values that are positive to the child, including the environmental concerns and awareness. The values of the environmental concerns and awareness embedded in the child are expected to be a provision of further activity both in the home and at school.

According to Newcomb (1968), as quoted by Khan (1984: 33), people prefer to like rather than dislike others. This is because a person will feel more safe and comfortable when you are in an environment that consists of people who have a similar character with him. According to Arelano (1973) as quoted by Partowisastro (1983: 235), the presence of good guidance is characterized by 1). Efforts to help individual to achieve the optimal development; 2). Assistance is given in a democratic situation, not the authoritarian situation; 3). Assistance is given to determine the objectives that must be achieved, as well as, how to achieve it by the development of the individual; and 4). Assistance is provided to increase the ability of the individual so that he can make decisions and solve his own problems. Guidance in this context emphasizes providing assistance to children in order to increase their awareness of the environment, especially at home.

METHODS

This study was conducted in Muhammadiyah 41 Elementary School in East Jakarta from July to December in the 2nd semester in the academic year of 2014/2015. The method used was Ex Post Facto method with the 2x2 research design. The dependent variable of this research was the environmental awareness on the other side, as the independent variables were green schooling knowledge (X_1) and parental guidance (X_2). Samples were taken randomly and grouped into two groups based on their green schooling knowledge and intensity of parental guidance, the upper group consists of 10 students and the lower groups also consist of 10 students. Overall, the samples analyzed in this study consist of 40 students. The data were analyzed by using two ways ANOVA to test the hypothesis. Significance level (α) used in this study was 0.05.

RESULTS

Environmental awareness on the group with high level ofgreen schooling knowledge

Environmental awareness was expressed by the score collected from 20 respondents after answering 30-grain instruments. The lowest environmental awareness score in the group of high-level green schooling knowledge (A_1) was 63 and the highest score was 75. The group range was 12 and the average (mean) was 68.20. From the 20 samples analyzed, distribution of the data could be tabulated in the frequency distribution as in Table 1.

As shown in Table 1, the distribution of score compared with the price mean = 68.20 are in the 2nd class interval (66-68) which consist of 9 people (45.00%). This frequency is also the largest, this means, environmental awareness profile on the learners with a high level of green schooling knowledge were moderate.

Environmental awareness of the group with low level of green schooling knowledge

Environmental awareness was expressed by the score obtained from 20 respondents after answering 30-grain instruments. The lowest environmental awareness score in the group of low-level green schooling knowledge (A_2)

Table 1. Distribution frequency of environmental awareness of the group with high level of green schooling knowledge.

Class interval	Lower limit	Upper limit	Absolute frequency	Relative frequency (%)	Cumulative frequency (%)
63 – 65	62.5	65.5	5	25.00	25.00
66 – 68	65.5	68.5	9	45.00	70.00
69 – 71	58.5	71.5	1	5.00	75.00
72 – 74	71.5	74.5	4	20.00	95.00
75 – 77	74.5	77.5	1	5.00	100.00
Total	-	-	20	100.00	-

Table 2. Distribution frequency of environmental awareness of the group with low level of green schooling knowledge.

Class interval	Lower limit	Upper limit	Absolute frequency	Relative frequency	Cumulative frequency (%)
57–59	56.5	59.5	2	10.00	10.00
60–62	59.5	62.5	1	5.00	15.00
63–65	62.5	65.5	6	30.00	45.00
66–68	65.5	68.6	11	55.00	100.00
Total	-	-	20	100.00	-

was 56 and the highest score was 68. The group range was 11 and the average (mean) was 64.80. From the 20 samples analyzed, distribution of the data could be tabulated in the frequency distribution as shown in Table 1.

As shown in Table 2, the distribution of score when compared with price mean = 64.80 are in the 3rd class interval (63-65) by 6 people (30.00%) which is classified as a medium category. The largest frequency is at 3rd inteval class (66-68) which consist of 11 people (55.00%). This means, the environmental awareness profile of learners group with high level of green schooling knowledge is relatively high.

Environmental awareness on the group with high intensity of parental guidance

Environmental awareness was expressed with a score obtained from 20 respondents after answering 30-grain instruments. The lowest environmental awareness score in the group of low-level green schooling knowledge (B$_1$) was 57 and the highest score was 75. The group range was 18 and the average (mean) was 67.70. From the 20 samples analyzed, distribution of the data was be tabulated in the frequency distribution (Table 3).

As shown in Table 3, the distribution score when compared with the price mean = 67.70 are in the 3rd class interval (65 - 68) by 8 people (40.00%), which is classified as a medium category. This frequency was also the highest. This means, the environmental awareness

profile of learners group with high intensity of parental guide are relatively moderate.

Environmental awareness of the group with low intensity of parental guidance

Environmental awareness was expressed with a score obtained from 20 respondents after answering 30-grain instruments. The lowest environmental awareness score in the group of low-level green schooling knowledge (B$_2$) was 57 and the highest score was 68. The group range was 11 and the average (mean) was 65.15. From the 20 samples analyzed, distribution of the data was be tabulated in the frequency distribution (Table 4).

From Table 4, the distribution of score when compared with the price mean = 65.15 are in the 3rd class interval (63-65) by 7 people (35.00%), which is classified as a medium category. The largest frequency score was in the 4th class interval (66 - 68) for 11 people (55.00%). This means, the environmental awareness profile of the group with low intensity of parental guidance was relatively high.

The results hypothesis test

Requirements analysis test

Normality of the population was tested with the Kolmogorov-Smirnov using the SPSS 16.0 for Windows; the result is summarized in Table 5. Based on the

Table 3. Distribution frequency of environmental awareness of the group with high intensity of parental guidance.

Class interval	Lower limit	Upper limit	Absolute frequency	Relative frequency (%)	cumulative Frequency (%)
57– 60	56.5	60.5	1	5.00	5.00
61 – 64	60.5	60.5	5	25.00	30.00
65 – 68	64.5	64.5	8	40.00	70.00
69 – 72	68.5	68.5	1	5.00	75.00
73 – 76	72.5	76.5	5	25.00	100.0
Total	-	-	20	100.00	-

Table 4. Distribution frequency of environmental awareness of the group with low-intensity of parental guidance.

Class interval	Lower limit	Upper limit	Absolute frequency	Relative frequency (%)	Cumulative frequency (%)
57 – 59	56.5	59.5	1	5.00	5.00
60 – 62	59.5	62.5	1	5.00	10.00
63 – 65	62.5	65.5	7	35.00	45.00
66– 68	65.5	68.8	11	55.00	100.00
Total	-	-	20	100.00	-

Table 5. Summary of population's normality test result.

Number	Sample group	Sig. Kolmogorov-Smirnov	Significance (α)	Conclusion
1.	A_1	0.283	0.05	Ho was accepted, normally distributed population.
2.	A_2	0.263	0.05	Ho was accepted, normally distributed population.
3.	B_1	0.260	0.05	Ho was accepted, normally distributed population.
4.	B_2	0.550	0.05	Ho was accepted, normally distributed population.

normality test population in Table 5, it can be concluded that the population was distributed normally. In the homogeneity test, the population variance tested as much as 4 sample data. Based on the homogeneity test of the variance with the Barlett test, the value 3.38 < 0.95 (3) = 7.81 was obtained. Because the calculated value was less than the value of table, Ho was accepted with the significance level of 0.05. Therefore the sample variance in this study was obtained from the homogeneous population.

Test results hypothesis

First, the test result of the hypothesis "there was influence of green schooling knowledge and intensity of parental guidance on the environmental awareness"

based on the calculation by using the two ways ANOVA, is summarized in Table 6.

Based on summary of the hypothesis test results in Table 6, from the first hypothesis test, Fcount= 6.168* > F (0.95)(1.36) = 4.11 was obtained which means that Ho was rejected. The test results prove that the influence of green schooling knowledge on the environmental awareness was significant.

Second, the hypothesis tested was "there was influence of intensity of parental guidance on the environmental awareness". Based on a summary results hypothesis test in Table 6, in this test, Fcount= 4.531* > F(0.95)(1.36) = 4.11 was obtained which means that Ho was rejected. The test results prove that the influence of the intensity of parental guidance on the environmental awareness was significant.

Third, the hypothesis tested was "there was influence

Table 6. Summary of two ways ANOVA test result of the effect of green schooling knowledge and intensity of parental guidance to the environmental awareness.

Source	Do	JK	RJK	F_{ount}	S_{table} α=0.05	α=0.01
Means	1	6502.500	6502.500			
Green schooling knowledge (A)	1	4.900	4.900	6.168*	4.11	7.39
Intensity of parental guidance (B)	1	3.600	3.600	4.531*	4.11	7.39
Int. A x B	1	6.400	6.400	8.056**	4.11	7.39
Error	36	28.600	0.794			
Total	40	6540.000	-			

of green schooling knowledge and intensity of parental guidance on the environmental awareness". Based on summary of hypothesis test results in Table 5, F(0.95)(1.36) = 4.11 <Fcount = 8.056** > F(0.95)(1.36) = 4.11 was obtained. The calculated value was different from the reception area, Ho (α= 0.05) then Ho was rejected. The results prove that the simultaneous effect of the green schooling knowledge and intensity of parental guidance on the environmental awareness were significant.

DISCUSSION

The hypothesis test results in this study were entirely significant. In relation to the findings of this study, the discussion could as follows:

First, a significant test results of influence of green schooling knowledge on the environmental awareness, was in accordance with the role of green schooling knowledge in the model built by Michael (1990: 272), that the information and knowledge a person or group of people have on the environment will determine whether someone has a concern or otherwise do not care about the environment. Descriptively, we could also find the fact that the average environmental awareness score in the group with high level of green schooling knowledge was 68.20. That average score was above the average score of the group with the low level of green schooling knowledge, which got an average of 64.80. Visually Profile of The Green Schooling of Muhammadiyah 41 elementary school in East Jakarta Figure 2.

Second, a significant test results of the intensity of parental guidance on the environmental awareness was relevant to what was mentioned by Ki Hajar Dewantara as cited by Santoso (2011), that children in the age range of 0-7 years, are called childhood or garden child, and the most suitable education for them are giving examples and habituations. The parent's guidance to their children

was more general. This counseling intends to instill the values that are positive to the child, including the environmental concerns and awareness. Similar statement was made by Purwanto (1990: 117), he explained that the attention of parents against children become one of the important factors that affect the desire or motivation of the children. Care of the parents was one of the important factors that influence the environmental awareness of the children. The desire or learning motivation in many children associated with family conditions, especially parents, without any desire to teach child might not be able to achieve satisfactory learning outcomes. The desire to learn in many children is associated with the state of their parent's condition. It is in accordance with the Santoso (2011: 11) opinion that parents play the most important role in their child education. Education will succeed if started from the beginning, in this case, since the children are at an early age. All aspects of personality could be guided, fostered and formed, so all the aspects are mature. Guidance has two meanings: 1). Guidance in general, which is equal to education or embedding the values, fostering morals, and directing students in order to be good; and 2). Guidance in particular, which is an effort or program to help to optimize the student's development. This guidance is provided through behavioral assistance, also to boost the development of student potential that mainly deals with concerns of the environmental awareness.

Conclusion

Based on the hypothesis testing and discussion, it could be concluded thus:

1. There was influence of green schooling knowledge on the environmental awareness of the learners who had a high level of green schooling knowledge as compared to participants who have a lower level of green schooling

Figure 2. Profile of The Green Schooling of Muhammadiyah 41 elementary school in East Jakarta.

knowledge.

2. There was influence of the intensity of parental guidance on the environmental awareness of the learners who had high intensity of parental guidance as compared to learners who had lower intensity of parental guidance.

3. There was simultaneous influence of green schooling knowledge and intensity of parental guidance on environmental awareness. The environmental awareness of the learners was determined by the green schooling knowledge and intensity of parental guidance.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Anderson KE (1972). Introduction to Communication Theory and Practice.Cumming Publishing Company: California.

Bennet DE (1997). Evaluate of Environmental Educational Program. John Willey and Son, New York.

Bloom Benjamin S, David RK, Betram BM (1984).Taxonomy of Educational Objectives: The Classification of Educational Goal.Longman Group Ltd: London.

Davenport T, Prusak L (1999). Working Knowledge.Available at: Http:www. Competent,Org.br/slidesallee22/tsldohtm,p.1. Accession date: 12 July 2014.

Gilmour R, Duck S (Ed).(1980). TheDevelopment of Social Psychology. Academic Press Inc. London.

Khan AS (1984). Social Psychology.America Psychology Association.Iowa State University: In. C. Brown Publisher Dubuque.

McKnight MR (2011). Available at: Irttm://cobeidbsu.edu/msr/skilldoc/mcknight.htm,p.5. Accession date: 12 July 2011.

Michael HW (1990). The Corporation, Ethics and the Environment.Quorum Books: London.

Miller GT (1993). Living in The Environment. Concepts, problems, and alternatives. Wadsworth Publication Inc: California.

Partowisastro K (1983). In the dynamics of Educational Psychology. Erlangga: Jakarta.

Purwanto MN (1990). Educational Psychology. Rosda Karya: Bandung.

Santoso S (2011). "Concept of Early Childhood Education in Indonesia" Concept of Early Childhood Education According to founder. State University of Jakarta: Jakarta.

Suriasumantri JS (1998). An Introduction to the Philosophy of Science. Pustaka Sinar Harapan: Jakarta.

Thio A (1994). Sociology A Brief Introduction. Harper Collins College Publications, New York.

Full Length Research Paper

Item response theory: A basic concept

Jumailiyah Mahmud

Institute of Teaching and Educational Sciences of Mataram, Indonesia.

With the development in computing technology, item response theory (IRT) develops rapidly, and has become a user friendly application in psychometrics world. Limitation in classical theory is one aspect that encourages the use of IRT. In this study, the basic concept of IRT will be discussed. In addition, it will briefly review the ability parameter estimation, particularly maximum likelihood estimation (MLE) and expected a posteriori (EAP). This review aims to describe the fundamental understanding of IRT, MLE and EAP which likely facilitates evaluators in the psychometrics to recognize the characteristics of test participants.

Key words: Expected A Posteriori, Item Response Theory, Maximum Likelihood Estimation

INTRODUCTION

Over the last decade, item response theory (IRT) has increasingly been popular. As noted by Steinberg and Thissen (2013), many studies have been conducted to enrich literatures in the field of psychometrics.

It is common to note that IRT is a pivotal methodology which has been globally used in many assessment programs. IRT is commonly applied in educational and psychological testing, and recently it is beneficial to assess health outcomes (Cai et al., 2016).

In educational context, IRT is developed to address the limitation in classic measurement theory, particularly its shortcoming that is dependent between test participant group and items in nature. Such dependent characteristics mean the outcome of the measurement depends on the participant group completing the test. If the test is given to participant group with high ability, the difficulty level of the question item appears to be low. On the contrary, if the test is given to participant group with low ability, the difficulty level of the question item turns out to be high (Hambleton et al.,1991b).

The estimation of parameters is a central matter in the item response theory, thou it is said that the item response theory is successful due to the success of implementing the parameter estimation (Swaminathan, 1983). Matter that strongly needs attention in parameter estimation is large number of empirical data despite its dependency on the model of parameter logistic in use. Based on the aforementioned outline, the writer in this review will describe basic concept of IRT, dichotomous logistic model and the type of ability parameter estimations, particularly that of maximum likelihood and expected a posteriori.

Item response theory (IRT)

The term of IRT in the literature can be found as latent distribution theory, *item characteristic curve* (ICC) and

item characteristic function (ICF). This item characteristic curve is presented in an item characteristic relation curve with participant characteristics which is shown on the abscissa while the ordinate shows the probability of the item answer.

The test participant characteristics and item characteristics are related by model in the form of function or graphical curve (Naga, 1992b). Each question item is represented by an ICC showing the relation between correct answer probability and the test participant ability.

In classic theory, the item characteristics will depend on the ability level of the test participants, if the item is completed by participant with high ability, the item shows low difficulty level, in contrast, for participant with low or medium ability, the item will show high difficulty level. On the other hand, item response theory predicts the participants' ability from their ability in answering the test items correctly, the higher their ability, the higher the probability of correct answer they provide. Likewise, the higher the item difficulty level, the higher the test participants' ability to answer the item correctly. Despite a claim stating that modern theory cannot substitute classic theory (Zanon et al., 2016), based on the aforementioned description, the basic concept of item response theory is considered a strong theory compared to that of classic theory.

Moreover, recent technology development has made IRT implementation far easier. Yet, the theory requires general assumptions or conditions of item response theory to satisfy by the items and the test participants including:

1. Unidimensional
2. Local independency, and parameter invariance.

Unidimensional specifically means an exam measure only one characteristic of the participants (Crocker and Algina, 1986). Firstly, unidimensional means the exam only measure one character or one ability of the test participants. For instance, one set measures ability in calculation and does not disclose the test participant ability in understanding or mastering language. Statistically, unidimensional can be calculated with factor analysis indicated by one dominant factor.

Secondly, local independency means that the influence of participant ability and test item are considered constant in which the participants' response to question item have no relation statistically. "This assumption will be satisfied when the participants' answer to one item does not influence the answer to another item. The participants' answer to several test items is expected to have no correlation" (Hambleton et al., 1991c). The implication of this assumption results in items analyzable item per item, and likewise the participants are analyzed per individual.

Thirdly, parameter invariance that is, "the function of

item characteristics is constant or remains unchanged albeit the participant group answering the items changes. In the same group, their characteristics will remain unchanged despite the items they answer change" (Naga, 1992b). The invariance is reviewed from the point of item characteristics and the participant characteristics, difficulty level and distinguishing capacity of the items will remain notwithstanding the question items are answered by high ability group or low ability group. The participant ability will be constant or remain unchanged despite the items they answer change.

The most essential assumptions in item response theory are unidimensional and local independency (Embretson and Reise, 2000a). This opinion was also proposed by Hambleton (1989). One of the most common assumptions is that in any test, only one ability is measured by the items instrument. This assumption is called unidimensional assumption (Azwar, 2004).

Dichotomous logistic model

Furthermore, the advantage of item response theory in relation with the analysis of the test result is to present the basis for making prediction, estimation or conclusion on the participants' ability. The process of education measurement starts with scoring the item response of the participant and response pattern matrix is developed, carrying out initial check on the data conformity by choosing the parameter model, estimating the item parameter and the participants ability, and composing the scaling transformation (Hambleton and Swaminathan, 1985)

Some types of data are analyzed with item response analysis model such as dichotomous, polytomous and continuous data. In dichotomous data, response to one item is shown in two categories such as: true-false, yes-no, agree-don't agree. Particularly, the participants' ability test consists of two categories with true or false content. In a test with multiple choice format of five answers option, the categorization of respondents answer will be grouped into two response categories that is, true or false where correct response will score one and incorrect response will score zero (Bejar, 1983)

There are three types of logistic model of item response theory that is, single parameter model, dual parameters model, and triple parameters model. The three models differ in the number of parameter to calculate in describing the item characteristics. The single parameter model calculates only the item difficulty level (b_i), while the distinguishing capacity of item (a_i) scores one or constant and the guessing parameter scores (c_i) zero. The dual parameters model calculates the item difficulty level (b_i) and the item distinguishing capacity (a_i), while the guessing parameter (c_i) scores zero.

Whereas, the triple parameters model calculates the
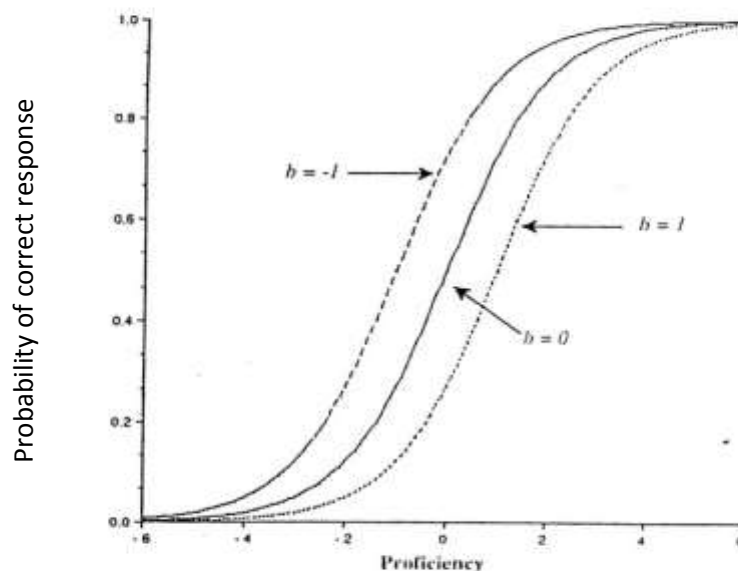
Figure 1. Item curve of single parameter logistic model (Hambleton et al., 1991c).

three parameters that is, b_i, a_i and c_i.

Single parameter logistic model

The description of single parameter model in an item characteristics curve, b_i parameter is a parameter location shown in ability scale, named item difficulty level. The higher the item difficulty level, the more to the right its position in a curve (Lord, 1980b) (Figure 1).

In Figure 1, item difficulty level parameter (b_i) is a point in the ability scale to have the opportunity of 50% to answer correctly. There are three items: the third items show the most right item, and therefore they are the items with the highest difficulty level (b_i = 1.0), while the first items show the left most items which are the items with the lowest difficulty level (b_i = -1.0), and the second items are the items with medium difficulty level that is, b = 0.

To be able to answer 50% of the first items correctly, participant ability of minimal -1.0 is necessary ($\theta = -1.0$). To be able to answer 50% of the third items correctly, participant ability of minimal 1 is necessary. 0 ($\theta = +1.0$). The higher b_i scores, the higher the ability necessary to answer 50% of them correctly. The higher b_i scores, the more difficult the items or otherwise, the lower b_i scores, the easier the items.

When the ability value is transformed with mean = 0 and deviation standard = 1, the b_i value will vary from -2.0 to + 2.0. b_i value close to - 2.0 indicates low difficulty level of the items while b_i value close to + 2.0 indicates high difficulty level of the items or difficult question item (Hambleton et al., 1991c).

Dual parameter logistic model

In single parameter model, the form of the curve is similar while the dual parameter logistic model calculates the curves with different curve slopes. The difference in items curve indicates the difference of a_i value. Items with steep curve indicates high distinguishing capacity or high a_i value, while gradient item curve indicates low difficulty level or low a_i value. Subsequently, a chart is presented showing two item characteristics with equal and different distinguishing capacity (a_i) and difficulty level (b_i) (Embretson and Reise, 2000b) (Figure 2).

Figure 2 shows 4 items with equal and different difficulty level, and distinguishing capacity. The first and fourth item have equal difficulty level that is, b_i = 1, this can mean that both items requires participants' ability of $\theta = 1.0$ to be able to answer 50% of the items correctly.

However, both items have different distinguishing capacity that is, the first items with =0.5 while the fourth item is a_i = 1 showing more gradient curve on the first items than that of the fourth's, the third items shows steep curve due to high distinguishing capacity (a_i = 3), and the second items on the left most indicate lowest difficulty level (b_i = -1) having the same gradient with the fourth items since they have the same distinguishing capacity(a_i = 1).
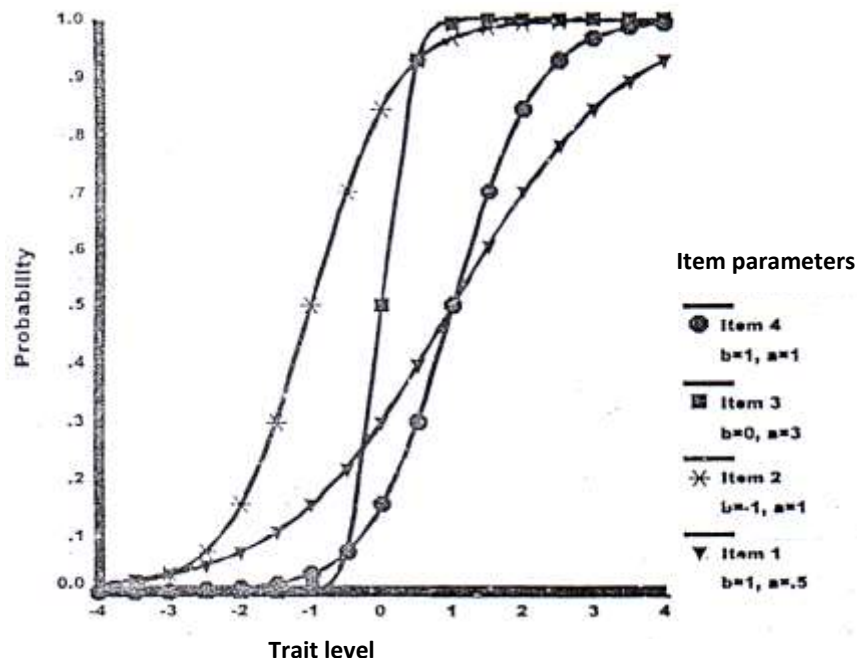
Figure 2. Item Curve of Dual Parameter Logistic Model (Embretson and Reise, 2000b).

Theoretically, parameter a_i is located at scale - ∞ to + ∞. However, a difficult case occurs to a_i negative value, or it is better to remove items with negative distinguishing capacity due to possible error, and this indicates correct answer probability decreases when the ability level increases. a_i is also unlikely to occur if it is bigger than 2.0. The a_i value commonly ranges from 0.0 to 2.0. Dual parameter logistic model formula are:

$$P_i(\theta_j) = \frac{e^{Da_i(\theta_j - b_i)}}{1 + e^{Da_i(\theta_j - b_i)}} \qquad i=1,2,3, \tag{1}$$

$P_i(\theta_j)$ = the j test participant probability with ability

answer (θ_j) the item i correctly (item i = 1, 2, 3... n)

b_i = difficulty level parameter of item i
a_i = distinguishing capacity of item i
n = number of item in the test.
e = number with value of 2.718
D = scaling factor made in order the logistic function close to ogive normal function (Embretson and Reise, 2000d).

Furthermore, to find out the items value (a_i and b_i) and the participants ability (θ) in logistic model, we need to

figure out the parameter value in a measurement. The determination of parameter value is known as parameter estimation, item parameter and ability parameter; participant ability value estimation is called scoring and item parameter estimation is called calibration.

Ability parameter estimation

Item response theory ability estimation

Estimation means the process of estimating or predicting. "The estimation contains the finding of value according to parameters of an expression with certain methods" (Makridakis et al.,1999). Estimation is made on regression model and item response theory model, yet they have the following differences:

1. Regression model is commonly applied to variable with linear relation, while parameter logistic model comes with nonlinear relation between question items and participant ability.
2. Independent variable in the regression is a variable that can be observed while in item response theory, the participants ability independent variable (θ) cannot be observed (Hambleton et al., 1991a). Since actual value of item parameter and participant ability are unknown, analysis and estimation

on respondent ability and items parameter are carried out.

At its emergence in 1950s, item response theory did not gain popularity due to the lack of worthy statistical estimation procedure (Birnbaum, 1968). After analysis made by using computer, estimation carried out by Bock and Lieberman (1970) shows that computer-made estimation can be done despite its limitation, that is, analysis is carried out on small number of question items and participants sample. The estimation of parameters is a central matter in the item response theory, even it is said that the item response theory is successful due to the success of implementing and procedure availability that is up the mark of parameter estimation (Chen W-H and Thissen, 1999).

Item parameter estimation is with the assumption that the participants' ability is known or otherwise, and the item parameter is known to estimate the participants' ability. The participants' ability estimation with test instrument where the items have been calibrated; the questions whose item characteristics have calculated will be saved in item bank and will be re-used according to the objectives and information function of the target test.

"Ability estimation procedure can be performed with maximum likelihood (ML), maximum a posteriori (MAP), and expected a posteriori (EAP), while items estimation can be performed with estimation approaches including Maximum Likelihood (ML), Bayesian, logistic regression and heuristic estimation" (Embretson and Reise, 2000c).

Ability estimation with maximum likelihood method is carried out through calculation process with various scoring algorithm. The researcher focuses on two methods that is, MLE and EAP, and provides the details for each method. Estimation method description viewed from theoretical point to facilitate the understanding. Based on the writer's experience, the analysis obtained with MLE and EAP methods is not exactly the same. This may be influenced by factors in data sampling (Mahmud et al., 2016).

Ability estimation and item estimation can be carried out simultaneously that is, an estimation process in which item parameter estimation is carried out with ability estimation. The first step is to estimate the item parameter, and the result will be used to estimate the ability parameter before using it as a value to estimate the item parameter in the subsequent stage.

Henceforth, iteration is carried out in which the value obtained in the current round will be taken as the initial value for the subsequent round; this iteration is carried out until the value difference between one round and another becomes a shade of difference called convergent. The iteration process will stop when it reaches the convergent, and the parameter value obtained on the convergent will become the parameter estimation value to figure out.

Maximum likelihood estimation (MLE)

Maximum likelihood is a common method for model parameter estimation, sufficiently effective with large sample and valid model application (Longford, 2008). The "*likelihood*" means probability or possibility, while "*maximum*" means the highest extent.

Therefore, *maximum likelihood*" is the occurrence with the highest possibility. In the literatures on item response theory, "*Maximum likelihood* is a mode of total *likelihood*" (Bock, 2003). The highest opportunity will depend on the probability of the correct answers and incorrect answers by the participants, and also on the logistic parameter employed, thus, the determination of maximum ability value is carried out through iteration calculation (Baker, 2001).

Ability estimation with *maximum likelihood* method is a calculation process which aims to figure out maximum ability (θ) value of each participant with the symbol of $L_i(\theta)$ and value of $P_j(\theta)$ obtained from formula 1. Afterwards, the calculation process with formula 2 to formula 5 that can be carried out to calculate ability estimation with *maximum likelihood* method through iteration process in Bilog MG program is:

$$\log L_i(\theta) = \sum_{j=1}^{n} \left\{ x_{ij} \log_e P_j(\theta) + (1 - x_{ij}) \log_e \left[1 - P_j(\theta) \right] \right\} \quad (2)$$

$L_i(\theta)$ = Maximum ability value for each participant

$P_j(\theta)$ = Ability probability on each item such as shown in formula 1.

x_{ij} = the number of correct items

x_{ij} = the number of incorrect items

The maximum likelihood value of each participant's ability $L_i(\theta)$ is derived in the form of logarithm equalized to zero with the following formula:

$$\frac{\partial \log L_i(\theta)}{\partial \theta} = \sum_{j=1}^{n} \frac{x_{ij} - P_j(\theta)}{P_j(\theta)[1 - P_j(\theta)]} \frac{\partial \log(\theta)}{\partial \theta} = 0 \quad (3)$$

ML estimation, $\hat{\theta}$, is calculated with Fisher scoring method named "*Fisher information*". Theoretically, the method that can be employed in iteration technique varies. Yet, common methods to employ are Newton–Raphson and Fisher. The logic in both approaches does

not have significant differences in which Fisher method employs "Fisher Information" while Newton-Raphson employs "Hessian" as the second "partial derivative" (Brown, 2014). For simplification purpose, the writer employs Fisher method with information function formula for dual parameter model as follows:

$$I(\theta) = \sum_{j=1}^{n} a_i^2 P_j(\theta)\left[1 - P_j(\theta)\right] \quad (4)$$

$I(\theta)$ = information function of respondent's ability
θ = respondent's ability level
a_i = distinguishing capacity of item i

Upon obtaining the ability information score of dual logistic parameter model, the iteration can be determined with the following formula:

$$\hat{\theta}_{t+1} = \hat{\theta}_t + I^{-1}(\hat{\theta})\left(\frac{\partial \log L_i(\hat{\theta})}{\partial \theta}\right) \quad (5)$$

$\hat{\theta}_{t+1}$ = ability estimation score in the current round

$\hat{\theta}_t$ = ability estimation score in the previous round

$I(\hat{\theta})$ = information function of the ability

$\left(\dfrac{\partial \log L_i(\hat{\theta})}{\partial \theta}\right)$ = *Maximum likelihood* estimation score of a respondent

The calculation is carried out until the ability score does not change in the last round as of the previous round or convergent. The convergent criterion is 0.05 or 0.01, or even less such as 0.001. With the convergent calculation, ability estimation score ($\overline{\theta}$) is obtained.

In fact, constraint in the logistic model is commonly encountered. Theoretically, the curve in logistic model extends towards 0 or 1 asymptotically. This means that the curve will reach 0 or 1 at infinite point that the estimation method is incapable of estimating the parameter when there are items or participants make all correct answer or all incorrect answer (Naga, 1992a).

Expected A posteriori (EAP) bayes

Lord (1980a) described possible use of Bayes estimation since education field usually "give test to the same participant year to year with parallel test or similar test.

Thereby, good description on ability frequency distribution in participants group can be represented".

Birnbaum paradigm is employed to estimate item parameter, and participant parameter individually and simultaneously as implemented in LOGIST program. In Bilog or Bilog MG program, estimation is made in two stages, the first stage is items estimation followed by ability estimation. Data analyzed in maximum likelihood estimation is the data from the participants' response or sample data. Bayes estimation procedure uses prior data and sample data which is used in maximum likelihood approach. During the initial use of Bayes approach, Swaminathan and Gifford (1985) used the hierarchy Bayesian estimation procedure, yet it was complicated to implement due to the lack of computer program available for such purpose. Researchers have adopted more pragmatic approach in which Bayesian approach is considered a tool to improve parameter estimation" (Baker and Kim, 2004a).

Posterior distribution estimation is a combination of prior distribution and sample distribution. The combination based on Bayes rule on conditioned probability often encounters complicated constraint, and this renders difficulty in formulating posterior distribution in statistics while Bayes estimation remains opposed due to the use of prior distribution as researcher's subjective consideration (Baker, 1991).

Despite Bayes estimation is presumed complicated from other review point, item response estimation is employed for its practicality, and complicated calculation in accordance with the new development in computer field that is getting steady and simpler. The estimation does not use integration but is based on discrete distribution in "Mislevy quadrature point".

In fact, Baker, on Bayes estimation stated "the latest advancement in IRT estimation procedure is Bayes estimation implemented for the first time in BILOG program (Mislevy and Bock, 1986), that it will be able to address various issues that comes with simultaneous estimation approach in JMLE method" (Baker, 1991).

EAP ability estimation method estimates respondent ability for response pattern of all correct and all incorrect. This method is part of Bayes approach derived from the average of *posterior* distribution, and does not use any mode. Analysis strategy logic employs Bayes principles in BILOG using Mislevy Histogram, a histogram description showing an area in a curve (Baker and Kim, 2004b). Figure 3 facilitates the understanding in ability estimation with Bayes approach as follows:

1. Determining X_k (k = 1, 2, 3,….. q) called *nodes*. Bilog MG default includes 15 nodes.
2. There is density in ordinate area that is, histogram ordinate. Density or weight is usually taken from normal distribution as well as from empirical data.
3. Since BILOG program does not use Hermit-Gauss that
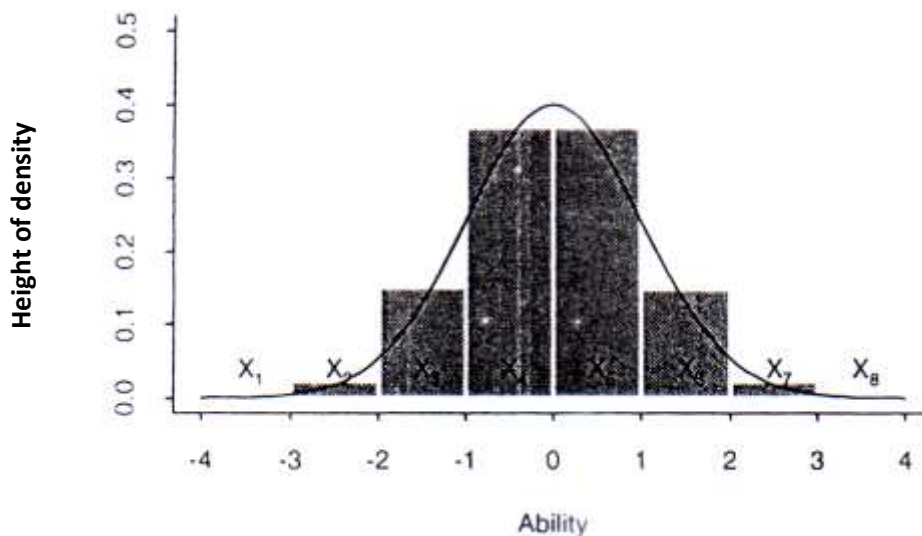
Figure 3. Area in a curve (Baker and Kim, 2004b).

applies integration, but "Mislevy histogram" instead while the it is assumed as normal distribution, then X_k value can be figured out, $A(X_k)$ weight shows the gap between X_k and other X_{k+1}. If X_k shows the same gap than $A(X_k)$ value can be figured out by: one divided into many nodes, otherwise if X_k does not have the same gap then $A(X_k)$ is X_k where X_{k+1} is called weight.

4. Calculating L (X_k) value $P_j(\theta)$ shows ability probability in an item like that obtained from formula 1, while the formula notation is based on Mislevy Histogram using P(X_k). Therefore, $P_j(\theta) = P(X_k)$ and $X_k = \theta_k$, while L is likelihood function of participant ability with formula in the form of multiplication such that that is indicated in formula 6.

$$L(X_k) = \prod_{i=1}^{n} P_i(X_k)^{u_{ij}} Q_i(X_k)^{1-u_{ij}} \tag{6}$$

$L(X_k)$ = maximum ability value for each participant

X_k = θ_k ability level

P_i = correct answer probability
Q_i = incorrect answer probability.
u_{ij} = the number of correct answer
$1 - u_{ij}$ = the number of incorrect answer

5. Calculating ability estimation value

$$6.\ E(\theta_j | U_j, \xi) = \bar{\theta}_j = \frac{\sum_{k=1}^{q} X_k L(X_k) A(X_k)}{\sum_{k=1}^{q} L(X_k) A(X_k)} \tag{7}$$

$E(\theta_j | U_j, \xi) = \bar{\theta}_j$ is average ability level, provide that participants' response in dichotomous 0 or 1 scoring is known

$E(\theta_j)$ = expected ability value

$X_k = \theta_k$ = ability level

$A(X_k)$ = weight, indicating gap between X_k and X_{k+1}
ξ = item parameter value
q = the number of node (quadrature point), the number of group by ability level.

EAP method will be able to analyze or calculate the participant ability notwithstanding that they make all correct answer or all incorrect answer; the calculation process is carried out without iteration but based on average answer score for each participant on answering a number of items.

Relevant to the aforementioned discussion, the working principle of Bayes method starts from posterior data as combination of sample data and prior data or initial data. In education field, prior data can be obtained from data before the study's data collection. In the implementation of item parameter or ability parameter estimation, prior data can be made as artificial data by Bilog MG program using formula 8 and 9 (Baker and Kim, 2004b).

$$\bar{f}_{ik} = \sum_{j=1}^{N} \left[\frac{L(X_k)\ A(X_k)}{\sum\limits_{k=1}^{q} L(X_k)\ A(X_k)} \right] \qquad (8)$$

$\bar{f}_{ik}$ = *artificial examinee* for each participant ability (X_k)

$X_k = \theta_k$ = ability level

$A(X_k)$ = weight, indicating gap between X_k and X_{k+1}
q = the number of node (quadrature point), the number of group by ability level.

$$\bar{r}_{ik} = \sum_{j=1}^{N} \left[\frac{u_{ij}L(X_k)\ A(X_k)}{\sum\limits_{k=1}^{q} L(X_k)\ A(X_k)} \right] \qquad (9)$$

$\bar{r}_{ik}$ = artificial data of correct answer in item i of ability level (X_k)

$X_k = \theta_k$ = ability level

$A(X_k)$ = weight, indicating gap between X_k and X_{k+1}
u_{ij} = the number of correct answer
q = the number of node (quadrature point), the number of group by ability level.

The aforementioned discussion includes two ability estimation methods from maximum likelihood approach that is, maximum likelihood estimation method and from Bayes approach that is, expected a posteriori ability estimation method. They differ in:

1. Calculation procedure, formulas used in the calculation. Maximum likelihood method calculates through iteration process while expected a posteriori ability estimation method calculates through average answer of each participant for each ability level.
2. For participants with all correct answer or all incorrect answer in maximum likelihood estimation method, the implementation of joint maximum likelihood estimation (JLME) will not bring calculation result, yet, in the calculation via Bilog MG program, the ability estimation result will be displayed.
3. Maximum likelihood estimation calculation data is based on sample data, while expected a posteriori method uses prior data generated by Bilog MG program using formula 8 and 9 as described earlier.

In this review, it is understood that ability estimate with MLE method implements formula 2, 3, 4, and 5, whereas

the ability estimate with EAP method uses formula 6, 7, 8, and 9. In actual context, formula 6 is quite similiar to formula 1, but they have different term and symbol as further implemented with Mislevy Histogram. Formula 8 and 9 are used to create prior artificial data by Bilog MG.

CONCLUSION

The implementation of IRT as a rigid theory requires requirements test and assumption that the implementation analysis can be further carried out. In general, the assumption does not require any test, however, when assumption test is performed then it can be considered a requirement test even beyond the three assumption tests that is, fitness model test to figure out whether the empiric data (items) is suitable for IRT analysis χ^2.

Item characteristics including difficulty level (b), distinguishing capacity (a) and correct answer (c); item characteristics calculated in the analysis influence the mathematics model employed and logistic parameter model. Difficulty level only, indicates its single parameter logistic model; difficulty level and distinguishing capacity indicate dual parameter logistic model; and calculating the three characteristic indicates triple parameter logistic model.

There are three methods that can be used in ability estimation are, MLE of maximum likelihood group, Bayes EAP, and Bayes MAP of Bayes (not discussed) group. Bayes group uses prior data, empirical data and combination of both data, posterior data, in the analysis. Prior data can be generated by BILOG MG program as artificial data using formulas. While theoretically, Maximum likelihood method does not use prior data. This method is said to have no bias elements yet it often fails in ability and items analysis to determine the estimation value; the failure to determine the value on item data all answered correctly and all answered incorrectly.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

Azwar S (2004). Dasar-dasar Psikometri. Yogyakarta: Pustaka pelajar.
Baker FB (1991). Comparison of minimum logit chi-square and Bayesian item parameter estimation. Br. J. Math. Stat. Psychol. 44(2):299-313. doi: 10.1111/j.2044-8317.1991.tb00963.x.
Baker FB (2001). Estimating an Examinee's Ability. In: Boston C, Rudner L, editors. The Basics of Item Response Theory: ERIC Clearinghouse on Assessment and Evaluation. pp. 85-102.
Baker FB, Kim S-H (2004a). Bayesian Parameter Estimation Procedures. In: Baker FB, Kim S-H, editors. Item Response Theory Parameter Estimation Techniques, Second Edition. Monticello, New York: Marcel Dekker. pp. 171-201.

Baker FB, Kim SH (2004b). Parameter Estimation via MMLE and an EM Algorithm. In: Baker FB, Kim S-H, editors. Item Response Theory Parameter Estimation Techniques, Second Edition. Monticello, New York: Marcel Dekker. pp. 157-75.

Bejar I (1983). Introduction to Item Response Models and Their Assumptions. In: Hambleton RK, editor. Applications of Item Response Theory. Vancouver, Canada: Educational Research Institute of british Columbia. pp. 1-23.

Birnbaum A (1968). Some Latent Trait Models. In: Lord F, Novick M, Birnbaum A, editors. Statistical theories of mental test scores. Canada: Addison-Wesley Publishing. pp. 397-423.

Bock RD (2003). Estimation in BILOG-MG. In: Du Toit M, editor. IRT from SSI: Bilog-MG, multilog, parscale, testfact. Lincolnwood, IL: Scientific Software International. pp. 599-610.

Brown JD (2014). Maximum-Likelihood Estimation. Linear Models in Matrix Form: A Hands-On Approach for the Behavioral Sciences. Cham: Springer International Publishing. pp. 69-104.

Cai L, Choi K, Hansen M, Harrell L (2016). Item Response Theory. Annu. Rev. Stat. Appl. 3(1):297-321. doi: 10.1146/annurev-statistics-041715-033702.

Chen W-H, Thissen D (1999). Estimation of item parameters for the three-parameter logistic model using the marginal likelihood of summed scores. Br. J. Math. Stat. Psychol. 52(1):19-37. doi: 10.1348/000711099158946.

Crocker L, Algina J (1986). Introduction to Item Response Theory. In: Crocker L, Algina J, editors. Introduction to classical and modern test theory. Orlando, Florida: ERIC. pp. 339-75.

Embretson SE, Reise S (2000a). Calibrating Items: Estimation. In: Embretson SE, Reise S, editors. Item Response Theory for Psychologists. Mahwah, New Jersey: Lawrence Erlbaum Associates. pp. 187-225.

Embretson SE, Reise S (2000b). Item Response Theory as Model-Based Measurement. In: Embretson SE, Reise S, editors. Item Response Theory for Psychologists. Mahwah, New Jersey: Lawrence Erlbaum Associates. pp. 40-61.

Embretson SE, Reise S (2000c). Measuring Persons: Scoring Examinees with IRT Models. In: Embretson SE, Reise S, editors. Item Response Theory for Psychologists. Mahwah, New Jersey: Lawrence Erlbaum Associates. pp. 158-86.

Embretson SE, Reise S (2000d). The New Rules of Measurement. In: Embretson SE, Reise S, editors. Item Response Theory for Psychologists. Mahwah, New Jersey: Lawrence Erlbaum Associates. pp. 13-39.

Hambleton R, Swaminathan H, Rogers J (1991a). Ability and Item Parameter Estimation. In: Foster D, editor. Fundamentals of Item Response Theory. California: Sage Publications. pp. 32-52.

Hambleton R, Swaminathan H, Rogers J (1991b). Background. In: Foster D, editor. Fundamentals of Item Response Theory. California: Sage Publications. pp. 1-6.

Hambleton R, Swaminathan H, Rogers J (1991c). Concepts, Models and Features. In: Foster D, editor. Fundamentals of Item Response Theory. California: Sage Publications. pp. 7-31.

Hambleton RK (1989). Principles and selected applications of item response theory. In: Linn RL, editor. Educational measurement, 3rd ed. New York, NY: Macmillan Publishing. pp. 147-200.

Hambleton RK, Swaminathan H (1985). Ability Scales. In: Madaus G, Stufflebeam D, editors. Item Response Theory, Principles and Application. Norwell, MA: Kluwer Nijhoff Publishing. pp. 53-74.

Longford N (2008). Maximum Likelihood Estimation. In (Casella G, Fienberg S, Olkin I, editors. Studying Human Populations: An Advanced Course in Statistics. New York, NY: Springer New York. pp. 37-66.

Lord FM (1980a). Estimating ability and item parameters. In: Lord FM, editor. Applications of item response theory to practical testing problems. Hillsdale, New Jersey: Lawrence Erlbaum Associates Publishers. pp. 179-91.

Lord FM (1980b). Item Response Theory - Introduction and Preview. In: Lord FM, editor. Applications of item response theory to practical testing problems. Hillsdale, New Jersey: Lawrence Erlbaum Associates Publishers. pp. 11-26.

Mahmud J, Sutikno M, Naga DS (2016). Variance difference between maximum likelihood estimation method and expected A posteriori estimation method viewed from number of test items. Educ. Res. Rev. 11(16):1579-89. doi: 10.5897/ERR2016.2807.

Makridakis S, Wheelwright SC, McGee VE (1999). Pengantar. In: Suminto H, editor. Metode dan aplikasi peramalan. Jakarta: Binarupa Aksara. pp. 13-25.

Naga DS (1992a). Estimasi Parameter Pada Model Logistik. In: Naga DS, editor. Pengantar teori sekor pada pengukuran pendidikan. Jakarta: Gunadarma. pp. 246-85.

Naga DS (1992b). Pengertian dan Model Teori Responsi Butir. In: Naga DS, editor. Pengantar teori sekor pada pengukuran pendidikan. Jakarta: Gunadarma. pp. 156-92.

Steinberg L, Thissen D (2013). Item response theory. The Oxford handbook of research strategies for clinical psychology. pp. 336-73.

Swaminathan H (1983). Parameter Estimation in Item Response Models. In: Hambleton RK, editor. Applications of Item Response Theory. Vancouver, Canada: Educational Research Institute of british Columbia. pp. 24-44.

Zanon C, Hutz CS, Yoo H, Hambleton RK (2016). An application of item response theory to psychological test development. Psicol-Reflex Crit.. 29(1):18. doi: 10.1186/s41155-016-0040-x.

Full Length Research Paper

Analysis of written expression revision skills of the students in faculty of education

Remzi Can

Ahi Evran University, Turkey.

This study aims to analyze written expression revision skills of students in Turkish Education Department, Education Faculty. This study was done using qualitative research method. The study group of the research consisted of 3rd grade students. The research data were collected by means of document review, a qualitative research technique. The data in the research were analyzed descriptively; content analysis was applied to the data as well. In the obtained findings, it was observed that Turkish teacher candidates did not have adequate knowledge concerning revising part of process-based writing model, and that they did not apply this step of process-based writing efficiently in the writing process. It was seen that the students made changes respectively in word level and surface level, mostly in the revision process. While these changes pertain to punctuation and correct use of particles in the surface level, they gather around sections of adding and placing in the word level.

Key words: Written expression, revision process, process-based writing.

INTRODUCTION

Individuals express themselves in writing and verbally through language. To express oneself in writing involves a more systematic and complex process compared to verbal expression. Individuals should receive a planned and process-based writing education for the development of writing skills which goes hand in hand with thinking skills. Students find it more difficult to write, and since writing lies in every step education, students prove inadequate in education.

It is easier to evaluate the morphological properties of a text in traditional written works rather than its content. It is a known fact that is not allocated enough time for activities of pursuing and evaluating the written expression processes (Coşkun, 2005). Teachers, generally, do not follow written expression with in-process

evaluation activities in order to improve their students' skills of creating text. Instead, they assess students' competency in grammar rules, especially punctuation and spelling, readability of their writing and the way they position their paper at the end of the work (Karatay, 2011).

Teachers play significant roles in students' obtaining required level of writing skill and improving a positive attitude towards writing. In this aspect, it is critical that teachers include process-based writing works in the class. Writing, in process-based writing works, is considered an exploration, renewing and changing of an idea and language. This process covers different stages before and during writing (Erdoğan and Yangın, 2014).

In Planned Writing and Evaluating Model based on the

understanding of process-based writing, individuals can develop the habit of writing while they learn how to express their emotions and ideas in a planned way, and to arrange them in a certain way. No matter the genre, a text has to have integrity. This obligation requires individual to create a writing plan. Implementing Planned Writing and Evaluating Model requires certain stages (Yılmaz and Aklar, 2015).

Conducting written expression works in a gradual way that helps students produce competent writings. Carrying out writing process with these stages will help in revealing students' deficiencies. Furthermore, it helps to provide feedback to students wherever necessary, to arrange their thoughts and correct their mistakes, to watch them during the course of their writing works' and to evaluate and manage this process well (Karatay, 2011).

There are four stages to writing process. These are: pre-writing, draft, revision of content, and sharing (Tompkins, 2000). In pre-writing stage, the subject is established and restricted. One makes a research on the subject and reveals the ideas to be written on. Target readers, the type of text and purpose of writing are determined. In the stage of creating a draft, the ideas that are determined are written in a way to create a meaningful whole. In revision, the writing is evaluated and works such as adding, deleting and correcting of spellings are performed. In the last stage, sharing (publication), the resulting product is shared with others (Uygun and oth., 2014).

Revision is the last subunit of the writing process. It is a process that a writer, with the purpose of correcting or evaluating the text in a systematical way, can resort to consciously re-reading and re-planning the composition created (Ülper and Uzun, 2009). Revision process is an inseparable part of the writing process. Taylor (1981) defines it as a creative exploration process while to Soven (1999), it is re-thinking the widest elements of a text (Sze, ???). Murray (1981) states that revision is not only a process of clarifying the text, but also a process of exploring the meaning of the text. Beason (1993) argues that revision process develops students' writing skill and is a valuable instrument of education; Britton (1993) states that revision makes the text more correct and more developed (Bridwell, 1980).

Revision process is both a complicated and easy process than it is thought to be. Revision is not a process of correction following the instructions in a manual. Authors should go back time after time, to think what writing means. In other words, writing is not an action that writer takes after thinking process is completed; to write is to think (Murray, 1981). A successful revision is not about how many times the author made changes. It is about creating a text that is the closest to the planned text (Faigley and Witte, 1981).

Revision might be the most satisfactory part of composition teaching. Teachers should hold students responsible for their text. Unfortunately, many teachers do not grasp the logic of revision process; hence they do not encourage revision and even do not allow it. When revision is encouraged as a natural process aiming at discovering the meaning of a text rather than used as a punishment, many writers will be motivated (Murray, 1981).

Students perceive revision process only as lexical changes. Experienced writers put more effort in an attempt to convey the meaning to the audience (Sommers, 1980). Good writers often turn back to read what they have written compared to ordinary writers. Teachers' way of structuring writing classes and the type of feedback they give will determine the type of correction in their writing (Stallard, 1974). Experienced writers differ from novice writers as such:

1. The time spent on writing
2. Nature and amount of correction
3. Thinking of what is written and re-reading during writing
4. Concern for clarity of the message.

Revision of inexperienced writers usually does not improve their texts. Such writers tend to revise in sections and neglect situational limitations. Correction, amount and type of change depend on some variables other than writer's skill. These variables are situational variables. Situational variables are: reason of writing, format, language, type, writer's confidence while writing, writer's familiarity with the subject, writer's understanding of the audience, level of formality, and length of writing (Faigley and Witte, 1981).

It is necessary to develop planning skills of inexperienced writers concerning writing. Conducting works in relation to process-based writing activities will be beneficial in terms of students' developing positive attitude towards writing and improving their skills regarding text creation and planning.

The related literature presents studies dealing with the revision processes of the students on the written expression level. To exemplify, Yagelsky (1995) studied the relationship between classroom context and the revisions of the students. Rijlaarsdam et al. (2003) analyzed the revision process as a component of the writing process and as a tool for learning to write. Ferris (1997) studied the influence of teacher commentary on student revision. Our study differs from the studies mentioned above in that the working group is comprised of university students.

METHODOLOGY

Aiming to analyze written expression revision skills of Students of Turkish Education Department, Education Faculty, this study was

designed as a descriptive situation determinant, using a qualitative research method.

The purpose of using descriptive analysis is to provide readers the acquired findings in an organized and interpreted way. With this, acquired data are initially described in a systematic and open way. Thereafter, these descriptions are explained and interpreted; cause-effect relations are scrutinized and a series of results are concluded. Associating and making sense of the resulting themes and making prospective guesses might be included in the dimensions of the comments to be made by researcher as well (Yıldırım and Şimşek, 2006).

Qualitative research, according to Creswell (2003), is a type of research based on interpretation. The researcher interprets the data acquired; he describes in detail and reveals the environment, participants and data analyses of the research and study results. Qualitative research is subjective, exploratory and open-ended.

The objective of the research

The aim of the research was to analyze written expression of the revision skills of Students in Turkish Education Department, Faculty of Education. Answers were given to the following questions:

1. On which levels do students make changes in revision process?
2. Do changes that student make in revision process make positive or negative effect to written expression?

Participants

Study group of the research consisted of 3rd grade students (n=62) who were studying in Turkish Education Department, Faculty of Education, Ahi Evran University.

Data collection instrument

Research data were collected by means of document review and a qualitative research method. Document review includes analysis of written materials containing information about the fact or facts which were aimed to be researched. Document review allows for analysis of documents, which were produced within a certain amount of time, or documents which were produced by multiple sources on a relevant subject on various intervals, based on a wide period of time (Yıldırım and Şimşek, 2006). Students were given 5 topics in conformance with their level and asked to create a text of their choice. Students were allocated 75 minutes. Afterwards, their writings were collected. These writings were photocopied. Students handed in their writings 1 week later and asked to revise their writings and make the changes they want using a different color pen.

Data analysis

The criteria in Bridwell (1980) study were utilized in an attempt to determine which revision strategies students had used, and these criteria were organized. The criteria concerning the changes that will be possibly made during revision process of written expression are as such:

1. Surface level:

1.1 Correct spelling
1.2 Punctuation

1.3 Upper case-lower case letter
1.4 Predicate inflection
1.5 Abbreviations
1.6 Symbols
1.7 Singular-plural
1.9 Correct use of particles
1.10 Page layout

2. Word level:

2.1 Addition
2.2 Deletion
2.3 Substitution
2.4 Changing the order of a single word

3. Word group level:

3.1 Addition
3.2 Deletion
3.3 Substitution
3.4 Changing the order of word group
3.5 Turning a word into a word group
3.6 Turning a word group into a word

4. Sentence level:

4.1 Addition
4.2 Deletion
4.3 Substitution
4.4 Replacement of sentence
4.5 Turning a word, word group into a sentence
4.6 Turning a sentence into a word or a word group
4.7 Rephrasing sentence

5. Multiple sentences:

5.1 Addition
5.2 Deletion
5.3 Substitution
5.4 Changing the order of two or more sentences
5.5. Changing two or more sentences into one sentence
5.6 To indent
5.7 To not indent

6. Text level:

6.1 Change in the type of text
6.2 Change in audience category of text
6.3 Holistic change in general content
6.4 Re-writing the whole text

The data in the research were analyzed descriptively; content analysis was applied to the data as well. The data are described and interpreted in a systematic and open way in descriptive analysis, and a series of results are concluded after cause-effect relations are scrutinized. Associating and making sense out of the resulting themes and making prospective guesses might be included in the dimensions of the comments to be made by researchers as well (Yıldırım and Şimşek, 2006).

Two Turkish education experts read the texts created by students and inspected the corrections they made in the revision process, and whether these corrections contributed to the text. Correspondence percentage formula was used in order to determine the reliability in the content analysis. Correspondence percentage was calculated by the use of "Reliability = (Consensus + Dissensus) x 100" formula (Miles and Huberman, 1994). In these

researches, it is required to attain a minimum of 70% reliability level (Yıldırım and Şimşek, 2006). Correspondence level in coding in the study was .92. This value was accepted for coding.

FINDINGS

Research findings are included in this part of the study.

1. The changes that students made in the surface level in their texts:

Punctuation: 17 changes were made; 1 being changing of a correct punctuation mark to the wrong one, the other changes were correct.
Abbreviation: 5 changes were made. All of these changes improved the quality of the text and were correct.
Correct spelling: 15 changes were made and all of these changes improved the quality of the text and were correct.
Correct use of particles: 20 changes were made and 14 of them improved the quality of the text and were correct.
Upper-Lower Case Letters: 5 changes were made and all of these changes improved the quality of the text and were correct.
Predicate Inflection: 4 changes were made and all of these changes improved the quality of the text and were correct.

2. The changes that students made in the word level in their texts:

Word addition: 34 additions; changes were made regarding addition of new words to the text and 7 of these changes improved the quality of the text and were correct.
Word substitution: 24 substitutions, changes were made regarding substituting a word with another one and 17 of these changes improved the quality of the text and were correct.
Word deletion: 12 deletions, changes of word deletion were made and 9 of these changes improved the quality of the text and were correct.
Changing the order of the word: 8; changes were made concerning changing the order of the word and all of these changes improved the quality of the text and were correct.

3. The changes that students made in the word group level in their texts:

Substitution: 12 word groups were deleted from the test and new ones were added in their place. 10 of these changes improved the quality of the text and were correct.
Addition: 6 additions were made in the text in word group

level and all of these changes improved the quality of the text and were correct.
Deletion: 1 deletion was made in the level of word group and this change improved the quality of the text and was correct.
Turning a word into a word group: 3 words in the texts were turned into word groups. These changes improved the quality of the text and were correct.
Turning a word group into a word: 3 word groups in the texts were changed into words. All of these changes improved the quality of the text and were correct.

4. The changes that students made in the sentence level in their texts:

Substitution: 4 substitutions; changes were made concerning substitution in the level of word group and all of these changes improved the quality of the text and were correct.
Sentence addition: 11 new sentences were added into texts. These changes improved the quality of the text and were correct.
Sentence deletion: 3 sentences were deleted from the texts. These changes improved the quality of the text and were correct.
Rephrasing sentence: 4 sentences in the texts were rephrased. 2 of these changes improved the quality of the text and were correct.

DISCUSSION

In the acquired finding, it was observed that Turkish teacher candidates did not have adequate knowledge concerning revising part of process-based writing model, and that they did not apply this step of process-based writing efficiently in the writing process. Researches, on the other hand, prove that Turkish teacher candidates, who apply process-based writing process which includes revision step, are more successful than teachers who apply traditional writing education (Karatay, 2011; Yılmaz and Aklar, 2015).

In the research carried out by Uygun et al. (2014), it was seen that the application of the revision process in the written expression provided students with the structural improvement in their writings. In this stage, the students' adding, deleting and reorganizing of their writings made the writings more qualified. The instructions given directly during the revision process improved the quality of students' writings in the experimental group more than the ones in the control group (Fitzgerald and Markham, 1987).

According to the research, the experienced writers spend 25% of their total writing time in the revision process whereas secondary school students spend less than 1% in the same stage. Students should learn about

the necessary techniques to revise their writings as the revision process plays an important role in the improvement of the writing (Christiansen, 1990).

In the findings, it was noted that the students made changes respectively in word and surface level the most in the revision process. While these changes pertain to punctuation and correct use of suffixes in the surface level, they gather around parts of adding and placing in the word level. In Bridwel (1980) study, it was seen that the changes were mostly in word and surface levels. In Sommers (1980) study, it was found that experienced writers focus the changes they make during revision process, in the sentence level and these changes include addition and deletion. Students seldom made more global changes, such as starting over, rewriting most of a paper, adding or deleting parts of the paper, or adding or deleting ideas (Lehr, 1995).

In this study, it is seen that the changes that students made are generally in the word level and these changes mostly improved the quality of the text. In Stallar (1974) research, good writers changed more words than novice writers. It was seen In this study that students did not make any paragraph change at all. In Stallard (1974) research, it was seen that good writers changed more paragraphs than novice writers.

In this study, students did not make changes in multiple sentences and text level. Based on this finding, it can be stated that the absence of changes in these stages which require the skill of synthesizing indicates that students have difficulty in text synthesizing. Bridge et al. (1997) also think that students have problems in synthesizing writing skills.

Students lack adequate repetition in thinking and information analysis, creating answers and use of knowledge in decision-making which they need in order to create their own essays (Cavkaytar, 2010). Below recommendations are made parallel to the research findings:

1. Instructors should allocate more time on process-based writing in writing classes.
2. Instructors should inform their students more about revision stage in writing classes and have   students make applications.
3. Instructors should examine students' works in writing and provide feedbacks.
4. The students have not needed a revision on paragraph and text levels. The revision processes on these levels should be carried out with the students themselves during the lesson hours.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

Beason L (1993). Feedback and revision in writing across the curriculum classes. Rese. Teach. English 27:395-422.

Bridwell LS (1980) Revising Strategies in Twelfth Grade Students' Transactional Writing. Res. Teach. English 14:197-222.

Cavkaytar S (2010). Utilizing writing process model in development of primary school written expression skills. Int. Soc. Res. J. 3(10):133-139.

Christiansen M (1990). The Importance of revision in writing composition. Education Digest. 56(2):70.

Coşkun E (2005). Correlation, Consistency and Text Elements in Narrative Expressions of Primary School Students. Ankara: Gazi University, Unpublished Doctorate Dissertation.

Creswell JW (2003). Research design: Qualitative, quantitative, and mixed methods approaches. London: Sage Publications, Inc.

Erdoğan Ö, Yangın B (2014). Effect of process-based writing applications on written expression and the attitude regarding writing J. Faculty Educ. Abant İzzet Baysal University. 14(1):438-459.

Faigley L, Witte S (1981). Analyzing revision. College Composition Communication 32:400-414.

Ferris DR (1997). The Influence of Teacher Commentary on Student Revision. TESOL Q. 31(2):315-339.

Fitzgerald J, Markham LR (1987). Teaching Children about Revision in Writing. Paper presented at the Annual Meeting of the American Educational Research Association.

Karatay H (2011). Process-based writing models: Planned writing and evaluation, Writing Education, M. Özbay (Ed.), Ankara: Pegem A Academy.

Lehr F (1995). Revision in the Writing Process. Reading English and Communication.

Miles MB, Huberman AM (1994) Qualitative Data Analysis: An Expanded Sourcebook, 2nd ed., SagePublications, Newbury Park, CA.

Murray DM (1981). Making meaning clear: The logic of revision. J. Basic Writing. 03(3):33-40.

Rijlaarsdam G, Couzijn M, Van Den Bergh Huub (2003). The study of revision as a writing process and as a learning-to-write process. Two Prospective Research Agendas, Revision. Cognitive and Instructional Processes. Series: Studies in Writing 13:189-207.

Sommers N (1980). Revision Strategies of Student Writers and Experienced Adult Writers. College Composition and Communication. 31(4):378-388.

Stallard CK (1974). An Analysis of the Writing Behavior of Good Student Writers. Res. Teach. English. 8:206-218.

Sze C (2002). A case study of the revision process of a reluctant ESL student writer. TESL Canada J. 19(2):21-36.

Tompkins GE (2000). Teaching writing – balancing process and product, 3rd edition. Columbus, OH: Merrill.

Uygun M, Aktürkoğlu B, Dedeoğlu H (2014). Effect of teaching of self-regulation strategy development on self-regulation skill and attitude aiming at written expression and writing. Int. J. Soc. Sci. 28(2):131-156.

Ülper H, Uzun L (2009). Effect of writing education programs prepared according to cognitive process model on success of students. Primary Educ. Online J. 8(3):651-665.

Yagelsky RP (1995). The Role of Classroom Context in the Revision Strategies of Student Writers. Res. Teach. English 29(2):216-238.

Yıldırım A, Şimşek H (2006). Qualitative research methods in social sciences (5th Edition). Ankara: Seçkin Yayıncılık.

Yılmaz M, Aklar S (2015). Effect of Planned Writing and Evaluation Model on Essay Writing Skills of 5th Grade Students Studying in Primary School, Bartın University Journal of Faculty of Education, XIV. International Participation Classroom Teaching Symposium (21-23 May 2015) Special Edition pp. 223-234.

Full Length Research Paper

Analyzing Institutional Evaluation Reports prepared from 2013-2015 by European University Association

Zeynep Bumin Süzen

Gazi University, Ankara, Turkey.

European University Association is an institution which guides not only European but all universities in their efforts to improve their quality within the context of Bologna Process. In this study Institutional Evaluation Reports prepared by EUA for all higher education institutions that applied to be evaluated between 2013 and 2015 were examined. These evaluations were grouped under six categories namely administration, finance, research, education, service to society and internationalization. It is understood that administration is the most evaluated subject, while finance is the least evaluated in the reports. As regards administration, the most emphasized points are the need of a more solid strategic planning and to improve quality assurance processes. In finance the universities are primarily advised to focus on raising money from different resources. For research, the most emphasized subject is the lack of research strategies in universities. Two important suggestions in education category are to use student centered teaching and to update curricula so as to focus on application. While for service to society category, the reports mainly suggest to involve external stakeholders more systematically in the universities and for the category of internationalization, it was pointed out that most of the universities are in need of an institutional strategy.

Key words: Quality in higher education, quality assurance, external evaluation, European University Association.

INTRODUCTION

When Bologna Process was first launched in 1999, the most important goal that was anticipated was to increase the competitiveness of European universities. One of the steps that had to be taken was to strengthen the quality assurance systems of universities. Quality and quality assessment started to rise as a major issue in 1980's, well before Bologna Process, because of two main reasons: massification in higher education and the private

sector becoming the main employer of university graduates (Amaral and Rosa, 2008: 22). Among the reasons for approaching quality as an issue in universities are; high increase in student numbers, emerging of different types of education programs in order to meet the demand, and extension of autonomy in state (Yükseköğretim Kurulu [YÖK], 2007: 22). Korkut (2001) lists the reasons why quality has become

E-mail: zeynepbumin@gazi.edu.tr. Tel: 90 312 202 22 31.

important in higher education as; the pressures imposed on state subsidy by the increase in demand to higher education, increase in the need for qualified human resources, the trend towards internationalization in higher education, development of a joint labor market as a result of globalization, and the increase in the demand to give more autonomy to higher education institutions.

Quality assurance can be defined as continuous assessment of a higher education institution, system or program according to predefined standards determined by various means like quality management, quality improvement, quality control, and quality evaluation (UNESCO-CEPES, 2007: 74). In other words, quality assurance is all the systematic and planned operations a higher institution does in order to guarantee that it carries out its activities and services like education, training, and research in accordance with certain standards (Edinsel et al., 2008).

Quality assurance is one of the most emphasized and supported areas of Bologna Process. Reports showed that higher education institutions place more emphasis on this subject day by day and develop new strategies to improve their service quality (Eurydice, 2015). One of these strategies is external evaluation.

External evaluation is a process of assessment of a certain unit or main activity in an institution by an expert organization through collecting data, information and evidence, and making a statement about its quality (UNESCO-CEPES, 2007: 56). Arslan (2009) mentions that external evaluation systems are important in evaluating activities of institutions from outside and using a different perspective, that they are crucial in determination of problematic areas in higher education institutions and therefore their numbers should be increased.

European University Association (EUA) is an important evaluation institution that works in the field of quality assurance. Founded in 2001 with the merging of two organizations, European Association of Universities (CRE) and The Confederation European Union Rectors' Conferences, the mission of this new foundation was stated thus: to promote the development of a coherent system of European higher education and research, through active support and guidance to its members as autonomous institutions in their development of the quality of teaching, learning and research, and in enhancing their contributions to society (EUA, 2002: 4).

EUA offers an external evaluation service called Institutional Evaluation Program (IEP) in order to promote quality assurance and evaluation studies in universities. Sursock and Amaral (2008: 37) point out that IEP aims at offering an alternative to the "more bureaucratic and intrusive methodologies" of governments. Long term objectives of the program are to strengthen autonomy of universities and to support institutional change. In order to realize this long term objective the program gives

universities external evaluation services that take into consideration their internal and external environments. With this purpose 315 evaluations in 45 countries were carried out between 1994 and 2014. The most evaluated countries are Romania (77 evaluations), Portugal (52 evaluations), Turkey (38 evaluations), Slovakia (28 evaluations) and Spain (19 evaluations) (EUA, 2014).

Important characteristics of IEP can be listed as follows (EUA, 2014: 9):

i) It depends on the voluntary participation of the members.
ii) It is independent of governments and national quality assurance institutions.
iii) It evaluates higher education institutions within the context of their internal and external environments.
iv) It is based on a detailed self-evaluation process.
v) It focuses on improvement.
vi) It does not impose any sanctions for the implementation of recommendations.
vii) It is a peer review carried out by teams that reflect the diversity of European higher education.

These characteristics emphasize that IEP does not depend on a standardized, and predefined set of criteria. It is rather an evaluation in the form of "plan-do-check-act" cycle in which the institutions are required to present "what they are doing, how they are doing it, how they know it works and how they change in order to improve". Therefore each institution is evaluated within its own strategic goals and by a team consisting of people from across Europe and with institutional leadership experience (EUA, 2013). Rosa et al. (2011: 371) defines the methodology of IEP as "institutional audit" which, instead of using a set of criteria, focuses on the quality assurance processes of institutions.

Institutional Evaluation Program is a five stage process. After the application of a higher education institution to EUA, in the first stage, the association forms an evaluation team. Sursock and Amaral (2008: 40) define the characteristics of these team members as follows:

IEP's visiting panels include small European teams of university leaders, experienced in understanding the specific challenges faced by institutions in their national and international contexts. They are knowledgeable about European and international higher educational trends and are sensitive in applying this expertise to specific national and institutional situations.

In the second stage, higher education institution prepares a detailed Institutional Self-Evaluation Report within the frame work defined by EUA. As the program is self – improvement oriented self-evaluation report is at the center of the process (Sursock and Amaral, 2008). Following the presentation of the self-evaluation report, in

the third stage the team makes a preliminary visit to get to know the institution. After the first visit the team may ask for additional information and documents if necessary. The fourth stage is the second visit that the team makes in order to get more detailed information about the institution, and at the end of this visit the team makes an oral presentation of their evaluation report. In the final stage, Institutional Evaluation Report is officially presented to the institution to be announced on its website (EUA, 2014).

Institutional Evaluation Report, which is the outcome of the evaluation process, consists of good practices of the institution and recommendations for the aspects that need improvement. The report depends on the self-evaluation reports prepared by institutions and the observations of the team members. The reports generally consist of eight parts. First part is the introduction in which the institutions are briefly introduced. Then the teams reflect their observation results in six general headings namely "governance and institutional decision making", "teaching and learning", "research", "service to society", "quality culture" and "internationalization". Last part of the reports is the conclusion and recommendations part in which the team members guide the institution to improve its "weak aspects".

As the Institutional Evaluation Program drew the attention of various higher education institutions around the world since it first started, many evaluation reports containing many findings and recommendations about problematic areas were prepared. For this reason analyzing these reports that were prepared for universities will help to reveal both similar and different problems of higher education institutions.

Purpose of this research is to analyze Institutional Evaluation Reports of higher education institutions that have joined Institutional Evaluation Program between 2013 and 2015, to determine the most frequently evaluated fields in the universities, and to present the areas that most need to be improved and the improvement recommendations made in the reports. The article aims to guide higher education institutions in their efforts to improve their quality by summarizing previous observations and recommendations of Institutional Evaluation Teams.

METHODS

This is a qualitative research in a descriptive survey model. Within the scope of the research, Institutional Evaluation Reports of all institutions that joined Institutional Evaluation Program between 2013 and 2015 has been analyzed; the distribution of problematic fields according to countries and three most mentioned suggestions are evaluated. These reports were obtained from the official website of European University Association (http://www.eua.be/activities-services/institutional-evaluation programme/who-has-participated/iep-evaluation-reports.aspx).

Sample of the research consists of 85 higher education institutions that applied to Institutional Evaluation Program of European University Association between 2013 and 2015, and received an evaluation report as a result. 54 of these institutions are public and the other 31 are private. Table 1 shows the distribution of evaluated higher education institutions according to countries.

When this distribution is examined, it is observed that countries mostly from Emerging Europe are interested in the program and there is no participation from developed European countries like United Kingdom, France, Belgium and Germany.

FINDINGS

Findings of reports and recommendations are evaluated under six topics namely, administration, research, education, internationalization, relation to society, and finance. Table 2 shows the frequency and percentage distribution of these topics observed in Institutional Evaluation Reports of universities.

It is seen that the most frequently evaluated topic in the reports is administration. All of the institutions have received a commentary on administration. Research, education and internationalization topics were evaluated in the same frequency in the reports. Relations to society follow them with a little lower frequency and the least evaluated subject in the reports is finance.

Findings and recommendations in Administration

The three most criticized sub-topics of administration in the universities are quality assurance, strategic planning and organizational structure. Table 3 shows the frequency and percentages of most criticized subjects in administration.

Regarding administration, improvement recommendations were made mostly in quality assurance and least in infrastructure. In institutions participating from Romania it is observed that strategic planning is a more prioritized subject than quality assurance. No criticism or recommendations for improvement were made for institutions participating from Montenegro, Slovenia, Lithuania, Hungary, Portugal, Ireland and Latvia about autonomy. In terms of infrastructure, institutions from Turkey, Ireland and Latvia received no criticism from the evaluation teams.

For quality assurance, at least one problematic situation was observed in 78 institutions and 36 of these institutions (46.1%) were recommended that "Improvements should be made according to evaluation and survey results. Evaluation results and improvements should be shared with the university community to ensure that everybody embraces quality assurance". 31 of these universities (39.7%) were recommended to "Define a strategy and a responsible department for quality" and 23 universities (29%) were recommended to "Include all employees and students in the process to enhance

Table 1. Distribution of universities evaluated in institutional evaluation program according to countries.

Country	Number of Universities
Romania	57
Montenegro	10
Slovenia	5
Turkey	4
Lithuania	3
Former Yugoslav Republic of Macedonia	2
Hungary	1
Portugal	1
Ireland	1
Latvia	1
Total	**85**

Table 2. Distribution of dimensions mentioned in Institutional Evaluation Reports of universities (N= 85).

Dimensions	f	%
Administration	85	100
Research	81	95.2
Education	81	95.2
Internationalization	81	95.2
Service to Society	76	89.4
Finance	43	50.5

Table 3. Distribution of items that need improvement in administration.

Country	Quality Assurance		Strategic Planning		Decision Making and organizational structure		Human Resources		Student Participation		Autonomy		Infrastructure	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Romania (N= 57)	50	87.7	52	91.2	45	78.9	30	52.6	25	43.8	21	36.8	9	15.8
Montenegro (N= 10)	10	100	8	80.0	6	60.0	5	50.0	5	50.0	-	-	5	50.0
Slovenia (N= 5)	5	100	3	60.0	2	40.0	3	60.0	2	40.0	-	-	2	40.0
Turkey (N= 4)	4	100	2	50.0	4	100	1	25.0	4	100	1	25.0	-	-
Lithuania(N= 3)	3	100	2	66.6	2	66.6	3	100	1	33.3	-	-	1	33.3
FYROM (N= 2)	2	100	2	100	2	100	2	100	1	50.0	1	50.0	1	50.0
Hungary (N= 1)	1	100	1	100	1	100	1	100	1	100	-	-	1	100
Portugal (N= 1)	1	100	-	-	1	100	1	100	1	100	-	-	1	100
Ireland(N= 1)	1	100	1	100	1	100	1	100	-	-	-	-	1	-
Latvia (N= 1)	1	100	1	100	1	100	1	100	-	-	-	-	1	-
Total(N= 85)	78	91.8	71	84.7	67	76.5	47	56.4	39	47.0	23	27.0	22	23.5

quality culture in the organization".

Of the 72 institutions that received an evaluation in strategic planning, 47 (65.2%) were recommended to "Support strategic plans with action plans and concretize and prioritize them with timetables and budgeting". 30 of the institutions (41.7%) were recommended to "Review their strategic plan by updating their vision and mission statements". 20 of the institutions (27.8%) were

Table 4. Distribution of items that need improvement in Finance.

Country	Funding		Budgeting	
	f	%	f	%
Romania (N= 57)	24	42.1	9	15.8
Montenegro (N= 10)	2	20.0	2	20.0
Slovenia (N= 5)	2	40.0	1	20.0
Turkey (N= 4)	-	-	1	25.0
Lithuania (N= 3)	2	66.6	1	33.3
FYROM (N= 2)	-	-	-	-
Hungary (N= 1)	1	100	-	-
Portugal (N= 1)	1	100	1	100
Ireland (N= 1)	-	-	1	100
Latvia (N= 1)	-	-	1	100
Total (N= 85)	32	74.4	17	39.5

recommended to "Ensure the cooperation between different departments of the universities towards university strategy, harmonize department plans with university strategic plan, and include all stakeholders in the process."

Organizational structure and decision making were evaluated in 65 institutions. 24 of these were institutions (36.9%) were suggested to "Simplify the organizational structure of the university (including the Senate) by decreasing the number of committees". 17 institutions (26.2%) were suggested to "Establish a balance of power and delegation of duties between different administrative boards (like the Senate and the Executive Board) in order to solve the problems arising from a multiple governance structuring". 15 institutions (23.1%) were suggested to "Unite different academic departments offering similar curricula".

When suggestions on human resources were analyzed, it was observed that 31 institutions (64.6%) out of 48 which received an evaluation on this subject were recommended to "Establish a center for the continuous professional development of academic staff, especially in terms of pedagogical skills". 7 of the institutions (14.6%) were recommended to "Review the existing HR systems like promotion, assessment and salaries with objective criteria to provide fair competition for all", and 7 institutions (14.6%) were recommended to "Update course contents and teaching methods and establish a balance between research and education by reducing course load of academic staff".

As a result of the evaluations in the field of student participation in 40 institutions, 33 (82.5%) were recommended to "Increase student participation in administration, decision making and quality processes". 6 of the institutions (15%) were recommended to "Give training to students on subjects like leadership skills to support student participation", and 4 institutions (10%)

were recommended to "Review the student representative election process".

In terms of autonomy 23 institutions were evaluated. 13 of these (56.5%) were recommended to "Increase university autonomy especially financially", whereas 11 institutions (47.8%) were recommended to "Ensure some degree of decentralization in decision making".

20 institutions were criticized for their infrastructure and this is the least criticized subject in the reports. 14 of the institutions (70%) were recommended to "Invest in infrastructure to improve facilities like library, cafeteria, laboratories and student lodgings", while 8 institutions (40%) were recommended to "Improve infrastructure (including informatics)".

Findings and recommendations in Finance

It is observed that in finance, recommendations are gathered under two subjects, which are funding and budgeting. Table 4 shows the two most criticized topics in finance and their percentages according to countries.

On the subject of finance, most recommendations were made in funding. It is observed that Turkish universities did not receive any suggestions in funding and the reason might be that the visiting teams evaluated funding efforts of universities as sufficient. Similarly, in FYROM, Ireland and Latvia no recommendations were made on funding but on budgeting.

30 institutions out of 32 (93.7%), which received a commentary on funding, were recommended to "Bring in extra income to the university through internationalization, medical schools, graduates, external stakeholders and alternative resources like lifelong learning and consultancy services". 6 of the institutions (18.7%) were recommended to "Make efforts to remove the legal boundaries against funding".

Table 5. Distribution of items that need improvement in Research.

Country	Research Strategy		Insufficient Incentives		Inadequate Resources		Inadequate Staff	
	f	%	f	%	f	%	f	%
Romania (N= 57)	45	78.9	26	45.6	23	40.3	12	21.0
Montenegro (N= 10)	9	90.0	3	30.0	2	20.0	-	-
Slovenia (N= 5)	3	60.0	1	20.0	2	40.0	1	20.0
Turkey (N= 4)	3	75.0	1	25.0	-	-	2	50.0
Lithuania (N= 3)	3	100	2	66.6	2	66.6	1	33.3
FYROM (N= 2)	2	100	1	50.0	-	-	1	50.0
Hungary (N= 1)	1	100	-	-	-	-	-	-
Portugal (N= 1)	1	100	1	100	-	-	1	100
Ireland (N= 1)	1	100	-	-	-	-	-	-
Latvia (N= 1)	1	-	-	-	-	-	-	-
Total (N= 85)	69	82.7	35	43.2	29	35.8	18	22.2

12 institutions out of 17 (70.6%), which received a commentary on budgeting, were recommended to "Make a more effective financial planning", while 3 of the institutions (1.6%) were recommended to "Have a more transparent and accountable budget sharing in the institution".

Findings and recommendations in Research

Lack of a research strategy, insufficient incentives, inadequate resources and inadequate academic staff are the observations put forward in reports concerning research. Distribution of these topics according to countries can be seen in Table 5.

In research, research strategy is the most criticized and commented issue. It is seen that all the institutions except for the one from Latvia received a commentary on this subject. The second most criticized subject is insufficient incentives. It can also be seen that inadequate resources are mentioned only in institutions from Romania, Montenegro, Slovenia and Lithuania.

In research strategy, which is pointed out as a field that needs most improvement, 52 institutions of 67 (77.6%) were recommended to "Develop a research strategy for the university and define priorities". 26 of the institutions (38.8%) were recommended to "Adopt an interdisciplinary approach in research", 10 institutions (14.9%) were recommended to "Strengthen research centers and their activities".

35 institutions were criticized for having insufficient incentives in research and 20 of these institutions (57.1%) were recommended to "Establish an office to support academic staff's research activities". 17 institutions (48.6%) were recommended to "Increase the number of incentives to overcome obstacles like too much workload and insufficient resources", and 3

institutions (8.6%) were recommended to "Use ISI publications and patent as criteria for academic promotion and salary raise".

Inadequate resource was mentioned in 29 institutions and 18 of these institutions (62.1%) were recommended to "Create resources for research through national, international, and industrial cooperation". 9 institutions (31%) were recommended to "Use existing university resources for research more effectively".

Inadequacy of academic staff is evaluated both qualitatively and quantitatively in the reports and 18 institutions receive a recommendation on this subject. 8 of these institutions (44.4%) are recommended to "Train and improve academic staff on projects". 7 institutions (38.8%) were recommended to "Improve hiring and promotion processes of academic staff to increase the number of academics who can mentor doctorate students" and 3 institutions (16.6%) were recommended to "Employ doctorate students in researches to overcome the inadequacy of academic staff".

Findings and recommendations in Education

Two prominent issues in education are teaching methods and programs. Distribution of these issues according to countries is displayed in Table 6. The table displays the distribution of these issues according to countries.

When the total results are analyzed, it is seen that both teaching methods and problems related to programs have received high percentages of recommendations which means the teams believed these two subjects needed improvement in most of the institutions. It can be said that in the institution from Ireland teaching methods don't need improvement but recommendations are made on programs. In institutions from Hungary and Portugal, all recommendations are on teaching methods and none

Table 6. Distribution of items that need improvement in Education.

Country	Teaching methods		Problems related to programs	
	f	%	f	%
Romania (N= 57)	47	82.5	41	71.9
Montenegro (N= 10)	9	90.0	9	90.0
Slovenia (N= 5)	3	60.0	3	60.0
Turkey (N= 4)	2	50.0	3	75.0
Lithuania (N= 3)	2	66.6	2	66.6
FYROM (N= 2)	1	50.0	2	100
Hungary (N= 1)	1	100	-	-
Portugal (N= 1)	1	100	-	-
Ireland (N= 1)	-	-	1	100
Latvia (N= 1)	1	100	1	100
Total (N= 85)	67	82.7	62	76.5

on programs. In universities from Turkey it is observed that programs need to be improved more when compared to teaching methods.

When recommendations on teaching methods are analyzed, it is seen that out of 67 institutions that received recommendations, 53 institutions (79.1%) were recommended to "Define learning outcomes, give more importance to practice, and promote self-learning in order to implement student centered learning more effectively". In 31 institutional reports (46.2%) the teams recommended to "Follow and implement new developments in educational technologies and pedagogic methods" and 3 institutions (4.48%) were recommended to "Share course evaluation results with students and academic staff".

For problems related to programs, evaluation teams made recommendations in 62 institutions. 27 of these (43.5%) were recommended to "Establish a balance between theory and practice in the programs and include more practice oriented courses". 25 institutions (40.3%) were recommended to "Review, assess, and update the programs continuously to ensure that the students acquire generic skills" and 21 institutions (33.9%) were recommended to "Take into consideration employer and alumni views while updating programs".

Findings and recommendations in Service to Society

Service to society has become an important topic in external evaluations especially in the last decade. Comments made on this topic can be gathered around two subtitles which are relations with external stakeholders and service to society. Percentages of these subtitles according to countries can be seen in Table 7.

Under service to society, it is seen that relations with external stakeholders need more improvement than service to society. However in the institution from Latvia it is seen that no recommendations were made on relations with external stakeholders. Similarly in universities participating from Turkey service to society arose as an area that needs more improvement than relations to external stakeholders.

In relations with external stakeholders, 62 institutions were mentioned that they needed improvement and 49 of these institutions (79%) were recommended to "Include external stakeholders in university operations in a more institutional and systematic way". 27 of the institutions (43.5%) were recommended to "Strengthen relations with graduates through Alumni Associations" and 16 institutions (25.8%) were recommended to "Advance cooperation with employers and other institutions".

48 universities received recommendations concerning service to society. 21 of these (43.7%) were recommended to "Use every opportunity to make service to society more institutional". 18 institutions (37.5%) were recommended to "Focus on lifelong learning and continuous education services for the society", while 11 institutions (22.9%) were recommended to "Increase the effect of university on society".

Findings and recommendations for Internationalization

Internationalization has become an important issue for universities especially after Bologna Process. In the evaluation reports, the most criticized points were strategies, mobility and foreign language practices. Percentages of these issues according to countries can be seen in Table 8.

It is seen in the table that institutional strategies and mobility have very close percentages which means they need more improvement compared to foreign language practices. In most of the reports situation of foreign

Table 7. Distribution of items that need improvement in Service to Society.

Country	Relations with external stakeholders		Service to society	
	f	%	f	%
Romania (N= 57)	40	70.2	32	56.1
Montenegro (N= 10)	10	100	6	60.0
Slovenia (N= 5)	4	80.0	3	60.0
Turkey (N= 4)	1	25.0	2	50.0
Lithuania (N= 3)	2	66.6	2	66.6
FYROM (N= 2)	2	100	-	-
Hungary (N= 1)	1	100	1	100
Portugal (N= 1)	1	100	-	-
Ireland (N= 1)	1	100	1	100
Latvia (N= 1)	-	-	1	100
Total (N= 85)	62	81.6	48	63.1

Table 8. Distribution of items that need improvement in Internationalization.

Country	Institutional Strategy		Mobility		Foreign Language	
	f	%	f	%	f	%
Romania (N= 57)	43	75.4	41	71.9	30	52.6
Montenegro (N= 10)	8	80.0	6	60.0	6	60.0
Slovenia (N= 5)	3	60.0	5	100.0	4	80.0
Turkey (N= 4)	1	25.0	1	25.0	3	75.0
Lithuania (N= 3)	2	66.6	3	100.0	1	33.3
FYROM (N= 2)	2	100	2	100	1	50.0
Hungary (N= 1)	1	100	1	100	-	-
Portugal (N= 1)	1	100	1	100	-	-
Ireland (N= 1)	1	100	1	100	-	-
Latvia (N= 1)	-	-	-	-	-	-
Total (N= 85)	62	76.5	61	75.3	45	55.5

language practices are considered to be adequate. However in universities from Turkey, foreign language practices need improvement more than institutional strategies and mobility. In Latvia no recommendations were made in any of these three subjects.

Evaluation teams in 62 institutions made suggestions on institutional strategies. 54 institutions (87.1%) were recommended to "Develop an institutional strategy on internationalization". 12 institutions (19.4%) were recommended to "Establish an office for internationalization activities and employ experts in this office" and 7 institutions (11.3%) were recommended to "Promote internationalization in research and publications".

The teams made recommendations on mobility to 61 institutions. 37 institutions (60.7%) were recommended to "Implement incentives/Take measures (financial support, recognizing credits, internship opportunities etc.) to increase mobility". 35 institutions (57.4%) were recommended to "Attach more importance to and

strengthen international partnerships" and 10 institutions (16.4%) were recommended to "Promote university more effectively to attract international students and staff more".

In order to improve foreign language practices, 45 institutions received recommendations from their evaluation teams. 33 institutions (73.3%) were recommended to "Increase the number of courses/programs offered in a commonly spoken foreign language, especially English" and 23 institutions (51.1%) were recommended to "Improve foreign language skills (especially English) of students and academic staff".

DISCUSSION

Institutional Evaluation Program is an important guide for universities. However when participation lists are considered it is seen that most participative countries are Romania, Portugal, Turkey, Slovakia and Spain (EUA,

2014). Schwarz and Westerheijden (2004) mention that less than 50% of European countries have already started national quality assessment activities in the beginnings of 1990's (as cited in Amaral and Rosa, 2008, p. 23). When participation dates of institutions from developed countries like Germany, The Netherlands and UK are analyzed it is understood that these institutions benefited from this program in the late 90's or early 2000's. It may be that universities from these countries are already subject to certain quality assessment procedures at the national level and do not need guidance at an international level. Similarly, institutions from emerging economies might need more guidance to adopt a more European view in higher education.

It is observed that the most evaluated and commented subject on the reports is administration, whereas the least commented subject is finance. A research by Çalık and Bumin (2013) showed that academic staffs working in universities that are located in Ankara, Turkey mostly agree with recommendations made under administration subject in the evaluation reports prepared by EUA. When these two findings are considered, it can be said that academicians and evaluation team members both believe that administration is an area that needs to be improved on in the universities.

Quality assurance is a tool to increase competitiveness in higher education. In order to reach its aim, it is essential for quality assurance to be implemented in every process of higher education institutions, from education to research, administrative services, student affairs and physical resources (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1998). For quality assurance to be implemented in all these processes, all the academic and administrative personnel involved in these processes should participate in quality assurance activities. Participation of all staff in quality assurance activities is one of the necessary conditions for these activities to be successful (Tükenmez, 1996, p. 134). However the employees will participate in these activities only if they internalize the concept of quality assurance. According to the evaluation reports, taking action in line with evaluation results will both ensure that quality assurance is implemented systematically in universities and make it easier for the staff to adopt quality.

It is understood that in finance creating alternative financial resources for the university is the most proposed recommendation in the reports. However it is observed that no recommendations were made to universities participating from Turkey. When ratio of higher education expenses of countries to their Gross National Product is compared, it is seen that Turkey has the highest rate of 1.54% and it can be argued that this is an important factor in this outcome (Eurydice, 2015). In recent years in Turkey, the share of higher education in national education budget remains 30% (Ministry of National

Education, 2016), and this leads higher education institutions to search for alternative financial resources as already mentioned in the evaluation reports. As a result, between 1995 and 2005 the share of revolving funds in higher education incomes has risen from 27 to 38% (Buyrukoğlu, 2010, p. 67). Akça (2012) summarizes finance resources in higher education as budget resources or in other words public resources, private sector endorsement procured from university – industry cooperation, student fees and grants and proposes income based credit facility in order to turn demand into income in Turkish higher education system.

Altbach (2012) states that research universities are important for advancing in technological, social and human sciences, that they are both "national institutions" that contribute to their community in various ways, and "international institutions" that make a contribution to global information. Under the title of research which has such an importance in local and global position of universities, the most primary subject that needs improvement appears to be the definition or prioritization of research strategy. Şimşek and Aytemiz (1998, p. 166) mention the problems that universities face in research activities in one of their researches and argue that reasons for not allocating enough time on research are deficiencies in reward system and the heavy workload of academicians. Among the important features of a research university are, promoting research by helping academicians to make enough time for it and self-generating research income (Altbach, 2012). For this reason, recommendations on the reports that propose giving training to the staff in research, decreasing their workload, and increasing the number of partnerships to generate income could be important directives for institutions that aim to become affective research universities.

One of the important quality indicators in education is teaching methods. According to all the reports that are analyzed, implementing student centered methods both in the classroom and in planning activities like defining learning outcomes is of vital importance for universities. However Bologna Implementation Reports show that learning activities are seldom used in student evaluations (Eurydice, 2015).

With the development of modern university beginning from the second half of 19th century, especially in the United States society and market began to take active role in administration as a third stakeholder of the university (Gürüz, 2010). But when the reports are considered, it is understood that this system, which has been implemented effectively in USA for many years, needs to be improved in European universities because according to the reports establishing institutional relations with external stakeholders needs the most improvement under the topic service to society. In addition, the reports show that service to society becomes more important

today as a third mission of universities because they emphasize the importance of cooperating with and concentrating on lifelong learning activities for the society. Korkut (2001: 76), advocates that relationship of a university with its society needs to be set on a legal basis for the institution to fulfill this duty. Including external stakeholders into institutional processes is an important component of modern administration models. According to Poister and Streib (1999), an important characteristic of strategic planning, which is vital for the effective management of organizations, is taking into consideration interests of external stakeholders (as cited in Coşkun, 2011: 45).

Lack of institutional strategies and problems in mobility were evaluated almost equally as areas that needed improvement in internationalization. Inadequate internationalization efforts of universities are reflected in Bologna Reports as limited number of countries with a national strategy and as mobility rate that is below 5% in many countries (Eurydice, 2015). Mobility is emphasized as an important subject in the reports because increasing the number of international students will not only increase the income generated from these students and the number of qualified students, but also these students will act as cultural exchange agents (British Council, 2015). Third area that needs improvement in internationalization was foreign language practices and the most recommended activity was to increase the number of programs offered in foreign language, especially English. This recommendation has been argued over in the recent years in Turkey and higher education institutions show a tendency in this direction. However to give education in a foreign language some preconditions have to be met so that the education can be successful and of high quality. Hence a report prepared by British Council in 2015 states that these programs need to be limited until adequate number of students and academicians with a sufficient level of English are obtained (British Council, 2015).

RECOMMENDATIONS

Considering the immense increase in the number of universities around the world, for the quality improvement of these universities their participation in international external evaluation programs like IEP. For this purpose, universities can be supported by their governments especially financially to join these programs.

Main purpose of external evaluation is to maintain continuous improvement in universities and continuous improvement can be monitored through follow-up evaluations. For this reason it will be beneficial for universities that participated in IEP, to prepare action plans according to recommendations in their evaluation reports and apply for a follow – up evaluation.

It was previously mentioned that participation of

universities from developed European countries to the program has been very scarce especially in the recent years. The reasons for this low rate of participation can be a separate research subject. EUA has been guiding universities as a quality guide not only in Turkey but also in many countries all around the world since the 2000's. Evaluation reports prepared by the Association can be evaluated in a country to see the progress in quality assurance and other areas over the years. Also, involvement of management and employees are essential for the success of these activities. A research can be done to evaluate the attitude of administrators and employees in the universities towards external evaluation activities.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

REFERENCES

Akça H (2012). Yükseköğretimin Finansmanı ve Türkiye İçin Yükseköğretim Finansman Modeli Önerisi. Yönetim ve Ekonomi, 19(1):91-104.

Altbach PG (2012). Araştırma Üniversitelerinin Geçmişi, Bugünü ve Geleceği. P.G. Altbach ve J. Salmi (Eds.) Akademik Mükemmeliyete *Giden Yol* (pp. 9-26) (K. Yamaç, Trans.). Washington.

Amaral A, Rosa MJ (2008). 'Trends in Quality in Higher Education. Does EUA Fall Into These Trends' in Amaral, A, Rovio-Johansson, A., Rosa, M. J. & Westerheijden, D. (Eds.), Essays on Supportive Peer Review. (pp. 21-34). Retrieved from https://ebookcentral.proquest.com/lib/gazi-ebooks/reader.action?docID=3020422.

Aslan B (2009). Accreditation of Higher Education in Different Countries And Improvements In Turkish Higher Education, Ankara University J. Faculty Educ. Sci. 42(1):287-309.

British Council (2015). Türkiye'deki Yükseköğretim Kurumlarındaki İngilizce Eğitimi. Ankara: Türkiye Ekonomi Politikaları Araştırma Vakfı.

Buyrukoğlu S (2010). Yükseköğretim Hizmetinin Finansmanı ve Devlet Üniversitelerinin Performansını Ölçmeye Yönelik Bir Analiz. Yayınlanmamış Yüksek Lisans Tezi. Karadeniz Teknik Üniversitesi Sosyal Bilimler Enstitüsü, Trabzon.

Coşkun S (2011). Stratejik Yönetim ve Toplam Kalite Yönetimi: Benzerlikler, Farklılıklar ve KamuYönetimi İçin Çıkarımlar. Amme İdaresi Dergisi. 44(2):43-69.

Çalık T, Bumin Süzen Z (2013). Avrupa Üniversiteler Birliği Kurumsal Değerlendirme Raporlarında Yer Alan Tespitler ve Öğretim Üyelerinin İyileştirme Önerilerine Katılım Düzeyleri. Kuram ve Uygulamada Eğitim Yönetimi. 19(3):355-390.

Edinsel K, Gözen R, Köktaş E (2008, 8 November), *Kalite Güvencesi Temel Kavramlar Çalıştayı*. Presented at Bologna Süreci Ulusal Toplantısı, Sakarya.

European Commission/EACEA/Eurydice (2015). The European Higher Education Area in 2015: Bologna Process Implementation Report. Luxembourg: Publications Office of the European Union.

European University Association (EUA), (2002). Annual Report. Brussels: European University Association.

European University Association (2013). EUA's Institutional Evaluation Programme: Self Evaluation Report. Retrieved from http://www.eua.be/Libraries/iep/iep_self_evaluation_report_final-sflb.pdf?sfvrsn=0.

European University Asscoiation (2014). A Twenty Year Contribution to Institutional Change. Brussels: European University Association.

Gürüz K (2010). The Changing Role of the State in Higher Education. P. Peterson, E. Baker and B. McGaw (Ed.) International encyclopedia of education. (pp.728-736). Elsevier. Retrieved from http://www.sciencedirect.com/science/article/pii/B9780080448947002050 on 29 June 2016.

Korkut H (2001). Sorgulanan Yükseköğretim. Ankara: Nobel Yayın Dağıtım.

Ministry of National Education (2016). National Education Statistics: Formal Education 2015/'16. Ankara: Ministry of National Education.

Rosa MJ, Cardosa S, Dias D, Amaral A (2011). The EUA Institutional Evaluation Programme: an account of institutional best practices. Q. Higher Educ. 17(3):369-386. doi: 10.1080/13538322.2011.625207.

Sursock A, Amaral A (2008). 'Self-Regulation in Europe: The Institutional Evaluation Programme' in Amaral, A, Rovio-Johansson, A., Rosa, M. J. & Westerheijden, D. (Eds.), Essays on Supportive Peer Review. (pp. 35-47). Retireved from https://ebookcentral.proquest.com/lib/gazi-ebooks/reader.action?docID=3020422.

Şimşek H, Aytemiz D (1998). Anomaly – Based Change in Higher Education: The Case of a Large Turkish Public University. *Higher Educ.* 36:155-179. Retrieved from http://www.springerlink.com/content/k5u818228446t645/fulltext.pdf on 06 August 2011.

Tükenmez NM (1996). Toplam Kalite Uygulamasına Getirilen Eleştiriler. Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 11(1):134-138. İzmir: Dokuz Eylül Üniversitesi

United Nations Educational, Scientific and Cultural Organization (1998). World Declaration on Higher Education for the Twenty-first Century: Vision and Action. World Conference on Higher Education. Retrieved from http://www.unesco.org/education/educprog/wche/declaration_eng.htm on 12 July 2010.

UNESCO-CEPES (2007). Quality Assurance and Accreditation: A Glossary of Basic Terms and Definitions. Bucharest: UNESCO.

Yükseköğretim Kurulu (2007). Türkiye'nin Yükseköğretim Stratejisi. Ankara: Yükseköğretim Kurulu.

Full Length Research Paper

Planetariums as a source of outdoor learning environment

Aksu Seyma* and Umdu Topsakal, Ünsal

Yildiz Technical University, Turkey.

The aim of this study is to study the effect of using planetariums as an outdoor learning environment regarding students' opinions. Therefore, descriptive qualitative research was used. The participants were from a school in Istanbul. Ten students, 4 male and 6 female, participated in a planetarium visit to a museum. The data of the study were obtained in 2016. A survey instrument consisting of 6 open ended questions and semi-structured interviews were used as data collecting tools. As a result of the collected data, using planetariums as outdoor activities in science education had a positive effect on students. The students found planetarium interesting and they stated that the visit was very fun.

Key words: Informal learning, outdoor activities, outdoor learning environments, astronomy education, planetariums.

INTRODUCTION

Manning (1994) stated that planetariums operate in all three realms of learning: cognitive realm, psychomotor area involving physical action; the affective realm; and the realm of feelings, as we encourage greater appreciation and enjoyment of the sky and try to cultivate a sense of the adventure of science.

The recognition of non-formal and informal learning is an important means for making lifelong learning available for all, and for reshaping learning to better match the needs of 21st century knowledge. Formal learning, in general, occurs at education centers like schools and it is defined as a learning that is scheduled, whereas informal learning is not scheduled and oriented. Informal learning is an independent learning which, like non-formal

learning, may take place in various environments, but is not preplanned and premeditated, not purposeful or specially organized, and can continue for a long time (Björnavåld, 2000). To make concrete these two types of learning, formal and informal learning- an example from Jay Cross can be stated. Cross (2007) makes an analogy in his book for formal learning and informal learning as riding on a bus vs. riding a bike. What he tries to say is that with the formal learning bus, "the driver decides where the bus is going; the passengers are along for the ride". When on the informal learning bike, "the rider chooses the destination, the speed and the route."

In education, formal and informal learning can be combined because informal learning activities can

support formal learning in education. Many studies show that outdoor activities have a positive impact on education. For example, science museums, science centers, zoos and botanic gardens are out of school environments in which science education is more attractive for students and complement school courses (Braund and Reiss, 2006). Activities that occur outside the school setting are not developed primarily for school use or to be part of an ongoing school curriculum but are characterized by voluntary as opposed to mandatory participation as part of a credited school experience (Crane et al., 1994)

Studies show that out of school learning environments (OSLE) are more effective with formal education. Luehmann (2009) argued that outdoor education is necessary for students. Braund and Reiss (2006) pointed out in their study that science education should be completed with out of school activities like science centers tour, planetarium or field trips.

The role of the OSLE in education is to make education more effective. According to the Science Education Program in Turkey, it involves environments (argumentation, problem-based ext.) in which the students are active and the teacher is a guide. To get information in these environments as permanent, in and out of learning environments should be considered (MEB, 2013). In this regard, informal environments such as science, art museums, zoos, natural environments are used. As an example of out of learning environments, there are studies that are of the opinion that planetariums are means of formal science education. Some studies suggest teachers' opinions about the role of planetariums as a medium for teaching science. Such studies opine that teachers agree that planetariums provide a lasting and meaningful learning effect on students (Bozdoğan, and Ustaoğlu, 2016). However, there are limited studies showing the effect of using planetariums as an out of learning environments on students' learning. As a result, the aim of this study is to examine the effect on students' opinions of using planetariums as outdoor activities in science education.

Astronomy education and planetariums

Astronomy is a discipline on the physical universe and the structure of the cosmos. That is astronomy, helps us to better understand the mechanism of the earth and the cosmos. In general, astronomical concepts are abstract and require 3D thinking. As a result of this requirement, astronomy education needs special interest and techniques. Many studies show that both students and teachers have misconceptions about some astronomy concepts. To correct the misconceptions of students and teachers, Emrahoğlu and Öztürk (2009) suggest that meaningful learning for conceptual change is required.

Accordingly, the abstract terms should be transmitted perceptibly. The visual and auditory materials and models can be recommended while designing teaching activities in astronomy education should be taken advantage of Tay (2004).

Also, studies show that students have incorrect mental models of basic astronomy. In a Kurnaz and Değermenci (2012) study, it was found that students have mental models related with sun-earth-moon system that are not consistent with scientific explanations. Another study shows that students have misconceptions on solar system, planets' orbit, the stages of the Moon, distance of the celestial bodies from the Earth. Because of these misconceptions, students and researchers have tried to provide suggestions about teaching the concept to eliminate them (Uğurlu, 2005). Some of the suggestions that Uğurlu (2005) stated in his study are as follows:

1. Use of visual materials
2. Using only teaching materials to give the subject is not sufficient. It may be more effective to use activities in which students join personally
3. Related documentary can be watched
4. Group should work on a related subject (Uğurlu, 2005)

Regarding these kind of suggestions, it can be figure outed that learning environments have an impact on students learning. The richness of learning environments can block revealing misconceptions. Studies also show that students have misconceptions on Sun-Earth-Moon relative movements like Moon phases, Sun and Moon eclipses and others in astronomy education. In a study, Şahin et al. (2013), found that students have alternative conceptions such as:

1. The sun is not a star.
2. The planets and the stars are the same.
3. The shape of the stars is the same as in the Turkish flag.
4. The students cannot explain the difference between meteor and meteorite.
5. The students think that stars are the smallest in the solar system.

Sahin and colleagues (2013) suggest that it can be useful to use different teaching techniques and strategies to break down the misunderstandings students have in science education. In the society, there are events results in the deficiency of the astronomy education. Some of the events are in the followings: The solar eclipses leads to different beliefs, December 21st and Şirince, suicide and UFO. This is because these kind of beliefs blocks scientific beliefs system; astronomy education should be studied scientifically. Developed countries give importance to astronomy training and education to solve this problem. Additionally, they established planetariums,

observatories and science centers almost everywhere throughout the country. Several studies have been conducted on the effectiveness of planetariums on astronomy education. In one study, Plummer (2009) found that planetariums improve understanding of celestial motion because of planetariums' rich visual environment and kinesthetic learning techniques. Another study shows that planetariums are useful for teaching constellation study and also for improving students' attitudes towards astronomy (Mallon and Bruce, 1982).

Planetariums create environments that encompass the audience, bringing them into the experience in a way that classroom, book, television, or computer screen cannot. Clearly, planetariums represent one of the biggest and most visible avenues for presenting astronomy and related subjects to the public (Manning, 1994). This gives planetariums better position to support both formal and informal science education. Planetariums, as a result, effectively demonstrate astronomical principles, represent concepts and information that other media cannot. This advantage should be taken into consideration for science education goals which are meaningful and permanent learning. Since planetariums are places for both formal and informal learning, the educators should benefit from the opportunities of planetariums. Manning (1994) found that the students felt the reality of the sky and also enjoyed learning astronomy concepts.

According to Barstow et al. (2001), education should continue outside the classroom with strong support and involvement from parents and in collaboration with museums, science centers, planetariums and other center of informal science learning. Planetariums make learning more enjoyable and efficient.

Research questions

1. Are there any effects on students' perception about visiting planetarium as an outdoor learning environment?
2. Do the students find visiting planetarium interesting according to the traditional science course?

MATERIALS AND METHODS

The study aims to realize the effect of using planetarium in astronomy education as an outdoor learning environment regarding students' opinions. The study used a descriptive qualitative research approach. The reason for choosing the method is that we want to represent their use from the perspective of the recipient, that is, the students.
The study group of the research consists of 10 students from the same school in Istanbul, Turkey and the same grade, but from different science classes. The students are seventh grades and 13 years old. They took the same required course in science. Moreover, the students volunteered to join the planetarium trip. The students were selected according to a criteria that they had totally a good grade (80 to 100) in science course. Since the focus

of the research is on the effectiveness of using planetariums as an outdoor learning environment regarding students' opinions, a planetarium in a museum was visited. An appointment was created by the researchers three days before the visit to the museum. Before visiting the planetarium, the students were informed about the trip rules and outdoor education. The students after the visits, knew that this was a study. One visit was designed because of the course schedule and time restriction. The visit took 2 h and during the visit, the students said that they came here for the first time and therefore, they heard the word 'planetarium' for the first time.

Data collecting tools

In this study, to get an idea about the effectiveness of using planetariums as an outdoor learning environment regarding students' opinions, a survey instrument consisting of 6 open ended questions was used. During the preparation of these questions, relevant literature was surveyed and after scanning the literature, appropriate questions were chosen by the researchers. Then, experts' opinions were taken (3 science educators). Necessary corrections were made and incomplete sections were organized.
Interviews are one of the data collection techniques through verbal communication (Büyüköztürk et al., 2008). In this study, an individual semi-structured interview with relevant open-ended questions was also used as a data collecting tool. Semi-structured interviews were carried out in order to examine the thoughts of the students more thoroughly. The answers received were recorded by the researchers by taking written notes and analyzed later. Each student's interview lasted for approximately 30 min. One of the researchers was also the students' instructors. The instructor informed the students that they did a visit and this visit concept was related with their science concept. The students were informed that the visit they had was named outdoor activities.

Data analysis

Content analysis was performed in the process of analyzing interview records. The opinions of the students were analyzed by open-coding (Bryman and Burgess, 1994). At data coding stage, the data were categorized and arranged by the researchers. The organized data are divided into meaningful sections and researchers try to find out what each section means conceptually and define the codes (Creswell, 2003). The collected data was coded by the researchers. For the reliability, the researchers make analysis separately and then they compare their results. According to the compared codes, there is compatibility of 78%.

RESULTS

The results are separately examined for each question in the survey.

Q1: What do you think about using outdoor activities in science education?

The students' answers to this question were coded. Nine students were of the opinion that outdoor activities are important for science courses. As an example, a student answer to the question is as follows:
"It is important using outdoor activities in science

education because the students learn the subject with love and fun. So, it is beneficial for the brain."

Five students said outdoor activities help them in visual learning, two found using outdoor activities in science education fun. The rest of the students think that those activities are helpful for memorability.

This answer and the others show that outdoor activities have a positive impact on students because they thought that this types of activities are important and help them to understand concept well.

Q2: Do you like science class as structuring like that? What do you think about that?
The answers to this question were coded 7, students reported that they like science courses and find it fun if outdoor activities are used. 4 students found those activities instructive. One student reported those kinds of activities are almost real. In general, students find planetarium as fun and one of the students reported:
"We already watch and listen in the class, but planetarium was different because we feel we are in the video." This student above felt as if he is acting in a film and this was very fun.

In this step, both Q3 and Q4 were analyzed together. The questions and their analysis are as follows:

Q3: What are the deficiencies of the planetarium visit?
Q4: If you had a chance to go to planetarium again, what would you want to change?

The answers to the above questions are similar. Students stated that the visiting time was short. They want to have more time to go around the museum. Otherwise, there were no deficiencies about the outing, students said. If they had a chance, they would change the outing time duration. One of the students said:
"I would go out early and visit much more."
Another student said: "I would extend the time, if I had a chance."

The following questions were on astronomy concepts. Actually, the questions were analyzed to reveal students misunderstanding concept or challenging subjects in astronomy education. That is, the questions reveal how planetarium affects students understanding.

Q5: Did you like astronomy subjects? To you, what lecturing style should be used in teaching those subjects in science classes?
The students' answers were coded and ten out of two students said that the subjects in astronomy education should be lectured by short videos. Two students think that they like the subjects but they want to have more information about the subjects. Three students like the subjects and also like the visiting. Therefore, the above students think that structuring the science course can be

combined by visiting activities. One of the students reported:

"Yes, I liked astronomy concept. The subjects would be enjoyable by going to museums, exhibition ext."

Two students think that the subjects require 3D thinking and because of this, the lesson should be supported with models. One of the students reported that:

"Astronomy is a discipline I liked since I was little. I was curious about astronomical subjects. These subjects should be lectured with the help of visual materials. When I see models, it is easy to remember the concept. Planetarium is the best example for that."

The last question was about the effect of the planetarium visit on students' understanding level. The question is that:

Q6: Was the planetarium visit helpful in understanding the subjects which you do not get? Explain, briefly.
The students' answers to that question were coded and five students said that they learned new things with the help of planetarium. Four students stated that planetarium helps us to be stronger in the subject. Two students pointed out that planetarium was intriguing, meaning that it causes curiosity about astronomy. One of the students says that:

"In the planetarium, I can say that things I have been curious about were revealed."

DISCUSSION

The aim of this research was to see the effect of using planetariums as outdoor activities in science education regarding students' opinion. In this direction, when the students' opinions about using planetariums as an outdoor learning environment in science education were examined, it seens that planetariums have positive effects on students. Pasachoff and Percy (2005) stated in their book that museums and planetariums can provide an informal learning environment to students, that is, very different from the formal one in a school. In another study, pre-service teachers stated that planetariums were educational, interesting, fun, and they had an impressive atmosphere which would promote students' motivation towards science courses (Bozdoğan and Ustaoğlu, 2016).

It is also stated that planetariums and museums are ideal places for providing wonder, for the opportunity of exploring variety of concepts and for expanding young minds (Pasachoff and Percy, 2005). In this research, it was found that the students wanted to spend more time in planetariums.

In this research, students are of the opinion that astronomy concepts should be lectured with short videos and visual materials like models. Planetariums include all of those strategies. A planetarium truly presents a "big picture", with images that immerse an audience in science stories (Wyatt, 2004). The students that participated in this research also said planetariums are beneficial for understanding concepts by visualizing, which is useful for the brain (Pasachoff and Percy, 2005).

Most of the students who participated in this study reported that they learned new things with the help of planetariums. Dunlap (1990) opines that planetariums provide students with increase in the understanding of astronomical concepts.

In this study, it is stated and supported with the students' opinions that the use of planetariums as an outdoor activity in science education has positive effect on students and the result have contributed to the literature on school learning environments in science education in Turkey.

CONFLICT OF INTERESTS

The author has not declared any conflict of interest.

REFERENCES

Barstow D, Geary E, Yazijian H, Schafer S (2001). Revolution in earth and space science education: Blueprint for change: Report from the national conference. June 21–24, 2001, Snowmass, Colorado. Cambridge, MA: TERC. P 100.

Björnavåld J (2000). Making learning visible: Identification, assessment and recognition of non-formal learning in Europe. Thessaloniki: Cedefop--European Centre for the Development of Vocational Training.

Bozdoğan AE, Ustaoğlu F (2016). Planetaryumların Öğretim Potansiyeli Hakkında Fen Bilimleri Öğretmen Adaylarının Görüşleri, Türk Fen Eğitimi Dergisi: Part B. 13(1):38-49.

Braund M, Reiss M (2006) Towards a more authentic science curriculum: the contribution of out-of-school learning. Int. J. Sci. Educ. 28:1373-1388.

Bryman A, Burgess R (1994) Analyzing Qualitative Data. London: Routledge.

Büyüköztürk Ş, Kılıç-Çakmak E, Akgün ÖE, Karadeniz Ş, Demirel F (2008). Bilimsel araştırma yöntemleri (2. Baskı). Ankara: PegemA Yayıncılık.

Crane V, Nicholson H, Chen M, Bitgood S (1994). Informal Science Learning: What the Research Says about Television, Science Museums, and Community-Based Projects. The Impact of Informal Education on Visitors to Museums. Research Communications Ltd. P 61.

Creswell J (2003). Research design: Qualitative, quantitative and mixed methods approaches (2nd ed.).Thousand Oaks, CA: SAGE Publications.

Cross J (2007). Informal Learning: Rediscovering the Natural Pathways that Inspire Innovation and Performance. San Francisco: Pfeiffer.

Dunlap JL (1990). Knowledge and wonder in the planetarium. The Teaching of astronomy, Proceedings of IAU Colloq. 105, held in Williamstown, MA, 27-30 July 1988. Edited by J.M. Pasachoff and J.R. Percy. Cambridge Univ. Press, 1990. P 383.

Emrahoğlu N, Öztürk A (2009). Analyzing the prospective science teachers' level of understanding the basic astronomical concepts and their misconceptions through a longitudinal study. J. Cukurova University Institute Soc. Sci.18(1):165-180.

Kurnaz MA, Değermenci A (2012). Mental Models of Seventh Grade Students on Sun, Earth, and Moon. Elementary Educ. Online. 11(1):137-150. Available at: http://ilkogretim-online.org.tr/vol11say1/v11s1m10.pdf

Luehmann AL (2009). Students' perspectives of a science enrichment programme: out of school inquiry as access. Int. J. Sci. Educ. 31(13):1831-1855.

Mallon GL, Bruce MH (1982). Student achievement and attitudes in astronomy: An experimental comparison of two planetarium programs. J. Res. Sci. Teach. 19:53-61.

Manning JG (1994).The Role of Planetariums in Astronomy. Astronomy Education: Current Developments, future coordination Astronomical Society of the Pacific Conference Series 89(20).

MEB (2013). 3-8. Sınıflar Fen Bilimleri dersi öğretim program. Talim ve Terbiye Kurulu Başkanlığı, Ankara.

Pasachoff J, Percy J (2005). Teaching and Learning Astronomy: Effective strategies for educator worldwide. USA, Cambridge University Press. pp. 221-225.

Plummer JD (2009). Early Elementary Students' Development of Astronomy Concepts In The Planetarium. J. Res. Sci. Teach. 46(2):192-209.

Şahin Ç, Bülbül E, Durukan GÜ (2013) .The Effect of Conceptual Change Texts on Removing Students' Alternative Conceptions about Celestial Bodies. J. Comput. Educ. Res. 1(2):38-64.

Tay R (2004). The place and importance of encoding strategies in social sciences courses. Gazi University Kırşehir Educ. Institute. 5(2):1-12.

Uğurlu NB (2005). Misconceptions of The Sixth Year Students of Primary Education on the Earth and the Universe. J. Gazi Educ. Faculty. 25(1):229-246.

Wyatt R (2004). The Big Picture: Planetariums, Education, and Space Science. Vol. 319. Astronomical Society of the Pacific. P 169. Available at: http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?2004ASPC..319..169W&data_type=PDF_HIGH&whole_paper=YES&type=PRINTER&filetype=.pdf.

Full Length Research Paper

University students' subject disposition according to text types

Zekerya BATUR

Turkish Education Department, Usak University, Turkey.

The aim of this study is to reveal the subject trends of university students according to species. This is a qualitative study based on document review. The data of the study was obtained from 67 volunteering in-service Turkish teachers' worksheets. The worksheets were classified according to text types. Text types were determined based on the opinions of three experts in the field. Text types were classified in the following order: 1. Story, 2. poem, 3. memoir, 4. biography, 5. travel and 6. essay. The study group comprised of 67 volunteering third grade pre-service teachers studying at Turkish Education. The teacher candidate was used to mean a student who is studying at the faculty of education. Students were coded 1F (female student in the first place), 2M (male student in the second place). Students wrote essay every two weeks for a period of 12 weeks. Students were given an average of forty minutes for each text type. Each student was coded and subjects written were classified based on main themes. Three copies of subjects were made and given to three scholars. The papers were evaluated in terms of subjects and subjects were evaluated in terms of frequency. Next, content analysis was performed for codes and themes. As a result, it was discovered that pre-service teachers chose to change subject based on the type of texts and it was shown that it was effective in the variation of subjects.

Key words: Turkish, subject disposition, types of text.

INTRODUCTION

Writing skill is regarded as the language area which develops the last and the hardest of all other language skills (Demirel, 1999; Ozbay, 2007; Sever, 2004). The reason for this is that this skill has different scopes as compared to the others (Raine et al., 2011). It has aspects including psychological, physical, physiological and sociological processes. Within this context, since the skill and habit of writing require a long time and several abilities, students tend to announce it as an undesired skill. This can be attributed to the fact that writing has different levels of knowledge and learning. It is known that students generally have difficulty in expressing themselves in written language in their daily life (Yalcın et al., 2010; Hamarta et al., 2010). Students that experience problems while talking, experience even more while writing. It is required for a student to have sufficient amount of vocabulary and writing skill to make writing a habit (Deane et al., 2008; Yigzaw, 2013).

E-mail: zekeryabatur9@gmail.com or zekerya.batur@usak.edu.tr. Tel: +90 276 221 21 21.

Students can express their emotions and their thoughts in different ways (Yalcın and Sengul, 2007). Tools used by human beings since first ages to express themselves have constantly changed (Tekin, 2016; Alp, 2009). This change has varied from literature to history, medicine to astronomy. Considering how individuals have expressed themselves in different periods, it is seen that they did so sometimes through poems, paintings or texts. Therefore, thoughts have been transferred constantly through different dimensions throughout history. One can use different types of texts while expressing himself in written language. The use of types affects the motion and change of an individual's emotions and thoughts. Emotions and thoughts are used in the types of texts in which they can be expressed more effectively. Within this context, it is imperative that theoretical and practical studies should be conducted in education and instruction with regards to the use of the types of text. It is crucial that studies on the students' disposition of types in elementary school should be done. By conducting studies on students' disposition of types in elementary school, future researches can be supported. Together with this, determining the subjects based on students' psychological, mental and sociological development and using them in educational settings will contribute to developing students' writing skills. This study was conducted for the purpose of determining the students' subject disposition. Subjects and genres are determined by six experts. Responses to the following questions were sought in line with these goals:

1. Is selection of subjects differentiated according to the story type?
2. Is selection of subjects differentiated according to the poem type?
3. Is selection of subjects differentiated according to the memoir type?
4. Is selection of subjects differentiated according to the biography?
5. Is selection of subjects differentiated according to the travel writing type?
6. Is selection of subjects differentiated according to the essay type?

METHOD

This is a study with a survey model, which was conducted via document examination. Data obtained were subjected to content analysis. Content analysis was interpreted by associating the data (Yıldırım and Simsek, 2013).

Working group

The study group comprised 67 volunteer third grade pre-service teachers studying at Turkish Education. Teacher candidates are used as students who study at the faculty of education. Students were coded 1F (female student in the first place) and 2M (male student in the second place).

Data collection tools

Determination of printed papers

The writing subjects were determined with the common opinion of three scholars. It means what is said on the subject. The type was used in the sense of experiment, article and story. The topics are printed in the following order: 1. story, 2. poem, 3. memoir, 4. biography, 5. travel 6. essay.

Student's papers

Students wrote essay every two weeks for a period of 12 weeks. Students were given 40 min for each type. Subjects chosen by students were classified based on themes. The students chose the subjects. Six field experts were identified. Subjects collected under a code written by students who work on similar subjects and which cannot be taken under any code were directly given. The subjects cover include: family code, interfamilial misunderstandings, childhood, friendship relationships, events in the environment, family picnics, helping each other, sightseeing, health code, health problems, school code, graduation, escape from school, in-class events, teacher behaviors, school report, passing exams and school memories. Other codes are taken directly.

Assessment of student's papers

Three copies were made out of worksheets and given to the scholars. They were evaluated in terms of subjects and the subjects were classified in terms of frequency.

Analysis of data

The codes and themes were evaluated by content analysis. The codes and themes are classified according to the specified topics. Girls are coded "F" (female) and men "M" (male). The findings were interpreted according to codes and themes.

Limitations

The study is limited to stories, poems, memoirs, biographies, travels and essays.

RESULTS AND DISCUSSION

Finding a subject and writing fluently on that subject could be mentioned as a challenge by the students. Subject disposition of students according to text types are shown Table 1. As seen in the table, students tended to choose subjects with more social aspect for their writing. Subjects that Turkish pre-service teachers chose according to the type of text are demonstrated in the Table 2. The choice of subjects that directly affect life in written narratives of students can be interpreted in relation to their age level.

It was discovered that students chose different subjects. The subject dispositions of the students could be the ones they were experiencing in their daily life.

It was noticed that students tended to write on different subjects after selecting the story type. The first five

Table 1. Subject trends according to students.

S/N	Text types						
	Story	**Poem**	**Memoir**	**Biography**	**Travel**	**Essay**	
1F	Regret	Loneliness	School	Scientist	Alanya	Imagine	
2M	Loneliness	Loneliness	Family	Teacher	Silifke	Education System	
3 M	Usury	Loneliness	School	Sportsman	Usak	Loneliness	
4 M	School	Love	School	Artist	Ordu	Nature	
5F	Imagine	Loneliness	School	Poet	Manisa	Imagine	
6E	Friendship	Love	Business	Poet	Kuşadası	Technology	
7 F	Friendship	Loneliness	School	Author	Ankara	Time	
8 F	Travel	Love	School	Scientist	Sakarya	Nature	
9 F	Escape	Loneliness	Family	Scientist	Ayasofya	Success	
10 M	Loneliness	Serenity	School	Scientist	Ayasofya	Dream and reality	
11 F	Death	Loneliness	Family	Artist	Eskisehir	Friendship	
12 F	Serenity	Nature	School	Business man	Eskisehir	Loneliness	
13 F	Fear	Loneliness	Family	Scientist	Usak	Time	
14 M	The importance of human	Serenity	Family	Artist	Usak	Friendship	
15 F	Patience	Longing	Family	Author	İzmir	Nature	
16 M	Loneliness	Loneliness	Family	Poet	Eskisehir	Love	
17 M	Friendship	Loneliness	School	Sportsman	Usak	Love	
18 F	Holiday	Longing	School	Scientist	Manisa	Friendship	**Handled**
19 F	Loneliness	Loneliness	Family	Poet	Canakkale	Maturity	**Subject**
20 F	Longing	Loneliness	School	Author	İzmir	Imagine	
21 M	Wonder	Loneliness	School	Poet	Usak	Habit	
22 F	Faithfulness	Loneliness	Family	Author	İzmir	Love	
23 F	Imagine	Dream	Family	Sportsman	İstanbul	Hospitality	
24E	Success	Loneliness	Family	Scientist	Denizli	Success	
25 F	Friendship	Longing	Family	Author	İstanbul	Time	
26 F	Loneliness	Longing	Family	Author	Sivas	Love	
27 F	Success	Loneliness	School	Sportsman	Usak	Friendship	
28 M	Friendship	Peace	Family	Artist	Antalya	future	
29 F	Happiness	Loneliness	Family	Author	Mugla	Friendship	
30 M	Friendship	Loneliness	School	Poet	Amasya	Sport	
31 F	Love	Love	Family	Scientist	Alanya	The importance of life	
32 M	Happiness	Dream	Health	Artist	Denizli	Success	
33 F	Success	Longing	Family	Poet	Usak	Friendship	
34E	Patience	Nature	Animal love	Poet	Denizli	Hospitality	
35 F	Death	Love	Family	Scientist	Amasya	Love	

Table 1. Contd.

36 F	Friendship	Loneliness	Family	Poet	Konya	Friendship
37E	Love	Longing	School	Poet	Denizli	Imagine
38E	Love	Love	School	Sportsman	Mugla	Time
39 F	Faithfulness	Longing	Family	Artist	Mardin	Imagine
40 F	Patience	Loneliness	Family	Author	Denizli	Friendship
41 M	Longing	Loneliness	School	Author	Burdur	Love
42 M	Lie	Love	Family	Scientist	Usak	Time
43 M	Loneliness	Loneliness	School	Artist	Ankara	Friendship
44 M	Friendship	Loneliness	School	Artist	Mugla	Maturity
45 M	Longing	Longing	School	Scientist	İstanbul	Love
46 M	Success	Loneliness	Family	Sportsman	Mugla	Loneliness
47 F	Friendship	Love	Family	Author	İstanbul	Time
48 F	Patience	Love	Friendship	Author	Eskisehir	Loneliness
49 M	Friendship	Love	Family	Poet	Elazıg	Friendship
50 M	Gift	Longing	School	Author	Antalya	Friendship
51 M	Heroism	Love	Business	Artist	Usak	Friendship
52 F	Compassion	Longing	School	Artist	Sanlıurfa	Childhood
53 M	Love	Love	Family	Poet	Ankara	Health
54 F	Love	Loneliness	Family	Author	Agrı	Love
55 F	Hate	Love	Family	Sportsman	Denizli	Childhood
56 F	Longing	Longing	Family	Scientist	Eskisehir	Friendship
57 F	Disobedience	Hope	School	Poet	İzmir	Time
58 F	Irresponsibility	Love	School	Poet	Konya	Loneliness
59 F	Hope	Loneliness	Family	Sportsman	Sanlıurfa	Tolerance
60 F	Longing	Love	Family	Scientist	Canakkale	Time
61 F	Fidelity	Love	Family	Poet	Bursa	Life
62 F	Success	Loneliness	Family	Author	Usak	Life
63E	Love	Loneliness	Family	Poet	Mersin	Life
64 F	Fidelity	Love	School	Author	Usak	Loneliness
65 F	Loneliness	Death	Family	Poet	Sanlıurfa	Life
66 F	Love	Loneliness	Family	Sportsman	Manisa	Happiness
67 F	Responsibility	Loneliness	Family	Business man	Balıkesir	Success

subjects most frequently chosen by the students in the story type are interesting. The subjects are as follows: 1. Friendship (10); 2. loneliness, (7); 3. longing (5) and success (5); 4. love (4) and patience (4); 5. love (3). Values such as loyalty, responsibility, death, happiness and honesty are in this list. The other subjects chosen were dreaming, travel, lies, hope, usury, vacation, not listening to advice, regret, school, hate,

Table 2. Subject variety and frequency of writing subject.

Story		Poem		Memoir		Biography		Essay		Travel	
Subject and variety of work	f	**Subject and variety of work**	f	**Subject and variety of work**	f	**Subject and variety of work**	f	**Subject and variety of work**	f	**Subject and variety of work**	f
Friendship	10	Loneliness	30	Family	37	Poet	17	Friendship	12	Usak	11
Loneliness	7	Love	15	School	25	Author	15	Time	8	İstanbul	6
Longing	5	Longing	11	Business	2	Scientist	13	Loneliness	6	Denizli	6
Success	5	Serenity	2	Health	1	Artist	10	Imagine	6	Eskisehir	5
Love	4	Love	2	Friendship	1	Sportsman	9	Success	4	Mugla	4
Patience	4	Dream	2	Animal love	1	Business man	2	Love	4	Antalya	4
Love	3	Nature	2			Teacher	1	Love	4	İzmir	4
Fidelity	2	Peace	1					Life	4	Manisa	3
Responsibility	2	Death	1					Nature	3	Ankara	3
Death	2	Hope	1					Maturity	2	Sanlıurfa	3
Happiness	2							Hospitality	2	Mersin	2
Faithfulness	2							Childhood	2	Konya	2
Imagine	2							The Importance of Life	1	Canakkale	2
Travel	1							technology	1	Amasya	2
Lie	1							Sport	1	Sakarya	1
Hope	1							Health	1	Sivas	1
Usury	1							Happiness	1	Ordu	1
Holiday	1							Tolerance	1	Mardin	1
Disobedience	1							Future	1	Aydın	1
Regret	1							Education System	1	Agrı	1
School	1							Friendship	1	Balıkesir	1
Hate	1							Habit	1	Burdur	1
Compassion	1									Bursa	1
Wonder	1									Elazıg	1
Gift	1										
Serenity	1										
The importance of human	1										
Escape	1										
Heroism	1										
Total	67		67		67		67		67		67

compassion, curiosity, gifts, peace, the importance of humanity, escape and heroism. The fact that pre-service Turkish teachers studying at 3rd grade chose their subjects from social values is important in terms of their personality development.

It is also shown that pre-service teachers tend to choose different subjects while writing poems. The five most chosen subjects for poems are as follow: 1. Loneliness (30); 2. love (15); 3. longing (11); 4. serenity, love, imagination, nature (2); 5. peace, death, hope (1). It is seen that pre-service teachers used the family concept a lot while writing memoirs. The following list is seen when they are ranked: 1. Family (37); 2. school (25); 2. business (2);3. health, friendship, animal love (1). It was also realized that pre-service teachers tended to choose the following subjects while writing biographies. 1. Poet (17), 2. author (15), 3. scientist artist (10), 5. sportsman (9). Other topics are listed below. Other topics are businessmen and teachers.

It is seen that pre-service teachers used different subjects while writing essays. The five most chosen subjects of poems are as follow: 1. Friendship (12), 2. time (8), 3. loneliness and imagination (6), 4. success, romance, love and life (4), 5. nature (3). Other topics listed are maturity, hospitality, childhood, the importance of life, technology, sport, health, happiness, tolerance, future, education system, friendship and habit. It is seen that the greatest variety in subjects is presented in the essay type. In this kind, the individual is concerned with the front plan.

The first five cities chosen by the Turkish pre-service teachers are as follows in their travel essays: 1. Usak (11), 2. İstanbul and Denizli (6), 3. Eskisehir (5), 4. Mugla, Antalya and İzmir (4), 5. Manisa, Ankara and Sanlıurfa (3). Other places in travel essays are as follows: Mersin, Konya, Canakkale, Amasya, Sakarya, Sivas, Ordu, Mardin, Aydın, Agrı, Balıkesir, Burdur, Bursa and Elazıg. Although, students came from different places, the city of Usak was in the first place, which may be the result of the fact that students live there.

DISCUSSION

Several factors influence the development of writing skills (Chokwe, 2013; Endut et al., 2016; Peder and Majnemer 2007; Cifci, 2001). The subject of the text has a significant place among these factors. The student's interest in the subject may affect the student's enthusiasm for positive or negative writing (Schneider and Andre, 2005; Engın, 2014; Marzban and Jalali, 2016; Rad, Khojasteh and Kafipour, 2014; Woody et al., 2014). It is not possible for students to write on subjects they do not like. Particularly, there is research on what kind of literature type increase the willingness of a student to write (Hismanoglu, 2005; Graham, 2008; Mintz, 2004). This study shows that students varied in terms of

subjects they chose to write about. It is seen that students believed one of the most easily written type of text is story. While students write stories, it was observed that their subjects were different. Students chose "friendship and loneliness" as the subjects of stories. Subjects chosen were parallel to the students' social development.

It was also discovered that students chose less subjects when they were writing poems than when they were writing stories. Poem is regarded as people's way of expressing their personal emotions, thoughts and states in a subjective way. It is a type of writing that shows one's skills because the ability to write poetry can vary from person to person. When these types of texts are examined, they emphasized subjects like "loneliness", "love" and "longing". Students mainly focused on abstract concepts. This is closely related to the students' emotional state.

Memoirs are series of archives representing important sections of one's life. This series sometimes include childhood, sometimes family or school or at times it includes unexpected events. In this study, the most frequent written code was "family. Because one of the most common values of life can be family values.

Biography is one of the text types that transfer the lives of people who came to front in the society from generation to generation. It has a nature of historical documentary and gives the clues for success while transmitting life experiences systematically. This type of text is one of the main forms that affect students mostly and guide them in their lives. The use of high quality biographies particularly in education and instruction is significant in this context. Students have shown trends such as "writer", "poet" and "scientist".

This type of essay requires high level of experience and know-how, although it is thought that it is the easiest to write among all literary types. This type of writing shows that the individual has reached a level of maturity and it makes one's sharing meaningful. One can write an essay on almost all subjects. Subject variation can be more in this type than the other types. It is seen that students mostly chose the subject of "friendship" when writing an essay. It can be said that other subjects varied depending on students' personal preferences.

Travel writing is one of the types of written expression by which people share their observations about the places they visit. This type of writing is the main tool appropriate for the principle of experience and living in education. Students' skill to describe a place or an object develops through this type of writing. It also makes the students to express abstract concepts by making them concrete. The city chosen the most in this study by the students was the city of Usak, then Istanbul. It can be interpreted that students chose Usak as the subject for their travel writing because they lived in that city.

In conclusion, it is shown that as the type of text changed, the subjects chosen by the students' changed

as well. This shows that education and instruction should support students at all levels with similar studies. One of the most important findings that came to the forefront as the subject disposition of students in all text types was friendship, loneliness and friendship because the students considered them important. This finding is parallel to students' current level of social and cognitive development. It is thought that making various studies would be beneficial in other grades and levels for text types written by students.

CONFLICT OF INTERESTS

The author has not declared any conflicts of interest.

REFERENCES

Andre BSA (2005). University preparation for workplace writing an exploratory study of the perceptions of students in three disciplines, J. Bus. Commun. 42(2):195-218.

Chokwe JM (2013). Factors impacting academic writing skills of English second language students, Mediterranean J. Soc. Sci. 4(14):377-383.

Cifci M (2001). Listening education and factors affecting listening, AKU Soc. Sci. J. 2(2):165-177.

Deane P, Nora Odendahl N, Quinlan T, Fowles M, Welsh C, Jennifer Bivens-Tatum J(2008). Cognitive models of writing: writing proficiency as a complex integrated skill, Educational Testing Service.

Demirel O (1999). Teaching Turkish in primary schools, Istanbul: Ministry of Education ministry publications.

Endut S, Rahimi MN, Yusoff N, Kamarudin MY (2016). Factors that influence efficiency of writing essays in Arabic, Creative Educ. 7:435-442.

Engın M (2014). Extending the flipped classroom model: Developing second language writing skills through student-created digital videos, J. Scholarship Teach. Learn. 14(5):12-26.

Graham S (2008). Effective writing instruction for all students, Renaissance Learning, USA.

Hamarta E, Baltacı O, Ure O ve Demirbas E (2010). Examining shyness of high school students in terms of perceived parental attitudes and problem solving approaches, Family and Society, 11(6):73-82

Hismanoglu M, Teaching English through literature, J. Language Linguistic Stud. 1(1):53-66.

Marzban A, Jalali FE (2016). The interrelationship among L1 writing wkills, L2 writing skills, and L2 proficiency of Iranian EFL learners at different proficiency levels, Theory and Practice in Language Stud. 6(7):1364-1371.

Mintz S (2004). The fundamentals of college and university teaching, Online Teaching Resource Collections. Ozlem KA (2009). Orta Asya'dan Anadolu'ya kültürel sembollere giriş, Ankara: Eflatun Publications.

Peder KP, Majnemer A (2007). Handwriting development, competency, and intervention, Dev. Med. Child Neurol. 49:312-317.

Rad RS, Khojasteh L, Kafipour R (2014). The relationship between multiple ıntelligences and writing skill of medical students in Iran, ADN, 7(3):1-9.

Raine RB, Mintz L, Crossley SA, Dai J, McNamara DS (2011). Text box size, skill, and ıterative practice in a writing task, proceedings of the twenty-fourth, International Florida Artificial Intelligence Research Society Conference.

Sever S (2004). Turkish teaching and full learning, Ankara: Anı Publications.

Tekin F (2016). The change of the post-modern turning body concept from the traditional period, Turk. Stud. 11(2):1153-1172.

Woody D, Zeleny MG, D'Souza HJ, Harder J, Reiser J, Szto P (2014). Student progress in a social work writing course: self-efficacy, course objectives, and skills, J. Soc. Work Educ. 50:507-524.

Yalcın B, Tetik S, Acıkgoz A (2010). A research for determining the problem-solving skills perceptions and control-centric levels of college students, J. Organ. Manage. Sci. 2(2):19-27.

Yalcın SK, Sengul M (2007). Role and functions in the language communication process, Turk. Stud. 2(2):749-769.

Yıldırım A ve Simsek, H (2013). Qualitative research methods in social sciences, Ankara: Seckin Publishing.

Yigzaw A (2013). High school students' writing skills and their English language proficiency as predictors of their English language writing performance, Ethiop. J. Educ. Sci. 9(1):51-60.

Educational Research and Reviews

Related Journals Published by Academic Journals

■ African Journal of History and Culture
■ Journal of Media and Communication Studies
■ Journal of African Studies and Development
■ Journal of Fine and Studio Art
■ Journal of Languages and Culture
■ Journal of Music and Dance