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A study on the consistency between university entrance exam (OSS) and questions published in examinations at schools on the subject of determinant

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Abstract

In this research, whether the questions in University Entrance Exam (OSS) and the questions asked to students during the exams in schools coincide or not has been investigated. This study is a qualitative one. Samples of the research are 55 students from 3 different classrooms in 11th grade, in the 2011-2012 education years in Mahmutbey High school. The data of the research has been gathered by application of the determinant questions of the previous years’ University Entrance Exam (OSS) and the course books to the students. This study shows the performance of the students during the exams. Research also covers the accordance of determinant questions in the previous University Entrance Exam (OSS) and the exercises in the course books which has the approval of Ministry of Education (MEB). Students are asked to answer 10 questions and the data acquired has been analyzed by researchers. As a result of the survey, it has been seen that the students were more comfortable while answering the multiple choice questions and had difficulties with the classic questions. It has been seen that the questions in the MEB approved books and the OSS questions of previous years are consistent. Although the questions are consistent, the reasons why the students are more successful in the multiple choice questions rather than the classical questions have been investigated. Especially in the written exam, it has been seen that students had problems with the questions where they had to calculate the determinant, having the knowledge of logarithm and triangle rules. It has been detected that the majority of the students were unable to answer these two questions.

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Keywords: Concept of determinant, Student Selection Examination (ÖSS), The Ministry of National Education (MEB) books, Mathematics education

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1. Introduction

When the secondary school’s studies on the linear algebra has been analyzed, the Erçerme (2008), the majority of the student’s knowledge on the linear algebra, in the context of the conceptual and procedural information is being, inconsistent, incomplete, and that are the complementing information and has determined that the operational information has the weight of. However, the Oktac (2008), did not see enough importance on the linear algebra topics during the secondary education by comparison with the other areas of the mathematics and stating that the processed is shorter and less content of those are being representing (Aydin, Delice, Kardes 2011). Linear algebra is an abstract field of mathematics which was used to introduce MA and PhD levels in Turkish Universities until 1960. After that it has been lectured at undergraduate level. The importance of linear algebra topics can be discussed in two dimensions. The first one is the applications of linear algebra not only to mathematic departments but also to other departments of faculties of arts and science, engineering faculties and even social sciences. And the second one is creating a base for abstract lectures which is introduced in the sophomore year. Since Linear algebra course is one of the most important subjects of mathematics, which are the basis of abstract algebra, students are required to learn them at a higher level (Ozdag&Aygör, 2011). The objective of the Linear Algebra course is to enable the students to create the mathematical proof in their minds. The Student’s intuitive dimensions on the Linear Algebra are to explain the mathematical relationship between the cause and the effect. These should be given in the first half or within the two-thirds of the courses. It is also important, in terms of similarity of movements of mathematicians before the 1850’s. (Uhlig, 2002). As the use of linear algebra have a wide field of the application and the mathematics education employees have been effective to make a number of studies in this area. However, as almost no work has been done on the educational aspect of these courses in our country, the textbooks of which was written in Turkish or been translated to Turkish are that either very few or inadequate. The studies in Linear Algebra field are; a) The historical researches to develop new programs, and to reveal some of the reasons of the student’s learning difficulties, b) Aiming at balancing the use of geometry in the linear algebra and to make researches in the cognitive flexibility, on the issues such as the formal structure of the linear algebra, c) To be classified as the evaluation of the teaching of the Linear Algebra by the software programs (Aydin, 2009). The basic causes of the students who are living the learning disabilities in the linear algebra, is that the students are not thinking in abstract, enough even though the linear algebra has an abstract form, the linear algebra has an axiomatic character and the students has been listed in the poor knowledge math basis "(Tatar, 2006). The conceptual exercises and the introduction of the types of the exploratory concepts enable the understanding of the linear algebra in the abstract form. The elaboration of this course is to teach on the basic concepts, rather than the concrete examples and by this course the Linear Algebra is quite easy to build a relationship basis. The Linear algebra has a powerful form of the self-expression, and is open to all the students; the need to be done via the algebra teachers is to guide their students in transfers as it was guided to themselves. However, a lively and accessible approach makes this course vivid and useful. This new approach that has been brought by Uhlig to the teaching field of the linear algebra has been seen in the linear algebra textbook that presents itself as wrote (Uhlig, 2002) "(Aydin, 2009).

Determinants are a major issue in the High school 11th class math program in Turkey. There are difficulties experienced in learning and teaching of this subject. It is observed that determinant subject is handled very abstract in schools and some learning difficulties appear caused of this situation. Harel focused on the reasons of learning difficulties of students about basic concepts of linear algebra and how a way should be followed to resolve this situation, in a research he made in 1989. It is expressed that’s the first reason of these difficulties is that the terms are abstract, the second is that application areas are unusual for students and the third is that most of the students don’t know proof methods yet.

At the various levels of the education, in our country, for the students who wish to pursue their education in a further education institution, an examination is carried out with the purpose of the selection and placement by the Center. These exams are made to measure of the student’s achievement, ability, or the level of readiness expected and for this purpose a measuring is often carried out by some quality selection exams. The vast majority of tests is done by the Student Selection and Placement Center (OSYM) in Turkey, (Deniz & Kellecioglu 2005). Basturk,
in his work of 2011 “Negative reflections of preparation process to the university entrance exam on students’ mathematics learning” named work is stating that for the students, the University Entrance Examinations are held either at the end of the high school or enter the examinations when they graduate. However, due to the existing race, the exam preparation starts within the lower grades. In this way and without having a good math infrastructure, the students are facing with many practical ways. Therefore, the high school teachers, should not rush in making short and quick ones, in particular, and without fully adopted of the long method by the students, had been proposed.

The written exams, problem solving and organizing the problems, to produce new and original ideas and monitoring the information and the assessment feedback, and to analysis the ideas for measuring behavior and the alike, it is considered to be the most appropriate test type (Tan and Erdogan, 2004). The teachers and the students are accustomed to this type of exams and are used in all levels of educations starting from the primary school levels. The respondent which is being applied to this question of the multiple-choice tests should read the expected questions carefully and to decide on the correct answer and do reflect accordingly by tagging the option. There is no freedom of answering multiple-choice tests. The answers are limited by the options (Ozdemir, 2008).

The textbook, “is either a selected book or had been prepared in relation to the teaching of a course” or "Specifically measured and reviewed according to a particular school, class and course and been recommended as a basic reference book for the students and the teachers "(Oguzkan, 1993, 83).A textbook includes the tested and verified information (Kula, 1988, 98). As can be seen, the teaching textbooks has significant effects on what the students can learn and what do teachers may teach (Semerci, 2004)

2. Research

The samples of this study, during the academic year of 2011-2012, has been included the students of the Mhamutbey High School and as of 55 students from various three classes of the eleventh grades. In this study and on the determinant subjects, the questions used in school exams and in the university entrance exams overlapping had been investigated. To do this, under the supervision of a math educator’s and in accordance with the opinions of a high school math teacher’s, 5 multiple-choice questions and five classical problems which were in question of the 11th year’s math textbooks of the National Education Grade and also were out in the OSS exams, a total of 10 questions, were asked to the students to answer. In the process of the preparing for the exam, firstly in relating to the determinants and on the gains of which were in the math programs and the mathematical textbooks, were studied. The reason of the application of the formal examination was; in what matters the students were in the lack of knowledge and to be able to observe where they were in the errors. Because the students were used to the techniques of the tests and although the answer on how to do was nameless, they can access to the correct answer by approaching to the answer choices. The exam’s time were set at 50 minutes.

2.1. Problem used in research

In order to obtain the data of this study, the following questions were provided for the students. The examination had been prepared, in order to measure the students’ knowledge about the determinants and therefore a five multiple-choice questions and the classical five questions were asked as a consist of a total of 10 questions. The reason for the formation of the multiple-choice questions and as well as of the classics; to become able to observe that on what type of exams, the students were more successful, and on what matters they were in the lack of the information and where their errors were.

2.1.1. Multiple-choice questions

1. Determine the value of $\alpha$ for which the matrix \[
\begin{bmatrix}
1 & 3 & 5 \\
3 & 0 & 7 \\
1 & 3 & \alpha - 9
\end{bmatrix}
\] is not invertible.
2. According to figure at the left,

\[ \frac{|DE|}{|BC|} \] and

\[ a, b, c \text{ are the length of } \triangle ABC \text{'s sides and } m, n, p \text{ are the length of } \triangle ADE \text{'s sides.} \]

Evaluate the determinants of

\[
\begin{vmatrix}
  1 & 2 & 3 \\
  m & n & p \\
  a & b & c
\end{vmatrix}
\]

A) 6 B) 3 C) 2 D) 1 E) 0

3. Evaluate the determinants of

A) \((99870)^2\) B) 99872 C) 99882 D) 4 E) 2

4. Find the slope of line

\[
\begin{vmatrix}
  x & y & -3 \\
  2 & 1 & 0 \\
  -3 & -2 & -1
\end{vmatrix} = 5
\]

A) 1 B) \(\frac{1}{2}\) C) 2 D) \(\frac{1}{3}\) E) 3

5. Evaluate the determinants of

A) 10 B) 9 C) 8 D) 6 E) 5

2.1.2 Classical questions

1. Determine the value of \( k \) for which the matrix

\[
\begin{vmatrix}
  1 & 2 & -3 \\
  1 & -3 & -1 \\
  -1 & 3 & k + 2
\end{vmatrix}
\]

is not invertible.

2. According to figure at the left,

\[ \frac{|ST|}{|LM|} \] and

\[ k, l, m \text{ are the length of } \triangle KLM \text{'s sides and } x, y, z \text{ are the length of } \triangle KST \text{'s sides.} \]

Evaluate the determinants of

\[
\begin{vmatrix}
  3 & x & m \\
  -2 & y & l \\
  1 & x & k
\end{vmatrix}
\]

3. Evaluate the determinants of

\[
\begin{vmatrix}
  3726 & 3727 \\
  3724 & 3725
\end{vmatrix}
\]

4. Find the slope of line

\[
\begin{vmatrix}
  x & y & 1 \\
  2 & -3 & 5 \\
  -1 & 2 & 0
\end{vmatrix} = 3
\]
5. Evaluate the determinants of \[
\begin{vmatrix}
\log_6 6 & \log_9 9 \\
\log_4 16 & \log_5 5
\end{vmatrix}
\]

2. Findings

The findings of the study were evaluated as qualitatively. This research is composed of two types of questions, as the classic and testing. A similar sort of questions has been selected for both of the question types. The objective of this is to measure in which way the students were more successful in the exam. Depending on the option chosen by the student, the test question would be either as a right or wrong answer. Also, the element of the luck, plays a role in the test method exams. In the classical tests, while the student solves the question, may start from the right but can result to improper handling or may stop in the middle of the process, or may solve the question correctly. In the classical tests, it can be seen more comfortable that which of the issues were known and what issues had not been discovered yet, by the students. Thus, by comparing of these two exams, it can easily be discovered that either the students really learned the subject or not. On the basis of the class, the student’s answers given to these classical questions are; in the form of the true, false, empty and incomplete solutions. However, the answers to the test questions are grouped as true, false and empty and transformed into the form of the solution table. And as acknowledged from the following tables, each of the three class’ students was more successful in the test questions.

Table 1. According to the classes, the number of true, incomplete, blank and false answers in classical questions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>IC</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>8</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 2. According to the classes, the number of true, false and blank answers in multiple choice questions:

<table>
<thead>
<tr>
<th>Questions</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>29</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>25</td>
<td>9</td>
</tr>
</tbody>
</table>

As can be seen from the above tables, all of the students participating in the survey of the classical questions were being forced during to solve the 2nd, 4th and the 5th questions. The reasons that they were being forced were the determinant question issues were contained the logarithm and the geometry.

Table 3. The number of correct answers and their percentage

<table>
<thead>
<tr>
<th>Questions</th>
<th>Classical questions</th>
<th>Multiple-choice questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>82</td>
<td>14</td>
</tr>
<tr>
<td>P</td>
<td>50</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Of the first 5 questions of these questions had been prepared to be solved by the classical methods by the students. The A class student’s success were 45% on these questions and the B class student’s success were 51% and the C class student’s success were 30% as had been determined. The next five questions were prepared in the
form of the test and the success of the A class students was 88% and the B class student’s success was 97% and the C class student’s success was 54% as determined. Some of the answers that were given to these classical questions, after scanning in the computer environment and as unchanged, some of the student’s answer sheets are given below as required.

Answer of Student A for 1st question:

If the A matrix’s determinate is to be equal to zero, then the inverse matrix does not exist. The student A as confused the subject and the values had found the answer wrong because he had written a different value apart from zero. Some of the students who had solved the question in wrong way made the same mistake as student A had done and some of them was operational mistake.

Answer of Student B for 2nd question:

In the classical questions the most undone question was the 2nd question. Some of them, even had known that, by taking advantage of the similarity of triangles, could make them be able calculate the value of the determinant, but due to the unawareness of the properties of the determinant had made them to solved the question by the wrong way. A number of students could not imagine to seek the benefit from the similarity of triangles and had tried to directly calculate the value of the determinant. This question that was prepared as the subject of geometry and the determinant as had been mixed and the difficulty was, in bringing together of these two subjects, were for the students.

Answer of Student C for 3rd question:

This question can be solved very easily by using the properties of the determinant. The students calculated the determinant directly, because they did not know this feature. Some of the students made the same
mistake as well as the student C’s paper that the figures were larger and either could not do the multiplication and also could not find the result.

**Answer of Student D for 4th question:**

![Image of student D's answer]

The student D had been solved the determinant correctly, but he cannot find the slope, because he has a lack of knowledge geometry. Most of the students in this question were unable to make a combination of these two issues and had responded the question in wrong way.

**Answer of Student E for 5th question:**

![Image of student E's answer]

The student E was also inconclusive, because he did not know the rules of logarithms very well. As it was created by combining the two issues in the question, and again, some of the students had been good knowledge on the determinants but not in the logarithm and could not solve any problems related to the logarithm in the question correctly. Another part of the students, even though they were aware on the subject of the logarithms, of whom that they do not know on the subject of the determinant had been solved the question in the wrong way.

**4. Conclusions and Recommendations**

According to the research that had been done by Başturk in 2011, from the primary education to the highest level, almost all the entrance examinations are being done by the multiple-choice questions, in our country. The quickly evaluation of these examinations which were done by these questions and especially in cases where the number of candidates are large, is a specialty sought. At the same time to be objective evaluations on these examinations had brought the feeling of confidence by the community (Baker, 2001; Dillon, 2004). By the effects of the entrance examinations and at the every stage of the primary and the secondary educations, these multiple-choice tests are being used in the courses and at the assessments. On the mathematics teaching, the student’s expressions to be given in writing and with the reasons, has an important place in learning. Unfortunately, it is
impossible to provide this via the multiple-choice tests. By these types of the questions, the student’s ways of thinking and the ways of solutions cannot be valuated.

Durmus (2004), in his study, had been determined that if a subject’s question is not being asked during the OSS examinations or the request to be just a little question, has negative impact on the motivation of the students and that also raises the index of the difficulty. Tall, (1993) in order to identify the learning difficulties in the mathematics had remarked that there were some different studies going on and for the reasons of the difficulties in these studies that had been referred to the "Lack of the knowledge on the basic mathematics" and “Not being able to compile the verbal expressions, to the mathematical symbols" and "The lack of knowledge in Algebra, geometry and trigonometry to connect”. Similarly, Kacar and Tuna (2005) has expressed that the students who are coming to the universities in short knowledge would be negatively affected in the implementations of the programs and would live difficulties (Gurbuz, Toprak, Yapici, Dogan, 2011).

Yenilmaz and Cimen (2012), in their study’s subject had stated that the students are not focusing on the understanding of the concepts and learning, instead their efforts were focusing on the achievement of the examinations. If these difficult issues weight to be increased in the university entrance examinations than the interest and the motivation of students will be increased on those issues too.

When our examinations are considered it is concluded that the students are more successful in the test examinations than the conventional tests. The textbooks, although they had been created that in both, for the university entrance examinations and conceptual figure so as to permit the students to be more successful in the test examinations is intended towards the education with to be in line of the university entrance examinations. As can be seen from the tables, the students that they have failed in the classical questions and in which the questions were particularly by low success of the 2, 4 and 5 questions. Within the process of the determinant, in the second and fourth questions where the concept of the geometry has passed were difficult for the students. The students also needed information on the geometry, in order to solve the question. Although knowledge on the determinants had been for some students, but due to the lack of the knowledge of geometry and in part, while those who have knowledge of the geometry, but in the lack of knowledge on the determinants had been caused for them not being able to solve the question of the determinants. On the fifth question, where in the determinant process occurrence were, in the concept of the logarithms had become difficult to the students. The students also needed knowledge about logarithms to solve the question. In this question, some of the students could not solve the question due to the shortcomings of the determinant knowledge and some of the other students were on the shortcomings of the logarithms information. In the test questions of the 2, 4 and 5 as of the classical examination questions and although had been in the same type of question, the achievement of the students were higher than the test examinations. The reason of this is; some of the student’s to reach to the correct answer by using the answering choices and some of the students do remember the path of the solution by seeing the answers and some of the students, even without knowing the correct answer, are marking the correct answer by the chance of.

In this study; within the types of the questions that had been asked by combining the two issues, if the students have a lack of knowledge, the questions were remained unsolved. These types of questions had proved that can be solved easily if the student is fully equipped. The problems had been faced by the students were the processing error, being closer the logic of the test in solving, and the lack of information and also been observed as misconceptions. The causes of the students to fail had been recognized as they are preparing themselves for the multiple-choice examinations and also they are not used to solve the classical method questions and therefore they do more errors.

The multiple-choice examinations, although is applied as the university entrance examination, this examination cannot provide the information’s retention. At the same time the student’s ways of thinking and the preferred solutions cannot be seen by this type of examinations. Therefore, we suggest to the teachers that, not only to prefer to focus on the OSS examination tests and regarding to the retention of the information, also to practice on the conventional examinations. On the mathematics education and while the teachers are teaching, to use a long way to ensure that the students may understand the topics, instead of memorizing the rules and make them to be aware of on why and how it is by standing on the questions and ask to the students in the written
examinations that the answer of the questions to be explained and that is important regarding to the retention of the information.

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