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Investigating Level of Mathematics Knowledge for Students Attending Vocational Schools in Turkey

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Students attend mathematics courses in Turkey for totally 11 years, throughout education life ranging from primary school to university, including eight years in primary education and three years in secondary education (four years based on new arrangement); however, level of mathematic knowledge of students is upsetting when they reach university education. Students attend various schools including normal high school, Anatolian high school, and science high school, and most students may leverage mathematics knowledge both in ordinary high school education and private teaching institution; however, mathematics skills and knowledge of students, who attend vocational high schools, could not be sufficiently improved. In many departments of vocational high schools, mathematics course is available only in the first education year of high school, and later, most vocational courses are emphasized. Those students are not well-educated in the field of mathematics and when they graduate from vocational high schools and they start to attend vocational colleges, they also take mathematics courses and they fail even in principal mathematics courses. Moreover, students perceive vocational colleges as a step towards four-year faculty education after they take ETE (external transfer examination). In current study, 275 students who had mathematics courses from the same teacher and attended various departments of a private charity university, were subjected to mathematics examination which was compiled from ETEs of previous years, and thus, level of mathematics knowledge of students was investigated. Findings of current study indicated that level of mathematics knowledge for students attending vocational colleges is upsetting.

Keywords: mathematics education, students of vocational colleges, ETE (external transfer examination)

Introduction

It is a fact that rapid changes and advances in technology, increase in communication tools, facilitation of information exchange, and access and advances about eliminating barriers against free trade influenced national economies of states and gave international competition prominence. When enterprises became more responsible for delivering goods and services produced in quality and timely manner, several principles emerged, such as highly qualified work force that has and actively uses technological knowledge and produces quality goods and services, efficient and effective use of resources, and providing most benefit with use of least resource. One of the most effective factors which may enable developing countries to participate in international competition is to grow vocational and technical intermediate staff. In Turkey, vocational colleges train this work force who shall be commissioned to produce goods and services which may adapt to conditions of international competition (Retrieved from http://www.yok.gov.tr).

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In order to enable young people to be active in all fields of life including social, cultural, economic, and scientific fields, it is an undeniable fact that they should be more comprehensive and have deeper knowledge of mathematics in their education life. People of modern age should also meet several qualifications, such as creative thinking, access to information, use of information, making correct decision rapidly, effective human relations, and teamwork in addition to knowledge of mathematics. Having all those qualifications, subjects should also undergo a qualified education process in order to make them ready for life.

Gündüz (2004) listed aims of contemporary education as follows:

(1) Growing subjects who may interrogate conditions;

(2) Growing human who may focus while she/he thinks and views events from different and wide perspectives;

(3) Teaching communication and relationship;

(4) Teaching the ability to take a chance;

(5) Growing sophisticated subjects;

(6) Growing open-minded subjects who do not value biases;

(7) Teaching to be sensitive;

(8) Growing subjects who have strict principles.

The Aim and Scope of the Study

The aim of this study is to prove mathematics knowledge level of students attending vocational colleges which offer two-year education to high school graduates in order to grow intermediate staff for business life of Turkey and to underlie contribution made to graduates by emphasizing importance of mathematics education. For this purpose, an examination consisting of questions of ETE (external transfer examination) was applied to students, among others attending to various departments of a vocational college which conducts education and training activities under umbrella of a foundation university in first term of education year 2010−2011 in Turkey, who participated in mathematics course of the same lecturer. ETE is a type of examination which is applied by higher education board (YÖK) who had successfully graduated from vocational college, and this examination enables students to continue education life in four-year faculties in a relevant field.

Mathematics Education

Ersoy (2003) specified that mathematics is the science of abstraction and modeling according to some authors, while it is the common language and tool of the science according to others. Here, the point which should be kept in mind is that mathematics is a global and abstract communication and common language of all sciences. The number of the users of this plain language, namely, scientists, gradually increases in all countries and the information produced by them has a tremendous growth; however, it becomes challenging to understand this language by people other than specialists of the relevant field (Ersoy, 2003, p. 18).

Conditions leading to challenges against learning and understanding mathematics are hidden inside its structure and content. As specified by Gözen (2001), mathematics examines quantities free from objects and events, while it appears like isolated from outside, nature, and human, resulting with a colorless or dead appearance. In this form, mathematics does not attract attention of children and adolescents who have a colorful mood and strong imagination. Mathematics does not directly penetrate area of interest of students, and based on influences of education defects' resulting from social condition, mathematics becomes a challenging and

hard-to-achieve lesson due to several factors including fear, inability to adapt to free thinking, and non-regular and non-systematic study (Gözen, 2001, p. 11).

Current information society necessitates the growth of subjects who have skills of critical thinking, may independently think by leaving borders of current ideological systems, is participative, realizes available information, and accordingly ensures individual and social development. Those necessities can be only met by growing subjects who may critically think, are not passive, and are active and research-oriented (Özden, 1998, p. 94). Students may be enabled to have knowledge and experience based on education of critical thinking resulting with elevation in life quality of students (Munzur, 1999). Undoubtedly, mathematics is one of the disciplines which make people view from different perspectives and think critically.

Growing students who have ability to think critically had become one of the main targets of education. However, the way to be one of the developed countries of current age is about growing students, teachers, and citizens who are active, interrogate, discuss, criticize, investigate, learn, and apply. One way to achieve this is to make students gain critical thinking skills and tendencies (Kazancı, 1989). Subjects with skill of critical thinking will not be passive against knowledge explosion and they will make critical preferences among problems encountered and they will substantially examine preferences they made. The field where thinking skills or the logic are/is most efficiently processed is “mathematics”. Mathematical thinking is not only an important issue in formal training at schools, but it is also a perfect field for individual development efforts of children and adults. An approach of mathematics education, which is characterized with student-oriented efforts, flexible and comfortable environment where all views are freely expressed, enables everybody to develop one’s own thinking strategy, has good links with daily life starting from the first day of school, and is expected to make contributions to the growth of subjects with mathematical thinking and problem-solving abilities by overcoming biases. Improvement of mathematics education will have close impacts on the whole society by increasing number of subjects who has knowledge of mathematics (Umay, 1996, pp. 145-149).

ETE

ETE was the first applied on September 3, 2000, and the 11th time on July 4, 2010, based on the regulation titled “Regulation enabling graduates of vocational colleges and distance education associate degree programs continue education in bachelor’s degree”. This examination was taken by graduates of vocational colleges and distance education associate degree programs. In ETE, candidates were exposed to a skill test consisting of two sections, math and verbal courses. In this examination, it is aimed to measure math and verbal reasoning skills (Retrieved from http://www.osym.gov.tr/belge/1-12228/2010-dgs-meslek-yuksekokullari-ile-acikogretim-onlisans-.html).

ETE is made once per year by OSYM (Student Selection and Assignment Center) which enables students who graduated from vocational colleges in Turkey to continue education in four-year faculty programs. This examination is comprised of 160 questions including 80 questions about Turkish language and 80 mathematics questions, and students are given 180 minutes to answer all questions. Based on scores obtained in this examination, students are assigned to relevant departments of state or foundation universities; should assignment is made to four-year faculties closely related with the graduated division. The abbreviation of this examination is ETE and distribution of mathematics questions by course topics is given in Table 1.

Table 1

Distribution of Mathematics Questions in ETE of Year 2011

Statistics on distribution of mathematics questions	
Topics	Number of questions
Principle concepts	3
Numeral systems	8
Rational numbers	2
Radical numbers	1
Exponential numbers	3
Solving equations—identity	2
Factorization	3
Simple inequalities	3
Ratio-proportion	1
Problems	14
Processes	1
Geometry	8
Digital logic	28
Analytic of line	2
Permutation	1
Total	80

Note. Retrieved from http://www.tasari.com.tr/upload/image/2011say%c4%b1salbilgi.pdf.

Study Method and Techniques Used

This study enrolled 275 students who attended the first mathematics course of education year, among 420 students who attend mathematics I course from the same lecturer in the first grade of vocational college. The reason for limiting the study to the first course is to ensure that students would solve problems or answer questions using mathematics knowledge obtained in high school before new lessons are taught. Thus, 65% of students are involved in the study. Fifty questions were selected among 80 questions asked in ETE of year 2010, which was prepared by OSYM, and students took the exam consisted of those 50 questions and each student was given a score at the end of the exam. Students were also asked nine questions measuring demographics and their views in addition to 50 mathematics questions. Various statistical analysis methods were exploited to evaluate data obtained from the study and SPSS (Statistical Package for the Social Sciences) 16.0 software pack was used.

Limitations of the Study

As of education year 2011, the total number of students is 30,893 in 34 universities which have vocational colleges among all foundation universities offering education in Turkey (Retrieved from http://www.yok.gov.tr /katalog/katalog2011/yok_vakif_2011.pdf). In current study, only 275 students attending a foundation university could be enrolled. However, it can be speculated that the level of mathematics knowledge is almost identical since students attending vocational colleges of foundation universities pay education fee to attend classes and those schools are usually preferred by students who may obtain low scores.

In current study, students attending foundation universities are addressed. Vocational colleges affiliated to state universities are not represented. It can be also speculated that students attending vocational colleges of state universities have higher mathematic knowledge in comparison with that of students attending foundation universities (since state universities offer free-of-charge education).

Evaluation of Findings

Of all students enrolled into the study, 45% were female (n = 124) and 54.9% were male (n = 151). Table 2 gives distribution of students by departments, programs terms, and the number of attendance to the course (subjects attending the course once, twice, or at the third time). Of all students, 76% were attending to financial and administrative programs, while 24% were attending technical programs. Of the participants, 72.7% were day-time education students, whereas 27.3% were evening education students, 78.5% were attending mathematics course for the first time, and 21.5% were comprised of students who attended this course previously but could not pass the class.

Details about status of scholarship of students of vocational college, type of high school they graduated from, their views about the mathematics course attended at high school, their overall view on mathematics course, and their views on ETE are given in Table 3.

Table 2

Distribution by Departments, Programs Terms, and the Number of Attendance to the Course

		Frequency	Percent (%)
Department	Financial and administrative programs	209	76
	Foreign trade	38	13.8
	Logistics	79	28.7
	Business management	49	17.8
	Office management and manager assistant	14	5.2
	Accounting and tax applications	29	10.5
	Technical programs	66	24
	Computer programming	40	14.5
	Textile technology	26	9.5
Term	Day-time education	200	72.7
	Evening education	75	27.3
Number of attendance to the course	First time	216	78.5
	More than once	59	21.5

Table 3

Status of Scholarship and High School Graduated, and Views on Mathematics Course and ETE

		Frequency	Percent (%)
Status of scholarship	No scholarship	104	37.8
	50% scholarship	88	32.0
	100% scholarship	83	30.2
Type of high school graduated	Normal	126	45.8
	Vocational	149	54.2
View on mathematics course at high school	I could gain no knowledge	80	29.1
	I had a little bit knowledge	183	66.5
	I gained good knowledge	12	4.4
View on mathematics course	I like	114	41.5
	I have no idea	83	30.1
	I do not like	78	28.4
View about taking ETE	No	21	7.6
	Maybe	77	28.0
	Yes	177	64.4

When data given in Table 3 are evaluated, it is observed that 37.8% of students have no education scholarship, while 32% have 50% scholarship and 30.2% have 100% scholarship. Accordingly, 62.2% of students enrolled into the study are comprised of students with scholarship.

Distribution of students graduated from high school is: 45.8% from normal high school and 54.2% from vocational high school.

When students were asked their views on mathematics course attended at high school, 29.1% specified that they could not learn mathematics, 66.5% specified that they could somewhat learned mathematics, and 4.4% stated that they were taught good level of mathematics. Considering the figure of 29.1% which corresponds to percent of students stating "I could not learn mathematics at high school", it is obvious that mathematics training and education offered to students at high school should be seriously reviewed. Moreover, it is another matter of discussion how a student with no mathematics knowledge could be graduated.

When students were asked their views on mathematics lesson, 41.5% stated that they liked the lesson, whereas 30.1% had no idea and 28.4% disliked the lesson. When those results are evaluated in combination with previous question, the percent of students who stated that they could gain no or low mathematics knowledge at high school was extremely high corresponding to 95.6%, while 41.5% stated that they like mathematics which can be considered as follows: Those students, in fact, like mathematics, but they could not learn it due to various reasons.

The number of students who want to take ETE is very high (64.4%). When "Maybe" responses are considered in combination with positive answers, the rate increases to 92.4%. Mission of vocational college is to grow intermediate staff and it is thought-provoking that students attending those schools want to continue education in four-year faculties thanks to ETE. Those rates indicate that students prefer compulsorily vocational colleges and they desire to continue education in faculties if they are given a chance and also the concerns about finding a job since education given to students of vocational colleges will be inadequate when they are graduated.

Scores obtained from mathematics exam are given in Table 4.

Table 4

Scores Obtained From Mathematics Exam

Grade ranges	Frequency	Percent (%)
0-10	89	32.3
11-20	84	30.5
21-30	55	20.0
31-40	22	8.0
41-50	14	5.0
51-60	6	2.2
61-70	2	0.8
71-80	3	1.2
Total	275	100

When Table 4 is evaluated, extremely worrisome and thought-provoking condition is encountered. Of all students, 32.3% gained scores ranging between 0 and 10. This result demonstrates that of all participant students, more than one third gave correct answer to five or less questions. The group gaining scores ranging

between 11 and 20 comprises 30.5% of all participants. The rate of students gaining score of 30 or less is 82.8%. The highest score of this examination is 80 points and these result maximum 40 questions were given correct answers among 50 questions. This picture reveals that mathematics knowledge of students attending vocational colleges is very poor. The underlying cause of this result is largely due to the fact that 54.2% of students participating to the study were graduated from vocational college and they had mathematics course only for one year throughout the high school education. However, when it is considered that percent of students taking score of 30 points or less was 82.8%, graduates of normal high schools could not achieve in answering questions. In addition, 62.2% of all students (with 100% and 50%) took scholarship at foundation universities.

Relationship Analyses

In this section of the study, efforts were made to reveal relations between scores obtained from exam and demographics and views of students. For this purpose, statements indicated in Table 5 were hypothesized.

Table 5

Hypothesis Pertaining to Relation Analysis and Result

Hypothesis	Test	Sig. (2-tailed)	Decision
1. Success point varies depending on gender	t = -4.036	0.000	Hypothesis is accepted
2. Success point varies depending on program attended by the student	F = 2.235	0.040	Hypothesis is accepted
3. Success point varies depending on department of the student	t = 0.906	0.366	Hypothesis is refused
4. Success point varies depending on education term attended by the student	t = -0.676	0.500	Hypothesis is refused
5. Success point varies depending on number of times attending to the course	t = 2.147	0.035	Hypothesis is accepted
6. Scholarship status influences success score of the student	F = 0.154	0.857	Hypothesis is refused
7. Type of high school graduated influences success score of the student	t = 1.083	0.280	Hypothesis is refused
8. View of the student on mathematics course attended at high school influences success score of the student	F = 4.742	0.009	Hypothesis is accepted
9. View of the student on mathematics course influences success score of the student	F = 9.523	0.000	Hypothesis is accepted
10. Thought of taking ETE influences success score of the student	F = 3.651	0.027	Hypothesis is accepted

Independent samples *t*-test (Orhunbilge, 1997, p. 140) (independent samples *t*-test) was applied for testing the first hypothesis and according to test result, it was identified that success score of female and male students varies at significance level of 0.05. Mean success score of female students was 15.73 (*SD* (standard deviation) = 10.919), while mean success score of male students was 22.83 (*SD* = 16.903). It can be speculated that male students are more successful in mathematics course than female students.

For testing the second hypothesis, the ANOVA (one-way variance analysis) (Kazmier, 2004, p. 242) was applied and a difference was found in terms of programs at significance level of 0.05. Programs with the lowest mean score was textile technology (mean = 12.69) and foreign trade (mean = 15.79), while programs with the highest mean score were logistics (mean = 21.75) and computer programming (mean = 22.84). Business management program having mean score of 20.49 took the third rank in the success list followed by office management and manager assistant program (mean = 18.43) and accounting and tax applications program (mean = 18.38).

For testing the third hypothesis, independent samples *t*-test is used for identifying differences according to departments and no difference was found (Mean score of students attending financial and administrative programs was 20.09 and standard deviation was 15.169, whereas mean score of students attending technical

programs was 18.18 and *SD* was 14.093).

Based on the result of *t*-test, the fourth hypothesis was refused and it was concluded that success score does not vary according to the education term attended by the student. Mean success score of day-time education students was 19.26 (*SD* = 14.233), while mean success score of evening education students was 20.63 (*SD* = 16.660).

T-test was applied to the fifth hypothesis and it was found that there was difference between students who attended mathematics course for the first time (mean score = 20.35) and students attending the course more than once (mean score = 16.05) and this difference was favoring students who attended the course for the first time.

ANOVA was used for testing the sixth hypothesis and it was observed that success score of students who has no scholarship (mean success score = 18.99), 50% scholarship (mean success score = 20.02), and 100% scholarship (mean success score = 20.02) did not vary and mean scores were very close. According to this result, it can be speculated that scholarship status had no influence on success in mathematics.

For testing the seventh hypothesis, *t*-test was used and it was concluded that success scores of normal high school graduates (mean = 20.39) and vocational high school graduates (mean = 18.44) did not vary. The underlying reason of above-mentioned result is due to the fact that the study was conducted on students of vocational college, and among graduates of normal high school, students preferring vocational college are usually less successful ones.

ANOVA test was used for analyzing the eighth hypothesis and a difference was identified. Mean score of students who stated that “I could gain no mathematics knowledge at high school” was 15.49, while mean scores of students who thought that “I could somewhat learned mathematics” and “I was taught good knowledge of mathematics” were 21.14 and 24.33, respectively.

The claim of the ninth hypothesis (view of the student on “Mathematics course influences success score of the student”) was confirmed based on the result of ANOVA test. Success points of students on mathematics varied according to views of students. When inter-group differences emerged, Turkey test (Daniel & Terrel, 1995, p. 417) was used, among post-hoc tests, to determine which groups gathered, and students stating “I like mathematics” gathered in a separate group with a mean success score of 23.81, while students saying “I dislike mathematics” (mean success score = 14.69) and “I have no idea” (mean success score = 18.54) gathered in another group. It can be speculated students who like mathematics become successful or they like mathematics since they are successful or understand mathematics.

In final hypothesis, an answer was looked for the question if decision on taking ETE influences success score of the student, and since a difference emerged as a result of ANOVA test, Turkey test was conducted; students who decided to take ETE formed a group and students who gave answers “Maybe” or “Yes” about the decision to take ETE formed another group. Mean success score of the second group was higher than the first group.

Conclusion and Advices

Mathematics course is taught almost in all departments of vocational colleges in Turkey and importance of this course is indisputable. Vocational colleges are perceived as a step towards four-year faculties thanks to the ETE, since 64.4% of students gave “Yes” answer to the question “Do you think you will take ETE?”. Mathematics knowledge offers advantage to students in terms of transfer to four-year faculties via ETE.

However, results of this study demonstrated that irrespective of normal high school or vocational high schools, students preferring vocational colleges have very poor level of mathematics knowledge. The percent of students stating that no mathematics knowledge was learned at high school was 29.1%, while 66.5% considered that they could somewhat gain knowledge. This worrisome result demonstrates that education methods used in teaching mathematics lesson at secondary school and high school should be interrogated, and moreover, science-literature faculties and teacher schools which grow mathematics teachers should be reviewed in terms of the education offered.

In Turkey, vocational colleges fulfill the mission of growing intermediate staff for relevant sector. However, graduates of vocational colleges can be transferred to faculty level if they pass ETE and accordingly, importance and necessity of mathematics education are indisputable for those students to achieve mathematical thinking ability and logical thinking ability in relevant discipline. Mathematics education methods should be reviewed and studies should be conducted to ensure that mathematics lessons are taught apart from memorizing formulas and new approach should attract attention of students and raise awareness that mathematics is such important for all fields of life. Moreover, the approach of mathematics education at countries where advanced level success is reached in the field of mathematics should be investigated.

References

Daniel, W., & Terrell, J. (1995). *Business statistics* (7th ed.). USA: Houghton Mifflin Company.

Ersoy, Y. (2003). Technology aided mathematics education 1: Developments, policies and strategies. *Primary Education (Online), 2*(1), 18-27.

Gözen, Ş. (2001). *Mathematics and teaching*. İstanbul: Evrim Publishing House.

Gündüz, S. (2004). *Mathematics projects*. İstanbul: Toroslu Publishing House.

Kazancı, O. (1989). *Critical thinking in education and teaching*. İstanbul: Kazancı Printing.

Kazmier, L. (2004). *Business statistics* (4th ed.). USA: Mc Graw-Hill.

Munzur, F. (1999). Turkish language and literature education textbooks an evaluation of critical thinking (Unpublished master's thesis, Institute of Social Sciences, Ankara University).

Orhunbilge, N. (1997). *Sampling methods and hypothesis testing*. İstanbul: Business Administration Publication.

Özden, Y. (1998). *Learning and teaching*. Ankara: Pegem-A.

Umay, A. (1996). Mathematics education and measurement. *Hacettepe University Journal of the Faculty of Education, 12*, 145-149.