

World Conference on Educational Sciences 2009

## Vocational and technical education problem-based learning exercise: Sample scenario

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Received October 25, 2008; revised December 23, 2008; accepted January 5, 2009

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### Abstract

Mathematics is rather important since the analytical approach is the main issue in industrial education. However, the researches showed that the industrial vocational high school students' success in mathematic lessons are low. As a result, student centered education methods should be preferred instead of teacher based education in mathematic lessons. The students do not acquire knowledge by hearth in teacher based methods. When students do not structure the knowledge by themselves, it tends to be forgotten in a short period of time. For this reason the student centered and problem based - learning methods are used in this study and it is aimed to give students meaningful and permanent learning. In problem-based learning (PBL), subjects are introduced to students in scenarios prepared according to real life. In this study "Factorial" was introduced to students in a scenario and students were given to solve the problem in formed groups.

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*Keywords:* Vocational and technical education; mathematics; problem-based learning; factorial concept

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### 1. Vocational and Technical Education

Vocational and technical education is described as to educate people who can turn knowledge into production, know contemporary and academic methods, make comments, solve problems, take responsibility and initiative in the production and development of materials and services (MEB 1991). Industrial vocational high schools, being among the important schools in vocational and technical education field, have 4 years of education after completing primary school education. These schools supply general culture and collective world veiw to students in high school levels. These schools are implementing programmes which supply training education for various business fields that

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the industry needs in order to prepare students for life, business and higher education. Having a mission to educate the students for the need of business life and in parallel to the student's abilities, these schools fell behind in education. Studies have shown that the success in vocational high schools in terms of social and numeric lessons were slower than the compared averages in other schools. It was stated from Köse's (1996) studies on the average scores of the 1995's examination results of selection and placement of students in higher education institutions. In this study, averages of 6 different types of colleges forming the % 79 of high schools who entered this examination, were examined. These 6 different types of colleges in 76 cities of Turkey are stated as; State owned high schools, Anatolian schools, Private high schools in Turkish language, Private schools in foreign language, Vocational religious high schools and Vocational high schools. Vocational high schools took its place at the bottom of the list having the lowest averages in social and numerical lessons. One of the main reasons for this result in vocational high schools is students' learning in pieces. And they can not associate main lessons like make with real life. Students mostly memorize the lessons and do not realize the importance of what they learnt in real life. In the teacher based education approach, students try to learn passively what has been taught. In this approach, memorizing and loading knowledge to the student is the main issue instead of producing and using the knowledge. But in the new approach in learning mathematics, it is aimed to make students discover the equations instead of memorizing equation that the students do not know where they were originated from. The students' progress in mathematical thinking is much more important (Olkun & Uçar, 2004). Accordingly, the new approach in mathematics learning interprets maths rather than just solve the problem (Olkun 2002). Today, teacher based education approach where students passively take part in learning and using only books as a source of learning and memorizing the equations should be left. Students centered approach, where both teachers and students actively take part in learning, using sources other than books and using hands-on methods in learning and aiming wide multi faceted and meaningful learning is being adopted. Problem-based learning, one of the student centered approaches, is used in this study. In the mathematics lesson, a scenerio was prepared according to problem-based learning. Students were asked to solve the problems in this. On the other hand, the aim of this study is not evaluating students' solutions of the problem. The aim of the study is; to progress students abilities by 1) giving meaningful and permanent learning to students, 2) Associate maths with real life, 3) Thinking logically, analyzing, making synthesis, reaching a knowledge and commenting during mathematic learning through scenarios.

## 2. Method

This study observes the solving period with the sample scenario. And comments on this scenario are gathered through "Problem-based evaluation form". Therefore the study is a qualitative general study which is carried out for 2 weeks with 20, 9th grade students". We prepared a scenario, "*My Father's Calculation*" on factorial concept with real life situations. Since the students have no idea on PBL method, we introduced the method in 4 lessons each 40 min. for one week and another PBL scenario was introduced as a pilot study. The second week students in the survey class formed groups of 5 students and the scenario was given to each group. Students tried to scope out the problem with the group and wrote their solutions and ideas on the scenario form. In this period the teacher joined the studies of each group, and directed the students by asking questions instead of just giving direct information when needed. Students' studies were videotaped in this period.

## 3. Findings and Comments

The PBL scenario which was introduced in this study is given in Table 1. With this scenario students were asked to multiply numbers from 1 to 10, and later 1 to 20. We wanted students to realize how hard it is to multiply numbers as it gets bigger. For this reason students will be in search of another mathematical solution and they learn the factorial concept by understand the meaning of it.

Table 1: The scenario

**My Father’s Calculation**

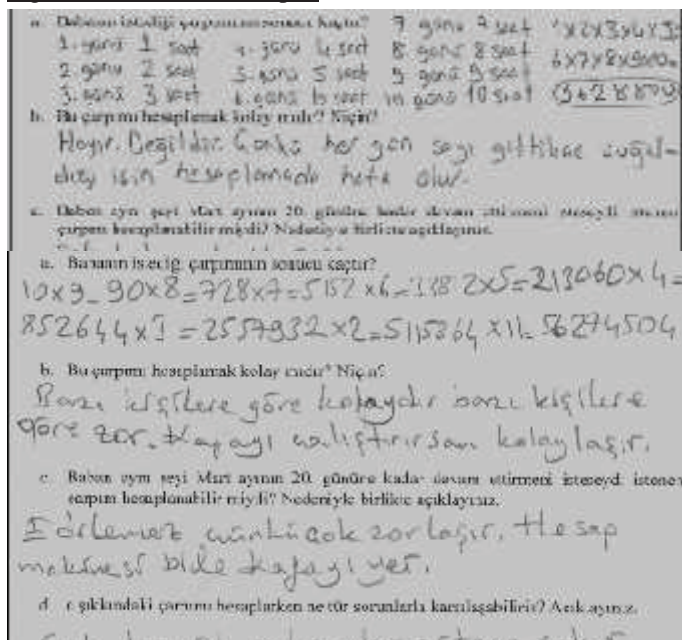
There is a cellular phone with a built in camera which you had been dreaming of buying for a long time. You tried to b it by saving your pocket money, but you couldn’t. Asked from mom, she replied “No”. The idea of asking from yc father is not a good idea because the phone is rather expensive. At last you found courage to ask him. Surprisingly said “Yes”, but he had a condition. Your father wants you to study one hour on the first day of March, two hours on t second day, three hours on the third day, four hours on the fourth day, five hours on the fifth day, six hours on the six day, seven hours on the seventh day, eight hours on the eighth day, nine hours on the ninth day and ten hours on t tenth day. Additionally, he wants you to multiply every studied hour with each other.

- a. What is the result of the multiplication which your father asked?
- b. Is it easy to multiply this? Why?
- c. What if your father asked you to carry this till the 20 th of March, could it be multiplied? If no, describe.
- d. What kind of problems did you face when multiplying the numbers in (c)? Describe.
- e. Are there any other solutions that can solve this in mathematics? If yes, describe.

by Hatisaru (2007).

Students reached the result of the multiplication in section (a) of the scenario. But they couldn’t reach the result of the multiplication to the question in section (c) even they tried. Students reported that it was rather hard to reach the result as the figures were increasing exponentially as a result of the multiplication. Students in the group thought that there must have been easy method to solve the problem. Only Group A discovered to use factorial in the first session. The answers of this group are given in Figure 1. The other groups suggested “exponential numbers, decimals, multiplication, addition and subtraction”. Group B’ answers which was chosen among the other four group are given in Figure 2. Rest of three groups have similar answers.

Figure 1: Answers of Grup A



Students in Group A have answered the question in (a) by writing the daily amonut of working hours for each day and multiplying them with each other. They answered the question in (b) as “not easy”. They stated that since the figures grow bigger due to multiplication, the risk of mistakes increases. The students insistantly tried to reach the solution till the 20th day. Finally on the 18 th day of multiplication, they gave up multiplying. They answered the question in section (c) as the numbers get bigger it becomes harder. The reason is that loosing the control of calculation. In section (e) they discovered factorial in multiplying.

Figure 2: Answers of Grup B

Students in Group B wrote the number from backwards and multiplied them with each other in (a). Students thought that multiplying numbers

work hard it will get easier” students pointed out that the solution could be reached by working hard. They answered the question in (c) as “the multiplying of numbers from 1 to 20 could not be reached”. The students kept on trying to make the multiplication by using a calculator. Since the calculator digit capacity is limited by 10 digit numbers, they ended up by saying that even the calculator gone crazy. Students spent long time periods on multiplying the numbers and had a hard time since the numbers grew bigger. They discovered that answering the question in section (d) as “sleeplessness could occur”. Therefore they realized how hard calculation would be, and how it would become a time consuming problem. The teacher realizing that they couldn’t reach the “factorial” definition as a result of internalizing the problem asked students to define the problem and to realize what they are trying to learn / research without saying “yes ” or “no”, in the end of the first session. In the second session which was held next day, the students discovered the factorial definition after they made some research. In the end of the research “Problem Evaluation Form” (Table 2) was distributed to the groups.

Students have answered the questions “My father’s calculation” scenario in the problem evaluation form, as “Yes, Not sure or No” grading from 1 to 3 respectively. The percentages of the grades obtained from the evaluation form were calculated and chart was prepared accordingly. From the chart given on right we see that 90% of the students think the problem has an educational issue. 90% think working with group increases their work and research abilities, almost % 80 associate maths with real life and more than 90% believe that it is suitable for their grade.

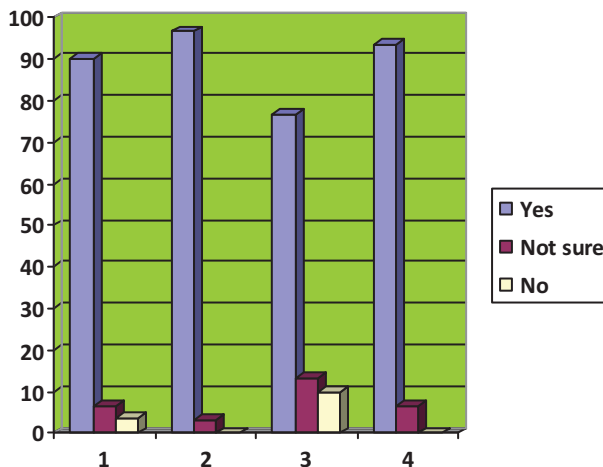


Table 2: Problem evaluation form

	Yes	Not sure	No
1. The problem included the subjects that we have to learn	90%	5%	5%
2. Our work and research ability increased with the group	95%	5%	0%
3. Associate maths with real life	78%	15%	7%
4. Believe that it is suitable for their grade	95%	5%	0%

#### 4. Conclusion

Problem-based learning has real life problems in reaching students goals in the educational programme and using their abilities adequately in analytical thinking and problem solving. These problems are in the form of improving their higher level of thinking abilities instead of testing their knowledge. These problems do not have certain and unique answers. Answers vary according to how they interpret the question, how they plot the problem, and how they plan to solve the problem. Emphasis is given to group work, analytical thinking, responsibility of learning in PBL method. In this study students spent time in calculation of the problem in the scenario and realized the problems aroused from multiplying. They tried to find which method will be used in multiplying numbers from 1 to n. According to <sup>1</sup>teachers' observations, students are having meaningful and permanent learning in this way. Students' statement as "I will never forget factorial till I become a grandfather" supports this observation. Students also worked with the group, shared their thoughts with each other, looked at the problem in different points in the PBL environment. So student centered and problem-based learning will help students progress their abilities in self confidence, analytical thinking and cooperative working.

<sup>1</sup>Survey is carried out by Mathematic teacher Vesife HATISARU with advisor Assistant Professor Ayşe Güler KÜÇÜKTURAN.

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