

Effect of Personalization on Students' Achievement and Gender Factor in Mathematics Education

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Abstract—The aim of this study is to point out whether personalization of mathematical word problems could affect student achievement or not. The research was applied on two-grades students at spring semester 2008-2009. Before the treatment, students personal data were taken and given to the computer. During the treatment, paper-based personalized problems and paper-based non personalized problems were prepared by computer as the same problems and then these problems were given to students. At the end of the treatment, students' opinion was taken. As a result of this research, it was found out that there were no significant differences between learners through personalized or non-personalized materials, and also there were no significant differences between gender through personalized and non-personalized problems. However, opinion of students was highly positive through the personalized problems.

Keywords—Personalization, word problem, computer aided personalization.

I. INTRODUCTION

PERSONALIZATION is taking more and more place in every corners of life in an increasing fashion. As one of these corners, personalization has been used in order to make education more authentic.

Personalization -as an educational meaning- can be defined as embedding students' past experiences and interests into the educational content. As [1] indicated, personalization was a method in which familiar people and stories from their own past experiences were used to construct a bridge between new information and existing ones.

In the earlier researches about this topic, it can be seen that, mostly, personalization is implemented on mathematical word problems, likewise in this research [1]-[2]-[3]-[4]-[5]-[6]-[7]-[8]-[9]. The reason for this situation is in mathematical word problems, personalizing data such as familiar person, place, etc. have been easier than the other topics.

Mathematical word problems pulled out mathematics from abstract world and made it practical and useful which students were able to use in their daily life. Moreover, students can learn easier with word problems comparing to numerical

problems and keep mathematical content easier in their memory due to the attractive nature of the word problems. However, the word problems, which create an opportunity to implement mathematical thinking methods to different situations and connect this method to real world, are problems which students experience difficulty frequently [10].

Below, the reasons for this difficulty which experience in solving mathematical word problems are empirically presented: (a) the diversity in the order and the presentation of numerical data in multi-step problems [11]; (b) verbalism, the abundance of sentences, and the length of the problem [11]; (c) the lack of the linguistic clues that help students to select appropriate arithmetic operation [11]; (d) the presence of data unrelated to the core of the problem [11]; (e) the traditional thinking process which students are accustomed to [12]; (f) the tendency of the students to take the easy way out [12]; (g) the scarcity of practical options [12]; (h) students' poor reading and comprehension skills [8]-[13]; (i) students' limited experiences in mathematical word problems [12]; (j) students' lack of motivation towards mathematical word problems [1]; (k) the fact that the students cannot understand the structure of a problem which is refined in a text [7]-[14]-[15] (l) the difficulty that students have in transforming the mathematical word problems into appropriate numeric format [1]-[14]-[15]; (m) the lack of students' ability to solve mathematical word problems [11]-[16]; and (n) students' inexperience in mathematical word problems and their structure [6].

The earlier researches suggested that personalization of mathematical word problems had various positive effects on students' learning, besides researches have reported some findings at this direction. To give an example, [17] indicated that mathematical word problems was highly appropriate for personalization, students didn't interest in how many apples did Bob give to Suzy, they interested in music, video games, friends, cinema and card games.

When discussions about this topic and findings of prior researches, handled together it can be seen that; the effects of personalization of mathematical word problems on learning output such as achievement, attitude, motivation, interest, etc were tested on different students' level which had unique features. Although some of the previous researches showed the positive effects of personalization on achievement [1]-[2]-[8]-[18]-[19], attitude against problem solving [1]-[5]-[7]-[8] and performance [8]-[20]; there were some researches which had findings which didn't verify the positive effects [5]-[7]-

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[9]-[11]-[12]-[18]-[21]. Moreover, some researches [4]-[22] indicated that the effect of personalization may be depend on various factors, such as mathematical talent, grade, background, type of problems, type of personalization (group/individual). Besides, in some researches there were findings that differ from one culture to another in a manner of the same design. Hence, this situation involved the testing of personalization on students who belongs to different cultures.

It was needed more researches, a) to determine the effects of personalization of mathematical word problems on students' learning (while testing of this effect particular variables had to be held under control), b) to determine the possible effects of personalization on students who belong to different cultures, c) to examine the possible environment options comparatively. In the researches which were studied so far, it was attained to different findings, and these inconsistent findings prevented researchers to mention about the precise effect of personalization and if this effect exists whether this effect varies from one culture to another,

In second grade mathematical problems were began to instruct, not only the issues about reading were disappeared but also in this level mathematical problems are not so complex, so second grade students were appropriate and used in this study.

This study were planed and realized to contribute to satisfy these needs and to determine the effect of personalization of mathematical word problems on the achievement of Turkish student.

II. RESEARCH QUESTIONS

The aim of this research is to determine whether the personalization of problems affects student achievement in the instruction of solving mathematical word problems. In accordance with this main purpose, researchers try to answer the following questions:

- 1) Does the application of personalized or non-personalized mathematical word problems affect students' achievement?
- 2) Does the achievement of personalized mathematical word problems differentiate with the gender?
- 3) Do the students' opinions positive on personalized mathematical word problems?

III. METHOD

A. Design

This research was designed according to quasi-experimental model. Quasi-experimental model opens the door to an entirely different approach to causal assessment that is extremely powerful. This research designed for two-variable case in a single group of participants. The notation of research indicates separate variables, not separate groups. Independent variable of this research is personalization (personalized and non-personalized

B. Participants

The study group consisted of 60 second grade students from a primary school in Turkey in the spring semester of 2008-2009 academic years. Although, all students were included to study, some students' data could not be included to analyses due to absence in some applications so the number in study group was 35, and 14 of whole group was female (%40), 21 of whole group was male (%60).

C. Instruments

In the research, information form was used in order to gather data which will be used in personalization of word problems, and mathematical word problems to determine achievement level, and survey to learn opinions about personalized word problems.

1) Information Form

The Information Form was designed and applied by the researchers to determine students' personal background and their interests. This instrument which was designed based on the literature consisted of 30 questions in order to determine students' interests, personal choices, favorite places/objects/friends as well as their demographic information. The information gathered via this instrument was used for devising teaching material for personalization.

2) Mathematical Word Problems

These problems consist of 8 personalized mathematical word problems and 8 non-personalized as totally 16, which were selected from second grade students' text book appropriate to their mathematical level, and 4 of these personalized word problems include addition, and the others subtraction, as well as, 4 of the non-personalized word problems composed of addition, and the others subtraction.

3) Survey

It was prepared and implemented by researchers to determine the students' personal background and interests. Four questions which were directed to the students were below:

- 1) Do you like mathematical problems?
- 2) Is it easy for you to solve mathematical problems?
- 3) Do you like mathematical problems which included your personal information?
- 4) Do you solve easier when the problems were chosen from your daily life?

D. Data Collection

Prior to the treatment, which lasted two weeks (4*45 minutes lessons) information form was implemented to gather personal information of students.

Prior researches [5]-[7]-[12]-[23] pointed out that, manual personalization takes too much time. Thus, the information technologies appear to be a necessity in personalization studies. [23] were developed "The Personalized Learning Material Generation System" aim the presentation of lessons specific to individual, exercises and tests by using the objects, people or places the individual likes. In this research, personalized mathematical word problems have been

generated on paper by mentioned generation system. Due to the lack of computers for each student in the application school, mathematical word problems have to be given as paper based.

Given that students were able to solve only 4 word problems in a lesson, each lesson four word problems implemented on students along four lessons. Finally, survey was implemented to the students in order to gather students' opinions.

E. Data Analyses

Basic descriptive statistics were computed for all items. There are open ended responses which are qualitative data that are provision of detailed and comprehensive data about the problem on hand [24]. The responses were content analyzed and grouped in empirically generated categories.

Mean, median, standard deviation, values of Kurtosis and Skewedness were calculated in order to determine whether or not parametric analysis methods were appropriate for the data analyses of the research, and Kolmogorov Smirnov Normality Test was carried out to determine assumption of normality.

It was approved to implement paired sample t-test due to the fact that usage of one group of people (achievement variable in a class) and two different occasions (personalized and non-personalized questions). Levene's test was used whether the variance of scores for the two groups (personalized and non-personalized) is the same. After checking whether, or not the assumption of equal variances has not been violated, paired sample t- test were carried out for achievement variable.

IV. FINDINGS

A. Findings in Accordance with Achievement Variable

A paired-samples t-test was conducted to evaluate the impact of the intervention on students' scores on the Personalized Paired Sample t-test (See Table I). There was no significant difference in scores on personalized mathematical word problems ($M=6.37$, $SD= 1.73$) and non-personalized mathematical word problems ($M=6.40$, $SD=1.80$), $t(34)=-0.13$, $p<.01$. The magnitude of the differences in the means was very small (eta squared=.0005).

TABLE I
PERSONALIZATION - PAIRED SAMPLE T-TEST

	N	M	S	Sd	t	p
Personalized	35	6.37	1.73			
Non-personalized	35	6.40	1.80	34	-13	0.90

This finding indicates that embedding personal data into the problems do not have any impact in the steps of solving the problem.

B. Findings in Accordance with Gender Variable

An independent-samples t-test was conducted to compare the personalized scores for males and females (See Table II).

There was no significant difference in scores on the personalized mathematical word problems for males ($M= 6.43$, $SD= 1.69$) and females ($M= 6.29$, $SD= 1.86$), $t(33)= -0.24$, $p>.05$. The magnitude of the differences in the means was very small (eta squared=0.001742).

TABLE II
GENDER DIFFERENCES PERSONALIZED - T TEST

	n	M	S	Sd	t	p
Female	14	6.29	1.86			
Male	21	6.43	1.69	33	-.24	0.82

There was no significant differences in scores on the non-personalized mathematical word problems for males ($M = 6.38$, $SD = 1.96$) and females ($M = 6.43$, $SD = 1.60$), $t(33)= 0.08$, $p>.05$). The magnitude of the differences in the means was very small (eta squared=0.000194) (See Table III).

TABLE III
GENDER DIFFERENCES NON-PERSONALIZED - T TEST

	n	M	S	Sd	t	P
Female	14	6.43	1.60			
Male	21	6.38	1.96	33	.08	.94

C. Other Findings

Exactly 100 % of students (N=35) like mathematical word problems. Almost, this finding is opposite to the all of the previous researches.

TABLE IV
ANSWERS OF DIFFICULTY MATHEMATICAL WORD PROBLEMS

	Frequency	Percent
Yes	20	57.1
Sometimes	13	38.1
No	2	5.7
Total	35	100

About 57 % of the students didn't find to solve mathematical word problems difficult, still (38.1%) of students are fluxional with the mathematical word problems, as they gave answer "sometimes" in the survey. 2 students (N=35) don't like to solve mathematical word problems and found it difficult to solve (See Table IV).

In addition, almost whole of the students (97.1%) liked personalized mathematical word problems and interestingly 1 student didn't like personalized mathematical word problems (See Table V).

One of the main responds emerged from the survey is that students like personalized mathematical word problems due to the familiar names and interest to themselves. The responds of survey demonstrate that many students found personalized mathematical word problems enjoyable and around the same ratio of the students think that this type of problems improve their brain.

TABLE V
ANSWERS OF LIKING PERSONALIZED MATHEMATICAL WORD PROBLEMS ?

	Frequency	Percent
Yes	34	97.1
No	1	2.9
Total	35	100

While the students who like the personalized word problems were able to express the reason why they like, the students who didn't like weren't. Typical reasons students gave for preferring like personalized mathematical word problems:

- I like solving mathematical problems.
- My name included
- Very good problems
- Very easy
- Enjoyable
- Very enjoyable
- It is related to me
- I'm included
- It's about real life
- I'm informed more.
- When you solve one, you want to solve thousands of these questions.
- I would like to see myself in the questions.
- Improves my brain
- Improves me
- There are my favorite sports and my mother's name in the questions
- Different questions
- It's about me and my family, so I became happy.

TABLE VI
DO YOU SOLVE EASIER WHEN THE PROBLEMS WERE CHOSEN FROM YOUR DAILY LIFE?

	Frequency	Percent
Yes	30	85.7
Sometimes	3	8.6
No	2	5.7
Total	35	100

One of the questions in the form is that "Do you solve easier when the problems were chosen from your daily life?" has been responded as "yes" from 85.7%, on the other hand, rest of the students may be little amount (14.3%) as "sometimes" from 8.6% and "no" from 5.7% of the students, (See Table VI), but it can be considered that they had some difficulties during the original lesson.

When asked to the students solved easier when the problems were chosen from your daily life, about 14,3% (N=35) of the students expressed that personalized mathematical word problems didn't affect their performance while solving. The reasons of the students who responded as

"sometimes" and "no" are as below:

- The questions are the same as our teacher (no)
- I'm not getting the answers from the names of my mother and my father (no)
- some of them are difficult.(sometimes)

Lastly, 30 students (n=35) agreed that the problems were getting easier when they were in personalized type. At the same time, about the same percentage of students found these personalized problems more comprehensive than classic type.

The reasons of the students who responded as "yes" are as below:

- It helps.
- I wanted to solve these problems
- I could do it
- They were not difficult
- They were so easy.
- Very good.
- It is easy to comprehend family names
- Enjoyable
- I was improved
- They are comprehensible

V. CONCLUSION AND DISCUSSION

In this research, it was found out that there were no significant differences between learners through personalized or non-personalized materials as the other researcher [5]-[7]-[9]-[11]-[12]. In contrary, in some researches, some findings were attained which showed that personalization of word problems had positive effects on students' achievement [1]-[2]-[8]-[18]-[19]-[21].

In the literature about this topic, it was expected that personalization of mathematical word problems had positive effects on students' achievement. Previous researches that confirmed this positive effect was consistent with these expectations. It was assumed that this expectation based on the idea which was personalization of word problems facilitate the comprehension [3]-[4]-[5]. In some researches of which findings were inconsistent with expectations, researchers easily said some mistakes were caused those unexpected results due to the strongness of positive expectation of personalization. Whereas, at least this expectation was invalid in terms of some variables. [12] indicated that unsuccess of students depended on many reasons and not to understand the question is not the only one reason. Moreover, they might experience problems in next levels such as setting up the equation and solving this equation, even if they understand the question completely.

According to [12], the possible reasons of no increment in students' achievement were a) the solutions which were provided by personalization could not be covered by the reasons of the situation that students' couldn't solve word problems, b) age of students, c) treatment which does not include personalized instruction practices.

However personalization didn't affect the achievement and there were no significant differences between genders,

besides, students' opinions were positive. Nevertheless the students found personalized mathematical word problems easier and liked them. Some of them even thought that personalization helped solving problems. Possible reason of this situation may be that students haven't ever experienced these types of questions before, so they were attracted and it contributed to their comprehension. In school mathematics, students learned that when they saw "increase" word it means that they have to do addition operation, in a same manner when they saw "decrease" word it means that they have to do subtraction operation. In the personalization method, these information might be meaningful for them. According to students' opinions personalization did its job in here.

This observation supported the idea which personalization can take important roles to attract students which is the first step of learning according to many learning theories [1]-[8]-[12].

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