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The Investigation of Strengths and Weaknesses of Primary School Teachers in Mathematics Knowledge

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Abstract This study aims to evaluate strengths and weaknesses of primary school teachers in mathematical knowledge based on self-made exam. This exam consisted of ten mathematics questions. To determine the reliability of our exam, Cronbach's Alpha coefficient was used and was estimated to be 0.74 by SPSS software. For this purpose, 80 teachers of grade fifth and sixth participated in Shiraz city, Iran. Teachers were selected by valuable sampling. The responses from teachers have been analyzed. In this paper, we used Descriptive Statistics for the data analysis. Data analysis indicated that the average mark of primary school teachers was low in some mathematics areas and they were strong in few topics. As a result, we propose several solutions for the education system in order to reduce the weaknesses in mathematics teaching.

Keywords: *mathematics knowledge, primary school teachers*

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1. Introduction

As one of the basic existing sciences, Mathematics has had great contributions in variety of scientific achievements and will continue to carry out its influence. "Salau (2000) points out that there exists an impregnable link between mathematics and other science subjects."[14]

It is an indisputable fact that education has a significant role in growth of all branches of science. In particular, primary education has a momentous impact on students' features. The role of teachers as crucial elements in primary education system cannot be neglected.

In recent years, there has been concern about primary school teachers in science teaching. Teachers' lack of confidence to teach science has been largely attributed to their poor background knowledge [1]. Therefore, teachers of mathematics, and in particular primary school teachers, are required to be proficient enough in their field of expertise. Studies conducted at the elementary school level indicated that teachers' mathematical knowledge is indeed connected to student learning [2].

Ball [3] states that the practical answer to the question about the type of mathematical knowledge needed for teaching mathematics should be based on three main principles. First, mathematics' teachers are required to have greater knowledge of mathematics in comparison to other educated people. Teaching mathematics involves more than topics and procedures. It involves the use of tools and skills for reasoning about mathematical ideas, representations, and solutions. It is the "more" of more understanding of insides of ideas, their roots and connections, their reasons and ways of being represented. Second, knowledge for teaching mathematics is different from the mathematical knowledge needed for other mathematically-intensive occupations and professions. The mathematical problems and challenges of teaching are not the same as those faced by engineers, nurses, physicists, or astronauts. Third, the mathematical knowledge needed for teaching must also be practical for mathematical problems. Mathematical knowledge for teaching must be suitable for the mathematical work that teaching entails, from offering clear explanations, to posing good problems to students, to mapping across alternative models, to examining instructional materials with a keen and critical mathematical eye, to modifying or correcting inaccurate or incorrect expositions.

There is also a danger that the teacher's approach who dislikes mathematics may unconsciously be followed by students and his/her lack of interest in mathematics can be widely accepted among students. Because "most adults' attitude toward mathematics come from their experiences of mathematics in school when they were very young" [15]. As a result, using a teacher who possesses great interest in mathematics and adequate mathematical knowledge becomes principally important.

According to the result of TIMMS research, the situation of Iranian students in math and science was evaluated unsatisfactory. The reason for this is primarily due to the method of teaching [4]. Daneshpajooh and Farzad stated that more teachers have difficulty in some teaching skills and they need some education to improve [5]. So in this research, the weaknesses and strengths of Iranian primary school teachers in mathematical knowledge were investigated. For this reason, the weaknesses of teachers in mathematics knowledge were

identified so that we can help as much as possible to develop mathematical education. For this purpose, a mathematical exam was designed by two mathematics experts. Then, the teachers of grade fifth and sixth respond this exam. Finally, responses of teachers analyzed and some solutions are presented to reduce this problem.

2. Literature Review

Mohammadi and Goya [10] have conducted a research as mathematical knowledge of middle school teachers. The data obtained in this research indicated that mathematics teachers identify misunderstanding of mathematical concepts among students. Teachers also believe that having adequate level of mathematical knowledge is enough to teach mathematics. This research shows that teachers rarely explore the methodologies proposed by students in solving mathematical problems. In addition, they also do not pay much attention to the creativity of students as well as their diverse solutions to the mathematical problems. The most interesting point in this research was the fact that teachers have little confidence on solutions and answers students supply on particular mathematics problem. Instead of trying to analyze the solutions provided by students and accordingly guide them, teachers enforce their own solutions to mathematical problems.

According to a research in the United States, the preparation of specialist-coach influenced on students achievement. Important features involved in teaching such as knowledge and professional practice teachers and the school mathematics program. It has also been noted that mathematical knowledge and mathematical content knowledge for teaching were changed during the specialist-coaches' first years of service in school [13].

Ball and Hill states that the concerns regarding rate of success in mathematics among US students has been increased. Indications have shown that teaching and learning of mathematics in America needs to be improved. The quality of math teaching depends on mathematical knowledge of teachers. Mathematics teachers lack skills and knowledge of mathematics and such teachers have graduated from an education system that we are aiming to improve. Studies of the last 15 years have indicated that mathematical knowledge of teachers is not satisfactory. The same studies have also pointed to the fact of American adults' substandard mathematical knowledge [2].

Eu loung et al. [6] investigated Pedagogical content knowledge and mathematical content knowledge in primary school and high school student teachers. They concluded that mathematical knowledge and pedagogical knowledge in Malaysian student teachers is below the international average and the knowledge of teachers influence the success of students.

According to a paper, mathematics teachers in Nandi-Central District public primary schools have a positive attitude toward mathematics. Mathematics performance in those schools where the teachers were committed to their duties had positive attitude towards mathematics, prepare well before going to teach, used plenty of teaching relevant resources, and engaged their pupils through evaluation and assessment [9].

3. Research Methodology

We used an exam for data collection. This exam has ten mathematics questions. In order to design the exam, we considered the comments and opinions of primary school teachers. In addition, they also mentioned some mathematical concepts and topics of the textbooks of grades fifth and sixth in Iran. Finally, two mathematics experts designed this exam based on teachers' comments. To determine the validity and reliability of our evaluation, the views and approval of experienced teachers and math specialists are also used. Finally, In order to determine the reliability of our exam, Cronbach's Alpha coefficient was used and it was estimated to be 0.74 by SPSS software.

According to above description, the exam was as follows:

1. Put suitable sign (< = >) in the blank.

a) $\frac{4}{7} \square \frac{5}{8}$ b) $0\times \frac{2}{9} \square \frac{5}{4} - \frac{4}{3}$

2. Write the following number numerically.

Two billion and forty-five thousand

3. A circle has _____ radius and _____ diameter.

4. Write the result of the following phrases.

a) $\frac{1}{3} - \frac{5}{7} =$

b) $6 - 6 \times \frac{3}{4} + 0.45 \div 3 \times 4 =$

5. Perimeter of a garden in the shape of square is 240 meters. If a tree is grown in every $3m^2$ of the garden. How many trees are there in the garden?

6. Write the results of the following phrases.

a) $3^8 \times 3^4 =$

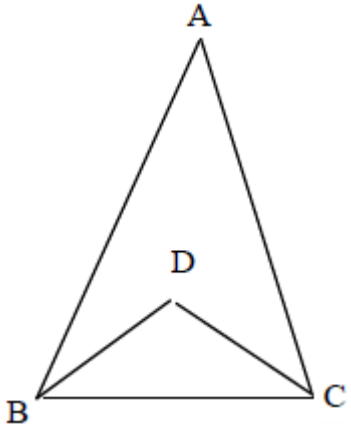
b) $4^5 \times 0.25^7 =$

7. How much is the perimeter of circle with a radius 3 (r = 3) more than of perimeter of semicircular with a radius 4 (r = 4)?

8. Five workers paint a building in 12 days. How many days 8 workers with the same ability do this?

9. A seller bought stuff 1000 $. How much does he sell his stuff that he can sell with 20% profit after 20% discount?

10. Large triangle below is isosceles. D is on the perpendicular of the sides of triangle. How much is the size of angel A?



80 teachers of grade fifth and sixth participated in this research from Shiraz city of Iran. We used a valuable sample but it should be noted that this sample has a suitable scattering. For the provided sampling, we used different schools such as poor, moderate and great schools in terms of their performance.

The mark of test was from zero to 100, and the score of each question was considered from zero to 10. In this paper, we used descriptive statistics for the data analysis. For this aim, data is analyzed by SPSS software.

4. Data Analysis

The following table shows the average and standard deviation in every question:

Table1. Average scores in each question

Question	Average	Standard deviation
Q_1	8.4375	2.46414
Q_2	8.7500	3.32805
Q_3	9.3750	2.16049
Q_4	5.6375	2.63973
Q_5	7.5125	3.82197
Q_6	5.1875	3.88145
Q_7	5.5250	3.60722
Q_8	5.4875	4.80504
Q_9	3.0500	4.22140
Q_{10}	1.0000	1.79310

As it can be seen in the table above, the average scores in q_1, q_2, q_3, q_5 are acceptable but in case of remaining questions, the average scores are relatively low.

Question 1 is about Comparison of two numbers. The average scores of teachers is high in this question. This question consists of two parts. The first one is about comparison of two positive numbers and the second one is about comparison of one negative number and zero. Almost 30 percent of teachers gave wrong answers to the second part. But most of them answered correctly to part A. Therefore, according to the self-made exam, primary teachers are good at comparison of positive numbers.

As the above table shows, the average scores of primary teachers in question 2 is also high. This question is about notation. Mathematical notation is an important topic in mathematics and almost everyone needs that throughout their daily life. In order to have a high standard of teaching on this topic, a teacher should be an expert on. This topic covers one of the most important chapters of fifth grade textbooks in Iran.

Question 6 has been selected from the topic of power in mathematics. The average score of teachers in this question is low. Some teachers have multiplied 3*3 eight times in part "a" in question 6. Similarly, 3*3 for four times and the answers obtained from these two were multiplied by each other. The result found is a large number. The other part has also been solved in the same way by some teachers. Some of them required calculator to solve this question. Therefore, this indicates that some teachers are either not familiar enough with this topic or they have partially forgotten about it.

Question 8 was selected based on the topic of proportion. According to Table 1, the average score of the teachers was low in this question. So, teachers did not attain satisfactory score in this case. Proportion includes three parts: direct proportion, inverse proportion and compound proportion. This question was chosen from inverse proportion. Some teachers have confused it with direct proportion. This topic is an important one, particularly in grade fifth and sixth. Students also need to be knowledgeable on this topic as they will be requiring it later on during their academic journey.

Question 9 was chosen from the topic of percent. Results indicate that the mean score of teachers is quite low in this question.

In this exam, 4 questions is about geometry (q_3, q_5, q_7, q_{10}). The average score of primary teachers in q_3, q_5 is high but the average scores is low in q_7, q_{10}. Question five and seven are about perimeter and area. Question 10 is about plane geometry. Teachers had poor performance in question 9. The following part is the solution provided by some of the teachers:

$$240 \div 4 = 60 \times 60 = 3600$$

It should be pointed that such notation is not correct in mathematics. In fact, from a=b=c we have a=c. Therefore, according to above equality, 60 equals 3600. The purpose of designing this question was to find out whether the teachers pay attention to such notation or not. Question 7 is from the topic of perimeter, too. Perimeter and area topics in mathematics are important in primary school. Many teachers calculated the perimeter of semicircular without considering the diameter. The last question was selected from geometry. This question is considered to be the most difficult in this self-made exam. It should also be noted that there are several solutions to this question.

5. Discussion and Conclusion

According to explanations provided above, teachers are knowledgeable enough at notion, comparison of two numbers, and some geometrical topics. But they have shown weaknesses in proportion, percent and some of the geometrical topics. Because of the importance of these topics in the textbooks of grade fifth and sixth**,** educational planners should pay more attention to these topics. As it can be seen table above, the average marks of primary school teachers is low in the topics of proportion and percent and these two topics are important ones in grades fifth and sixth in Iran.

It should be noted the results of this study are limited to teachers of grades fifth and sixth Shiraz city, Iran. Therefore, in generalizing the results to other fifth and sixth grade teachers, we have to be discreet. In addition, due to the limited research tools used (self-made exam), we need to be careful in interpreting the results.

According to past researches, mathematics learning largely depends on the teachers [11]. And performance in mathematics has remained one of the global concerns. Studies conducted by American Institute for Research (AIR) to investigate mathematics performance on USA students – 4th and 8th grades- as compared with their peers around the world and another by National Assessment of Education Progress (NAEP) assessed the progress in mathematics of students in grades 4, 8, and 12. The results showed that grade 4 pupils performed below the average mark consistently from 1996-2007. The survey also revealed that teachers are the major causes of poor mathematics performance in the US [9].

According to Opolot-Okurut et al. [12], 83% of factors in mathematics learning are related to teachers such as

poor teaching method, lack of teaching experience, teachers' weak academic background, poor teacher attitudes towards mathematics and few qualified teachers.

Some suggestions proposed are as follows:

1. Teacher training centers should pay more attention on mathematics in the training of teachers such that the teachers will possess more skills in mathematics. Especially for issues that were expressed in this research teachers, they are weak in them. These centers should be familiar with the issues of primary school textbooks and they should provide training to teachers in this context. It is always better to have a two-way interaction between education system and teacher training centers.
2. In addition to the entrance exam, education system should conduct an interview for selection of primary school teachers (teachers of grade fifth and sixth). This can help in evaluating how much primary school teachers are interested in various subjects and mathematics in particular. This requires allocating sufficient funds to education system.
3. In order to improve the quality of math teaching, education system should design coherent and practical plan for less experienced teachers so they can solve their issues when it comes to mathematical knowledge.
4. It is also suggested that education system should put more focus on workshops and training courses for teachers during their work. These workshops should be held for the purpose of solving teacher's issues and teachers need to feel the effectiveness of such workshops. Also, education system should use the opinions of experienced teachers for changing the textbooks.

References

[1] Appleton K., "student teachers' confidence to teach science is more science knowledge necessary to improve self - confidence", *International Journal of Science Education*, volume 17, issue 3, pp 357-369. 2007.

[2] Ball, D., Hill, H. and Bass, H., "Knowing Mathematics for Teaching", *Journal of the American Federation of Teachers*, 29(1). 2005.

[3] Ball, D., "What Mathematical Knowledge is Needed for Teaching Mathematics", Feb 2003, preprint.

[4] Daneshpajoo, Z., "Evaluation of professional skills in science and math teachers of middle school and providing its qualitative methods", *Journal of Educational innovation*, 2(6). 69-93. 2002. [In Persian].

[5] Daneshpajoo Z., Farzad V., "Evaluation of professional skills of primary school teachers", *Journal of educational innovation*, 18 (5). 2006. [In Persian].

[6] Eu leong, K., Chew, C., Abdul Rahim, S., "Understanding Malaysian pre-service teachers mathematical content knowledge and pedagogical content knowledge journal of mathematics", *Eurasia Journal of mathematics, Science &Technology Education*, 11(2). 363-370. March 2015.

[7] Goerges, A., Borman, K. M., Lee, R. S., "Mathematics reform and teachers quality in elementary grades: assessment, teacher licensure, and certification". *Educational policy analysis archives*, 18(13). 1-36. Jun 2010.

[8] Kashani A., Noorbakhsh Z., "The investigation of the causes of academic failure in middle school mathematics", *Journal of Improvement of mathematics education*, 91(3). 2009. [In Persian].

[9] Makewa, L. N., Role, E., Too, J. K., Kiplagat, P. ,"Evaluation of Teacher Factors Associated with Mathematics Performance in Primary Schools in Kenya", *International Journal of Scientific Research in Education*, 5(1), 47-62. 2012.

[10] Mohammadi J., Goya Z., "The investigation of knowledge of mathematical teachers in middle school", *Journal of Improvement of Mathematical Education*, 26(3). 12-19. 2010. [In Persian].

[11] Onwuakpa, F. I. W., Nweka, A. O., "Enriching science, technology and mathematics education in schools through effective utilization of resources in the classroom", 41st annual conference proceedings of STAN 33-37. 2000.

[12] Opolot-Okurut, C., Nakabugo, M. G., Ssebbunga, C. M., Ngobi, D. H., Maani, J. S., Gumisiriza, E. L. . . , & Bbosa, D. "Instructional strategies for large classes: Baseline literature and empirical study of primary school teachers in Uganda". Centre for the Study of International Cooperation in Education (CICE), Africa-Asia University Dialogue for Basic Education. 2008.

[13] Patricia F. Campbell, Nathaniel N. Malkus, "The mathematical knowledge and beliefs of elementary mathematics specialist-coaches", *Zdm*, volume 46, issue 2, pp 213-225. 2013.

[14] Pavlovna Okello N., "Peer interactions and positive student-lecturer relationship ASA tool for improving the teaching and learning of college algebra: a case study at USIU". *Journal of Language, Technology & Entrepreneurship in Africa*, Volume 5.No.1. 2014.

[15] Sparrow L., Hurst C., "Developing a Positive Attitude to Primary Mathematics Learning" *Australian Primary Mathematics Classroom*, 18-24. 15(1). 2010.