Mathematics Education Trends and Research 2016 No.1 (2016) 37-41

Available online at www.ispacs.com/metr
Volume 2016, Issue 1, Year 2016 Article ID metr-00089, 5 Pages
doi:10.5899/2016/metr-00089
Research Article

The main problem solving differences between high school and university in mathematical beliefs and professional behavior

Reza Akhlaghi Garmjani[1*], Ahmad Shahvarani[1]

(1) Department of Mathematics, Science and Research Branch, Islamic Azad University, Tehran, Iran

Abstract
Teaching science and math has been underdeveloped in nurturing the talents and motivations of young people who are in search of professions in these fields. Identifying and strengthening the students' problem solving beliefs and behaviors, can be a great help to those involved in teaching mathematics. This study investigates on the university and high school students, teachers and professors' problem solving beliefs and behaviors. Considering the research method, this study is a field research in which questionnaire is used. Participants in this research were senior high school and university students, math teachers and math professors. Data collection method for beliefs and behavior variables was via the use of a questionnaire. The Mann-Whitney test results showed that problem solving in high school and university was different and the main difference was in mathematical professional beliefs and behaviors.

Keywords: Problem-solving, Beliefs, Behaviors, Mathematics, High school, University.

1 Introduction

One of the main goals of teaching mathematics is to develop problem-solving skills in students. The goal in teaching mathematics is to develop creative critical thinking and the number of these types of thinking, but the teachers do not exactly know how to develop the creative skills. This is the duty of math teacher to teach problem-solving skills to students. Problem-solving skills affect the students' achievement in mathematics, and those students who lack problem solving skills do not achieve much success in mathematics. Using new methods of teaching mathematics can strengthen the students' problem solving skills (Zarei, 2012) [1]. Mathematical problem solving can be considered as the most important element of mathematics culture. High school mathematics' teaching does not successfully act in representing a true picture of the mathematics' culture. Using cultural vision in mathematics, we can express the problems in a new way. Explaining a problem along with its different solutions is called culture. By considering the cultural characteristics and a successful transition from school mathematical culture to university

* Corresponding Author. Email address: mathe8877@gmail.com

mathematical culture, it is identifiable and predictable why students perform poorly in high school math and they do not take step in the direction of professionalism (Parent, 2009). Methods of teaching mathematics in the last years and in different countries have been usually affected by planning policy and the study of researchers in the field of teaching. In this regard, many believe that for school mathematics to have, many more affecting power and lead to meaningful understanding of mathematical concepts, it must be embodied and intuitive (Fallahi, 2010) [2]. From cross-cultural studies, it can be concluded that the mathematical behaviors of learners, are complex processes in which teachers and learners are directly related to each other. The root of this complexity is in this fact that each learner is an individual with a unique personality that acquires his knowledge, skills and understandings through different methods and approaches and through different levels, because mental processes, readiness levels and the individual's accountability practices are different (Alamolhodaei, 2010) [4]. Making relationship between school mathematics and university mathematics and also between various mathematical subjects and making them related to real life is essential for a math teacher. Without having the advanced knowledge of math in teaching university courses, the teacher will not be able to make relationships or discuss the different questions. According to Standar (NCTM) (2000), without making relationship, the students have to rely only on their memories and remember many of the concepts and disparate methods. Relating the mathematical theories mean to relate the new ideas to the ideas that have been previously considered. Solving the challenge of mathematical problems through thinking about how the familiar concepts and methods may help the individual's new positions and beliefs, is thought-provoking (Zazkis, 2010) [6].Teachers with advanced mathematical beliefs and behaviors may present the problems in the fields familiar to the students and make a relationship between the school mathematics and university mathematics. The way mathematical knowledge of the learners emerge in different situations of a mathematical task (teaching, learning, problem solving and evaluation) which is under the influence of internal and external factors is called mathematical behavior. Thus, according to this perspective, the researcher seeks to answer this question whether the main differences between high school and university affect the mathematical beliefs and professional behaviors or not?

2 Literature review

In a study focusing on Iranian high school math teachers' beliefs about the nature of mathematics, teaching and learning in two theoretical frameworks of traditional and constructive beliefs and non-traditional beliefs conducted by Shahvarani and Savizi (2008) [3], about 100 high school math teachers in educational district 1 of Tehran filled a questionnaire about their traditional and non-traditional beliefs. The results showed that compared to the teachers with non-traditional beliefs, the teachers with traditional beliefs have more agreement with the importance of mathematics, the students' learning and mathematics curriculum. Some conflicting views have been observed in teachers, which can be the flawed process of the new reform movement among high school mathematics teachers. On the other hand, the relationship between different variables shows that the teachers' beliefs can affect the nature of mathematics, the mathematics curriculum, the students' learning and the teachers' teaching. Perrenet and Taconik (2009) [5] conducted a pilot study on freshmen and senior university students and their professors. To do so, they investigated their beliefs and behaviors both at the time of entrance to the university and graduation by the use of a questionnaire; hence their beliefs and behaviors were evaluated in two stages. The results and discussion showed that undergraduate education had a positive impact on the students' problem solving beliefs and this impact reflects the different culture between the university and high school math.

Zazkis (2010) [6], in a research on high school teachers, investigated on 30 teachers through survey and interview, to examine their beliefs on whether the advanced mathematical knowledge of the teachers can have a positive impact on their teaching practice and increase their self-esteem or not. Sharing the different ideas, the teachers recommended that the basic mathematics course should be redesigned and to help the

future teachers, a relationship must be held between the advanced mathematics being taught at the University and the high school mathematics they teach. Second, they also recommended an in-service course that deals with reviewing the fundamental issues in high school mathematics curriculum that develops from the point of advanced mathematics.

3 Methodology and Research Instruments

The present study is an applied research that compares the mathematical beliefs and behaviors' culture in high school and university period through selecting four independent groups of senior high school and undergraduate university students and also some math teachers and professors, and comparing and examining all groups two by two. To compare the problem solving beliefs and behaviors, the selected questionnaire was adopted from the questionnaires with a same mathematical thinking (Cooper 1984, Plegram and Egen). The additional factors of the presented ideas were inspired from Shonfield (1985) and Ernest (1991). This questionnaire contains 17 items in Likert scale, with five options, in which completely agree is with the value of 5, agree is with the value of 4, no idea is with the value of 3, disagree is with the value of 2, and completely disagree is with the value of 1.The validity of the questionnaire was confirmed by the related professors and teachers. In order to evaluate the validity of the research instrument in terms of the face and content validity, after preparing the items, the list of items were given to the supervisor, advisor, Master's students and the professors in the math department, and after evaluating the research instrument based on the objectives of the study, these experts confirmed its validity. In order to assess the reliability of the items in the questionnaire of problem solving beliefs and behavior, we used Cronbach alpha method. The obtained Cronbach alpha value was 72/0, that this value indicates the ideal reliability of the items in the research instrument.

4 Participants

The population in the present study included the male senior high school students, studying in the field of mathematics, and the state high school math teachers in the district 1 of Rasht, and the female senior undergraduate math students studying at university, and also the professors at Gilan state university in the academic year 2011-2012. In this method, using Morgan table where the number of samples turns out according to the number of the population, two classes from four male pre-university centers with the total number of 67, 20 senior university students, 30 teachers and 20 math professors, were selected randomly and were analyzed and investigated.

5 Findings

Considering the inferential statistics section, having the two groups of high school and university students on one hand and the group of teachers and professors on the other hand, due to the non-normality of the data, the Mann-Whitney test was used. Considering the statistical software, in this study SPSS software was used that its effectiveness has been approved by the important statistical experts and has been used by many researchers.

Table 1: Descriptive statistics related to the variable of problem-solving beliefs and behaviors in high school and university students, teachers, and professors

group	mean	standard deviation	Standard error of mean
High school student	52.55	6.30	0.77
University student	59.35	4.73	1.06
Teacher	58.97	4.25	0.76
Professor	72	3.08	0.69

As can be seen in Table 1, the mean of problem solving beliefs and behaviors in high school students, teachers, university student, and professor, were respectively reported as 52.55, 58.97, 59.35, and 72, in which compared to the university students, the high school students had a higher mean and the professors had the highest mean in problem solving beliefs and behaviors. The apparent difference has been significant, thus for closer examination, we use the inferential statistics in table 2:

Table 2: Results of Mann-Whitney test for comparing the total mean of the two groups of high school and university students and the groups of teachers and professors

group	mean	standard deviation	Standard error of mean
High school students	43.61	73.45	0.0001
University students	79.82	--	--
Teachers	80.10	75.31	0.0001
Professors	126.58	--	--

To investigate after running the Mann-Whitney test, the results in Table 2 show the significant level of 0.05 with the P value of 0.0001 and comparing the three mean rates of the two groups of high school students and university students and the teacher and professor, respectively (126. 58, 79. 82, 80. 10, 43. 63), indicate on the significance of problem-solving beliefs and behaviors in the two groups, and this mean difference shows that the key differences in problem solving between high school and university is in the professional mathematical beliefs and behaviors of the high school and university students.

6 Discussion and conclusion

Math problem solving is a central factor in the culture of mathematics. According to the research report, the university students change their problem solving beliefs and behaviors during the years of undergraduate period. For example, the undergraduate university students, in metacognitive, accurate and effective aspects of mathematical problem solving stages are better than high school students or even their teachers. Maybe that's why during the undergraduate period the Bachelor's students often get more involved with the problems than when they were beginner; even the parameters such as accurate formulation and being in the correct direction of solving a math problem, and after that, investigating whether the used solution was the most convenient and the most appropriate solution or not, seem more important to them than high school period. Undergraduate university students mostly believe that mathematics is an open and a growing knowledge-base as most of them believe that mathematics is not a closed issue. They mostly believe that one can invent mathematics himself. In their technical ways for solving a math problem, behaviors such as accurate understanding at the beginning of problem solving, making a mathematical plan or table is more important. In the other words, giving the exact answer is less important and the mathematics is nothing more than a basic insight and less work. On average, in this study we can conclude that the high school students' behaviors and beliefs toward some independent changes are non-professional, compared to the beliefs and behaviors of their teachers. When the university students explain the changes in their behaviors and beliefs,

they basically refer to the differences between problem-solving in high school and university. According to their ideas, the difference is in the nature of math problems in university and high school. The high school problems are limited, standard and simple. Following suggestions are offered:

- Despite the contradictions between the teachers' beliefs, changes in beliefs seem quite difficult and require a serious commitment which needs to review teaching methods, textbooks and new methods of teaching.
- The art of teaching mathematics is being practically followed in in-service training workshops.
- In writing textbooks, the problem-solving approach, intuition and modern methods of teaching are used more.

References

[1] R. Zarei, The role of intuition in problem solving and teaching mathematics in first grade of highschool in Arsanjan city, Science and Research branch, Islamic Azad University, Tehran, (2012).

[2] M. R. Fallahi, Mathematical intuition and its role in teaching mathematics, Master's thesis. Science and Research branch, Islamic Azad University, Tehran, (2010).

[3] A. Shahvarani, B. Savizi, The analysis of some Iranian highschool math teachers' beliefs about teaching and learning mathematics, Journal of Mathematical Instruction. 106 (2008) 5-10.

[4] H. Alamolhodaei, The principles of mathematics education, Jahan Publications, Mashhad, (2010) p29.

[5] Jacob Perrenet, Ruurd Taconis, Mathematical enculturation from the students' perspective: shifts in problem–solving beliefs and behavior during the bachelor programme, Edus stud math, (2009) 181-198. *http://dx.doi.org/10.1007/s10649-008-9166-9*

[6] L. Zazkis, Advanced mathematical knowledge in teaching practice: perception of secondry mathematics teacher, Mathematics thinking and learning, (2010) 279-280. *http://dx.doi.org/10.1080/10986061003786349*