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Procedia - Social and Behavioral Sciences 182 (2015) 737 – 741

Procedia Social and Behavioral Sciences

4th WORLD CONFERENCE ON EDUCATIONAL TECHNOLOGY RESEARCHES, WCETR-2014

Correlation between mathematics anxiety with metacognitive knowledge

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Abstract

The purpose of this study is to identify the correlation between Math anxiety and metacognitive knowledge. 323 out of 1950 Seventh grade female students were selected by cluster random sampling. The validated Persian version of standardized questionnaires of Chiu and Henry's Math anxiety scale and Swanson's metacognitive knowledge scale were used. Math anxiety was negatively correlated with Metacognitive knowledge (r=-0.48). Moreover, Metacognitive knowledge was negatively correlated with different domains of Math anxiety of learning Math, r= -0.43; of Math evaluation, r= -0.42; of solving problem, r= -0.409; and Math teacher anxiety, r= -0.38. These findings highlight the effect of math anxiety of seventh grade female students in their metacognitive knowledge.

Peer-review under responsibility of Academic World Research and Education Center.

Keywords: Metacognitive Knowledge, Math Anxiety, Mathematics

1. Introduction

Metacognition refers to "the ability of reflecting upon, understanding, and controlling one's learning" (Schraw & Dennison, 1994). Flavell first coined this term and defined it as "cognition about cognition" or "thinking about thinking" (Flavell, 1979). Two categories were distinguished for metacognition, including knowledge of cognition and regulation of cognition (Flavell, 1979). He classified knowledge of cognition into three categories: person, task,

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Peer-review under responsibility of Academic World Research and Education Center.
doi:10.1016/j.sbspro.2015.04.822

and strategy knowledge. Person refers to general knowledge that one has about human beings' cognitive capabilities. Task is the knowledge about the nature of the task and finally strategy indicates the knowledge about strategies that may be useful for different tasks and in different situations. Considerable researches have been done in the past few years about how students think about their own cognitive processes. Metacognition knowledge helps us to learn and know when things matter. This knowledge helps us to evaluate the results of our efforts and proficiency.

Mathematics anxiety exists in some adults (Perry, 2004) and is influenced by people's beliefs (Tobias, 1978). It has been described both as an irrational phobia (Hodges, 1983), and a rational fear rooted in real experience of failure and inadequacy (Perry, 2004). Math anxiety is defined as negative affective responses to Mathematics. These are generally feelings of tension or fear that interfere with Mathematics performance (Ashcraft, 2002). Researchers have recently connected high Math anxiety to lower performance on Math tasks, developmental dyscalculia, and lower self-efficacy and beliefs towards Math learning (Maloney,Ansari & Fugelsang, 2011; Rubinsten & Tannock, 2010; Hoffman, 2010; Kesici & Erdogan, 2010.e.g). Math anxiety has four dimensions. These dimensions include "anxiety of learning Math, anxiety of solving problem, Math teacher anxiety, and anxiety of Math evaluation". Anxiety of learning Math explains the following activities and processes associated with learning Math, such as preparing a new Math book, attend a Math class or starting a new Math book. Anxiety of solving problem is the aspect of referring to Mathematical problems in a position rather than the exam such as reading and interpreting graphs and charts and Mathematical problem solving by listening to other students. Math teacher anxiety displays that Math teacher features could lead to students' fears and tension. Anxiety of Math evaluation expresses anxiety in positions relevant to the assessment such as to get ready for Math exam or thinking about Mathematics exam one day before (Chiu and Henry, 1990). The difficulties in learning Mathematics are a fascinating and complex area for studying. The interactions between factors that can be attributed to the cognitive domain and those that can be attributed to the affective domain are many and varied. For example, although a moderate amount of anxiety may actually facilitate performance; higher anxiety level has a negative influence on working memory (Ashcraft et al, 1998). Skemp (1971) suggested that the reflective activity of intelligence could be inhibited by anxiety. Reasons for Math anxiety are usually classified as environmental, personal or cognitive. Environmental causes can include negative experiences in Math classes or with particular Math teachers. Personal causes include low self-esteem, lack of confidence and the influence of previous negative experiences. Cognitive causes involve innate characteristics, being either low intelligence or simply poor cognitive abilities in Mathematics. (Rubinsten & Tannock, 2010) The purpose of this study is to identify the correlation between different domains of Math anxiety and metacognitive knowledge.

2. Methodology

Three hundred and twenty three out of 1950 seventh grade female students were selected by cluster random sampling. Persian version of two standardized questionnaires, Mathematics Anxiety Scale for Children (MASC) and Metacognitive knowledge Scale (MKS), were used in this study. MASC is an instrument developed by Henry and Chiu (1990) to measure student levels of Math anxiety precisely for students in grade seven (Batton, 2010). The instrument utilizes a 4-point Likert type scale and has 22 questions. MASC is numbered with a scale from 1 to 4 where 1 is "not nervous"; 2 is "a little bit nervous", 3 is "very nervous", and 4 is "too very, nervous". Internal consistency for the MASC was estimated by computing alpha coefficients for each grade and for the total group (Henry and Chiu, 1990). These coefficients ranged from 0.90 to 0.93 with a median of 0.92. The consistency as measured by Cronbach's alpha was 0.924. MKS was assessed by questionnaire that was filled by students with supervision of the researcher. The Persian questionnaire validity has been addressed by Karimi (2009). Among them the criterion validity and construct validity (including convergent validity, divergent, doing internal differentiation and age groups) noted. This analysis showed that the questionnaire is an indicator of the narrative. Also using the Cronbach's alpha reliability, retest reliability between the ratings that were calculated. Reliability coefficient for the total sample was 0.73.The coding for this questionnaire was compiled by Karimi (2009) found that the complete of six-degree scale. However, the recent encryption is much more complete and more suitable for young adults, and we can say this is a localized scale. In the current study, Cronbach's alpha was calculated to test the reliability of the optimal number 0.84 the questionnaire.

3.Results

First hypothesis: Math anxiety has negative correlation with cognitive knowledge.

Table1.Indices and Pearson correlation test of first hypothesis

Variable	Number	Mean	Minimum	Maximum	SD	correlation coefficient	P value
Math Anxiety	323	43.8	22	88	14.2	-0.48	0.000
Metacognitive knowledge	323	61.2	0	110	17.5		

As table shows (r= - 0.48), there is moderate negative correlation between two variables. Thus, students who have low Math anxiety have more metacognitive knowledge.

Second hypothesis: Anxiety of Math evaluation has negative correlation with cognitive knowledge.

Table2.Indices and Pearson correlation test of second hypothesis

Variable	Number	Mean	Minimum	Maximum	SD	correlation coefficient	P value
Anxiety of Math evaluation	323	20.1	8	32	6.7	-0.42	0.000
Metacognitive knowledge	323	61.2	0	110	17.5		

As table shows (r= - 0.42), there is moderate negative correlation between two variables. Thus, students with low Math anxiety evaluation have more metacognitive knowledge.

Hypothesis third: Anxiety of learning Math has a negative relationship with cognitive knowledge.

Table3.Indices and Pearson correlation test of hypothesis third

Variable	Number	Mean	Minimum	Maximum	SD	correlation coefficient	P value
Anxiety of learning Math	323	10.2	6	24	3.9	-0.43	0.000
Metacognitive knowledge	323	61.2	0	110	17.5		

As table shows (r= - 0.43), there is moderate negative correlation between two variables. Thus, students with low anxiety of learning Math have more metacognitive knowledge.

Hypothesis fourth: Anxiety of problem solving has negative correlation with cognitive knowledge.

Table4.Indices and Pearson correlation test of Hypothesis fourth

Variable	Number	Mean	Minimum	Maximum	SD	correlation coefficient	P Value
Anxiety of problem solving	323	10.5	6	24	4.1	-0.41	0.000
Metacognitive knowledge	323	61.2	0	110	17.5		

As table shows (r= - 0.41), there is moderate negative correlation between two variables. Thus, students with low anxiety of problem solving have more metacognitive knowledge.

The fifth hypothesis: Math teacher anxiety has negative correlation with cognitive knowledge.

Table5.Indices and Pearson correlation test of fifth Hypothesis

Variable	Number	Mean	Minimum	Maximum	SD	correlation coefficient	P value
Math teacher anxiety	323	2.93	2	8	1.4	-0.38	0.000
Metacognitive knowledge	323	61.2	0	110	17.5		

As table shows (r= - 0.38), there is moderate negative correlation between two variables. Thus, students with low Math teacher anxiety have more metacognitive knowledge.

4. Discussion

As we mentioned, low Math anxiety correlated with higher cognitive knowledge. We can assume if Math anxiety in students becomes less, they can make more use of their metacognitive knowledge. Ozsoy (2011) also showed the positive relationship between metacognition and achievement in Mathematics. Yilmaz (2007) study indicated that increasing levels of Math anxiety and depression was associated with negative metacognition. Legg & Locker (2009) examined the metacognitive impact on Math performance, reaction time and confidence in performing Mathematical tasks. The results showed that those who have a modest metacognitive skills, Math anxiety and performance anxiety experienced greater Math decline, but those who have higher cognitive levels show less anxiety. It could be assumed that less anxiety of Math evaluation in students, they can make more use of metacognitive knowledge. Cates & Rhymer (2003) found that students' Math anxiety affects Math performance and with high levels of anxiety, Mathematical function of the learners would be reduced. Zare (2009) in a study titled "Effects of metacognition in Mathematical problem solving students" demonstrated metacognitive instruction on Mathematics problem solving abilities of the students and encouraged them to learn Mathematics. Haffman & spatariu (2009) showed metacognitive knowledge has a positive relationship with learning and students who know their efficient of cognitive and metacognitive strategies are less anxious and more successful in problem solving. It could be expected if students have less anxiety of problem solving, they can make more use of metacognitive knowledge. Aamos & Perkkil (2012) are mentioning how school can respond to the Math learning challenges of anxious children. Wei (2010) has studied about how an animated pedagogical agent could help decrease student's Math anxiety. The benefits of animated pedagogical agents include enhanced information presentation; increased sense of ease and comfort, increased motivation, and enhanced learning. The effect of pedagogical agent was higher in most anxious students (Wei, 2010). Our results emphasized the mutual interaction between math anxiety and metacognitive knowledge and high Math anxiety could interfere with metacognitive knowledge.

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