The role of math learning anxiety, math testing anxiety, and self-efficacy in the prediction of test anxiety

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Original Article

Abstract

BACKGROUND: As a common educational phenomenon, test anxiety is known to be closely related to the academic performance and achievement, and even the future performance of most students. Math anxiety is considered to be one of the possible contributing factors to test anxiety. This study aimed to determine the role of self-efficacy and math anxiety in predicting test anxiety among girl students.

METHODS: In this descriptive-analytic study, the statistical population included all girl students studying in junior year in high schools of Urmia City, Iran, in the academic year of 2016. Of them, 351 students were selected using multistage cluster sampling method. The data were collected using Spielberger test anxiety inventory (TAI), Chiu and Henry mathematics anxiety scale for children (MASC), Sherer et al. and general self-efficacy scale (GSES). The collected data were analyzed using Pearson correlation and stepwise regression tests.

RESULTS: Self-efficacy and math anxiety could significantly predict test anxiety in studied students (P < 0.010).

CONCLUSION: The result indicated that increasing self-efficacy decreased math anxiety level and test anxiety in students. The findings imply that self-efficacy improvement and test anxiety reduction should be taken important in educational and counseling services provided for students.

KEYWORDS: Test Anxiety Scale, Mathematics, Self-Efficacy

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Introduction

Test anxiety is an educational phenomenon which is directly related to students' academic performances and achievements, and even their future performances.[1] Test anxiety is taken as a general term referring to a certain type of anxiety or specific social anxiety, making people cast doubt on their abilities and competencies, and reducing their ability to deal with conditions like an exam through which they are supposed to be evaluated. Test anxiety can also be labeled as a form of evaluation anxiety, that is, given the point of its occurrence, testing situation can be seen and assessed as a threat for those experiencing test anxiety. Test anxiety appears due to cognitive problems such as negative and worrisome thoughts regarding the exam under academic pressures. These abnormal reactions to stressful conditions reduce working memory performance.[2]

Test anxiety is one of the most prevalent and acute problems which students encounter

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during educational course negatively affecting their proper assessment by teachers through disrupting students' academic performance.[3] Based on the systematic studies by Sarason and Mendler on test anxiety as an important cognitive and emotional phenomenon, two types of drives are evoked by test situations: first, task-related drives are induced, and then the learned anxiety-related drives are elicited as task-irrelevant behaviors.[4] Spielberger et al. introduced worry and emotionality as main components of test anxiety.[5] Math anxiety is considered as one of the possible contributing factors to test anxiety.

Math anxiety can be defined as one's inability to cope with quantitative situations, including those involving numbers, particularly in mathematics.[6] Anxieties, in general, and math anxiety, in particular, disrupt mental processes and information processing procedures by increasing the distraction and invasion of negative thoughts, resulting in distorted perceptions of events including mathematical phenomena.[7] Math anxiety creates emotional and mental barriers that make it difficult to make mathematics progresses in the future. Accordingly, the student chooses a fatalistic attitude, and tends to get a poor grade on the math exam. This condition is gradually converted into a defective cycle and a self-fulfilling prophecy, such that the mathematical performance is influenced by the math anxiety.[8]

The anxiety reduction leads to better progress in the courses as well as decreased math anxiety. In a longitudinal study, researchers examined how anxiety was related to math performance in second- and third-grade students and showed that math anxiety was significantly related to math performance of 3rd-grade students. They also found that the 2nd-grade's math anxiety influenced math performance in the 3rd grade indicating the need for monitoring and paying attention to math anxiety in early eduaction.[9]

Students with higher anxiety hurriedly judge the whole test upon seeing the first few questions while those with lower anxiety postpone their judgment until the end of the exam.[10] Nowadays, self-efficacy beliefs are known as effective factors contributing to motivational regulation, guiding human behavior, and coping with anxiety and stressful situations.[11,12] Self-efficacy is one's belief in his ability to accomplish a certain activity. Bandura's self-efficacy theory put emphasis on the role of one's self-esteem and confidence in his abilities to display the behaviors expected from him.[11-13] Self-efficacy is one's assurance in displaying a particular behavior appropriate to the encountered situation and expecting its consequences.[14] Researchers have investigated the relationship between self-efficacy and anxiety, including test anxiety.[15-17] They have also suggested self-efficacy as an important factor in academic achievement in specific areas.[18-20]

Even though a little anxiety is necessary for students to perform their tasks and to help them with educational scheduling and further study, excessive anxiety reduces student's academic achievement, leads to discomfort caused by inability to accomplish activities such as math exercises, and results in math anxiety, decreased self-esteem, helplessness, distress and embarrassment, disability, nervous pressure, and lack of concentration which elucidate the necessity of doing these kinds of studies, and the importance of determining the factors contributing to test anxiety. Therefore, given the aforementioned literature review, the main issue of the present study was to determine whether test anxiety can be predicted through math anxiety and self-efficacy.

Materials and Methods

In this descriptive-analytic study, the statistical population included a total number of 1750 girl students studying in the final year of

high schools in Uremia City, Iran, in the academic year of 2016. Of them, 351 were selected according to Morgan's formula using multistage cluster sampling method. Firstly, 8 schools from different geographical areas (2 northern, 2 southern, 2 eastern, and 2 western schools) were selected randomly from 18 girls' high schools located in Uremia, and afterwards 2 classes (each class with 20 students) were selected from each high school. Then, the questionnaires were distributed among students, and completed after obtaining informed consent from them.

Pearson correlation and stepwise regression tests were employed to analyze the data.

Spielberger's Test Anxiety Inventory (TAI): This 32 item-inventory was developed by Spielberg et al.[5] Jadidi et al. determined the validity of Persian version of this questionnaire in a study on 538 high school students in Kurdistan Province, Iran (Cronbach's alpha = 0.761).[21] Correlation coefficients of TAI were 0.82, 0.72, and 0.67 using Sarason test anxiety scale, trait anxiety, and situational anxiety, respectively.[5] In our research, Cronbach's alpha calculated as 0.768.

Mathematics Anxiety Scale for Children (MASC): This 22 item-inventory was developed by Chiu and Henry.[22] To measure the validity of MASC, they calculated its correlation using different tools. They reported 0.92 and 0.71 for the correlation coefficients of this scale using mathematical anxiety scale (MARS) and Sarason's Test Anxiety Scale for Children (TASC), respectively. The reliability of MASC reported by Cronbach's alpha for all subjects was 0.92.[22] In our

research, Cronbach's alpha was 0.769.

General Self-Efficacy Scale (GSES): This questionnaire, developed by Sherer et al. is composed of 17 items.[23] Asgharnejad et al. reported the reliability of Persian version of GSES as 0.88 using Cronbach's alpha coefficient.[24] Najafi and Fooladchang determined the reliability of 0.8 and the validity of 0.61 for GSES using Cronbach's alpha and its correlation with self-esteem scale, respectively.[25] In this research, Cronbach's alpha was calculated as 0.871.

Results

The descriptive indices of variables including mean, standard deviation (SD), and variables correlation are shown in table 1.

According to table 1, there was a negative significant relationship between self-efficacy and test anxiety (-0.37), while positive significant relationships was observed between test anxiety and math learning anxiety (0.29), test anxiety and math testing anxiety (0.30), and test anxiety and math anxiety (0.34). Thus, it can be concluded that test anxiety is negatively related to self-efficacy and positively related to math anxiety.

The multiple stepwise regression was used to predict test anxiety from self-efficacy and math anxiety, such that, in the first step, self-efficacy, in the second step, math testing anxiety, and in the third one, math learning anxiety were introduced into the equation and their relationships were preserved in these steps. Table 2 shows the results of regression analysis.

Table 1. Mean, standard deviation, and internal correlations of variables

Variables	Mean ± SD	Correlations				
		1	2	5	4	3
Self-efficacy	33.30 ± 12.07	-0.21[*]	1			
Math learning anxiety	25.43 ± 8.46	-0.15[*]	0.45[*]			1
Math testing anxiety	58.14 ± 18.29	-0.21[*]	0.81[*]		1	0.73[*]
Math anxiety	50.15 ± 11.60	-0.37[*]	0.29[*]	1	0.34[*]	0.30[*]

SD: Standard deviation
[*] P < 0.050

Table 2. Summary of regression model, analysis of variance, and statistical characteristics of test anxiety regression on predictive variables

Step	Model	Sum of squares	Degree of freedom	Mean square	F statistics	P	R	R^2	ΔR^2
1	Regression	5943.01	1	5943.01	51.19	0.001	0.37	0.14	0.14
	Residual	36333.04	313	116.08					
2	Regression	8547.35	2	4273.67	39.53	0.001	0.45	0.20	0.06
	Residual	33728.70	312	108.10					
3	Regression	9163.02	3	3054.34	28.68	0.001	0.46	0.22	0.02
	Residual	33113.04	311	106.47					

Criterion variable was test anxiety in all steps; and predictive variable(s) was self-efficacy in step 1, self-efficacy and math testing anxiety in step 2, and self-efficacy, math testing anxiety, and math learning anxiety in step 3.

Based on table 2, it can be concluded that 0.22 of the variance of the criterion variable is explained by total predictive variables, namely, three mentioned predictive variables explain 22% of the test anxiety score, out of which, 14% is explained by self-efficacy; while math testing anxiety and math learning anxiety predict 6% and 2% of the variance, respectively. The observed F level for predictive variables is significant at the level of 0.001. This finding suggests that these three variables can significantly predict test anxiety.

In table 3, standardized and unstandardized regression coefficients and their significance are presented.

According to table 3, the effect of math testing anxiety (r = 0.19) and math learning anxiety (r = 0.14) on test anxiety are positive and significant while the effect of self-efficacy (-0.32) on this variable is negative and significant; so, it can be said that increasing in self-efficacy and decreasing in math anxiety result in test anxiety reduction.

Discussion

The main objective of this study was to determine the test anxiety using math anxiety and self-efficacy. In this regard, the data were analyzed using Pearson correlation and multiple stepwise regression tests. The results showed that math testing anxiety and math learning anxiety explained 6% and 2% of the variance of test anxiety, respectively. The observed F level for predictive variables was significant at the level of 0.001 which is consistent with the findings of Rekabdar and Soleimani.[26] No study was found to be inconsistent with this finding. It can be said that studies on anxiety and individuals' performances convey the evidence that depression anxiety and, in general, psychological pressures reduce one's effective behavior in the face of different realities, especially when the requested assignments need more attention and focus. A student, who becomes anxious during a math activity, cannot think properly and organize his own knowledge into performance; so he/she often intentionally puts more effort into his activities; even though his efforts do not result in the proper learning of mathematical concepts which ultimately makes her/him desperate and depressed, and math anxiety causes fear and worry about failure in the exam.

Table 3. Stepwise regression coefficients of test anxiety on predictive variables

Indices Variables	B	Standard error b	β	T	P
Constant (a)	53.18	3.40		15.62	< 0.001
Self-efficacy	-0.32	0.05	-0.32	-6.15	0.001
Math learning anxiety	0.13	0.05	0.14	2.40	0.020
Math testing anxiety	0.26	0.07	0.19	3.40	0.001

The results also showed that self-efficacy predicted 14% variance of test anxiety. The observed F level for predictive variables was significant at the level of 0.001. This finding is consistent with that of the studies conducted by Jex and Bliese[15] and Janice.[16] It is enough to explain this finding by the fact that people with higher self-efficacy beliefs have lower test anxiety because one's perception of his abilities is one of the most important factors in dealing with stressful situations.[15] On the other hand, higher self-efficacy increases one's interest, effort, endurance, and diligence in performing assigned tasks, and one's confidence in his ability;[16] which, in turn, lower one's anxiety. Individuals with higher self-efficacy employ cognitive and metacognitive strategies, and diligence in doing their tasks. Therefore, self-efficacy plays an important role in academic achievement. Mehrabizadeh Honarmand et al. showed that test anxiety is negatively related to self-efficacy.[27]

According to Bandura, individuals' knowledge, skills, and previous achievements do not predict their future performance, but their beliefs regarding their skills and abilities affect their performance.[13] Alborzi and Seif in a study on students pointed out that there was a negative relationship between test anxiety and academic achievement in statistics.[28]

Conclusion

Paying attention to people's beliefs and perceptions of their abilities is very effective in improving their mental health and also their future academic and professional performances. It is recommended that, besides incorporating courses in students' curriculum, teachers receive adequate training and employ teaching methods contributing to self-efficacy improvement and the development of a strong sense of competence in order to reduce the level of test anxiety caused by low self-efficacy and to decrease the sense of incompetence in the students significantly. It is also suggested that future studies be conducted among boys and also students of both sexes studying in other educational levels.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

References

1. Hill KT. Debilitating motivation and testing: A major educational problem, possible solutions, and policy applications. Research on motivation in education: Student motivation 1984; 1: 245-74.
2. Parks-Stamm EJ, Gollwitzer PM, Oettingen G. Implementation intentions and test anxiety: Shielding academic performance from distraction. Learn Individ Differ 2010; 20(1): 30-3.
3. Mehrabizade M, Abolghasmi A, Najarian B, Shokrkon H. The relationships between self-efficacy and control place and intelligence. J Educat Sci PSychol Ahvaz Uni 2007; 21: 52-72.
4. Sarason SB, Mandler G. Some correlates of test anxiety. J Abnorm Psychol 1952; 47(4): 810-7.
5. Spielberger CD, Gonzalez HP, Taylor CJ, Algaze B, Anton WD. Examination stress and test anxiety. Stress and anxiety 1978; 5: 167-91.
6. Fuson JY. A study of the relationship between math anxiety and select demographics [PhD Thesis]. Minneapolis, MN: Capella University; 2007.
7. Ashcraft MH, Krause JA. Working memory, math performance, and math anxiety. Psychon Bull Rev 2007; 14(2): 243-8.
8. Bonnstetter R. A follow-up study of mathematics anxiety in middle grades students [PhD Thesis]. Vermillion, SD: University of South Dakota; 2007.
9. Hasking PA. Reinforcement sensitivity, coping, and delinquent behaviour in adolescents. J Adolesc 2007; 30(5): 739-49.
10. Schutz PA, Davis HA. Emotions and self-regulation during test taking. Educ Psychol 2000; 35(4): 243-56.
11. Bandura A. Self-regulation of motivation through anticipatory and self-reactive mechanisms. In: Dienstbier R, Dienstbier RA, Editors. Perspectives on motivation. Lincoln, NE: University of Nebraska Press; 1991.

12. Wolters CA. Self-regulated learning and college students' regulation of motivation. J Educ Psychol 1998; 90(2): 224-35.

13. Bandura A, Adams NE. Analysis of self-efficacy theory of behavioral change. Cognit Ther Res 1977; 1(4): 287-310.

14. Bandura A, Schunk DH. Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. J Pers Soc Psychol 1981; 41(3): 586-98.

15. Jex SM, Bliese PD. Efficacy beliefs as a moderator of the impact of work-related stressors: A multilevel study. J Appl Psychol 1999; 84(3): 349-61.

16. Janice WE. The relationship between efficacies for self-regulated: Learning and dommin. Specific academic performance controlling for test anxiety. Journal of research and development in education 1996; 29: 77-80.

17. Muris P, Schmidt H, Lambrichs R, Meesters C. Protective and vulnerability factors of depression in normal adolescents. Behav Res Ther 2001; 39(5): 555-65.

18. Rodebaugh TL. Self-efficacy and social behavior. Behav Res Ther 2006; 44(12): 1831-8.

19. Greene BA, Miller RB, Crowson HM, Duke BL, Akey KL. Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. Contemp Educ Psychol 2004; 29(4): 462-82.

20. Wolters CA. Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. J Educ Psychol 2004; 96(2): 236-50.

21. Jadidi H, Behrouzi N, Shehniyeylagh M, Hashemi SE. The causal relationship between optimism, test anxiety and mathematical performance, with the mediating role of dispositional and situational coping strategies in sophomore students at Kurdistan University. Journal of Psychological Achievements 2015; 22(1): 269-90. [In Persian].

22. Chiu LH, Henry L. Development and validation of the Mathematics Anxiety Scale for Children. Meas Eval Couns Dev 1990; 23(3): 121-7.

23. Sherer M, Maddux JE, Mercandante B, Prentice-dunn S, Jacobs B, Rogers RW. The self-efficacy scale: Construction and validation. Psychological Reports 1982; 51(2): 663-71.

24. Asgharnejad T, Ahmadi Deh Gotboddini M, Farzad V, Khodapanahi MK. Study of the psychometric properties of the general self-efficacy scale. Journal of Psychology 2006; 10(3): 262-74. [In Persian].

25. Najafi M, Fooladchang M. The relationship between self-efficacy and mental health among high school students. Clinical Psychology & Personality 2007; 1(22): 69-83. [In Persian].

26. Rekabdar GH, Soleimani B. To compare the mathematics anxiety based on perfectionism typology among Khoramshahr high school prep students. Knowledge & Research in Applied Psychology 2008; 10(35-36): 33-52. [In Persian].

27. Mehrabizadeh Honarmand M, Allameh A, Shehni Yeylagh M. The relation of self-respect, social anxiety, perfectionism and belonging to academic performance and test anxiety. Journal of Psychology 2007; 11(3): 242-55. [In Persian].

28. Alborzi S, Seif D. A study of the relationships between motivation, learning strategies, and some demographic variables with achievement: Case study of Shiraz university students in statistics course. Journal of Social Sciences and Humanities of Shiraz University 2003; 19(1): 73-82. [In Persian].