The influence of personal qualities and informational sources of self-efficacy on mathematics performance and mathematics self-efficacy

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Abstract: - A covariance structural analysis was used to test the direct and indirect effects of self-efficacy beliefs and personal qualities (mathematics ability, mathematics attitudes, and self-regulation strategies) on mathematics performance and mathematics self-efficacy. Students completed four questionnaires and assessed for mathematics ability and performance. According to the most important results, independent variables were significant Paths (direct) on all latent variables except performance. Its effect was indirect via math self-efficacy. In addition, self-regulation strategies and mathematics ability and direct effect on mathematics self-efficacy and indirect effects on performance by mediating of Mathematics self-efficacy. There was lack of any significant path from mathematics attitude to mathematics self-efficacy and mathematics performance.

Key-Words: Personal qualities, informational sources of self-efficacy, mathematics performance, mathematics self-efficacy

1 Introduction

Among all the personal variables that have attracted researchers in the area of mathematics performance, self-efficacy in mathematics seems to be gaining more attention. (Ayotola,&Adedeji,2009). In an effort to improve students cognitive and affective outcomes in mathematics and/or school learning, educational psychologists and mathematics educators have continued to search for variables (personal and environmental) that could be manipulated in favor of academic gains especially in the subject mathematics due to student’s disposition, low enrolment and poor performance in the subject (Chief Examiner Report, 2005-2009).The students Judgment of their capability to solve mathematics problems is predictive of their actual capability to solve those problems. These judgments also mediate the influences of other predictive such as mathematics background, mathematics anxiety, and perceived usefulness of mathematics, prior achievement and gender (Pajaros, 1996, Pajarers & Miller, 1994). Mathematics self-efficacy, defined as “a situational or problem-specific assessment an Individual’s confidence in her or his ability to successfully perform or accomplish a particular(mathematics) task or problem”(Hackett and Betz 1989,p.262).
Bandura (1986) In order to show that the beliefs about one’s own ability are not identical to beliefs about the likely outcomes of one’s action. Has drawn a distinction between the role of self-efficacy beliefs versus that of outcome expectations-which are often positively related- in influencing and predicting motivation and behavior (Usher and Pajares, 2008). The review of the literature in relation of mathematics Self-efficacy and mathematic performance shows that besides mathematic self-efficacy, other variables, such as informational sources of self-efficacy play roles in this area (Bandura, 1986).
Causal Models in mathematics achievement

Based on Randhow& et. al (1993). Mathematics self-efficacy along with direct influence on mathematics achievement, it mediates the influence of mathematics attitude on mathematics achievement.

Randhow& et. al (1993, P.42)

They found mathematics self-efficacy as strong variable influencing mathematics performance.

Pajares & miller (1994, P.199)

Pajares and Miller(1994) have reported that student judgment of their capability to solve mathematics problem are predictive of their actual capability to solve those problems. These judgments also mediate the influences of other predictive such as math background, perceived usefulness of mathematics, prior achievement and gender.

The model and the coefficients show the strong influence of experience & self efficacy on mathematics performance.
2 Method

2.1 Sample
420 males and 428 females’ eight graders were randomly selected from 135 middle schools of two educational districts in Yazd city (Iran).

2.2 Measures

2.2.1 Mathematics Performance Test
This test consists of 15 open-ended items in five content areas of school text: linear equation, algebra geometry, arithmetic and vector. This test developed by expert mathematics teachers and then several stages of psychometric analysis, these item results from questions repertoire with 25 items. Selected item have difficult coefficients between 40 to 60 and item discriminating power up to 40. Content validity was confirmed by psychometric specialists and concurrent validity of this test with student’s score of mathematics in first semester was 0.75. The reliability of the test by 21 kuder-richardson formulas computed 0.93.

2.2.2 Mathematics self-efficacy scale
Consistent with Banduras (1986) guidelines, the problems on which self-efficacy was assessed must be the same as those on which performance was measured. Thus accorded to pajares's, mathematics self-efficacy scale (MSES), the items of this questionnaire (15) was developed by cooperation of teachers group in same content area. Students indicated their confidence on an 11-point scale ranging from no confidence at all (0) to complete confidence (10). These items also selected from item repertoire that have difficult coefficients between 30 to 70 and item discriminating power up to 40 in pilot study. In addition- acknowledgment of content validity, the reliability of questionnaire was 0.92.
2.2.3 Mathematics ability Test

According to literature about componential of mathematics ability (Terston, 1974, Gary and Videman, 1992, and Grine et.al, 1984) this test was developed in two subscales: Conceptual ability and strategically ability. These 14 items developed in four choice responses and selected from different Tests: Graded Arithmetic’s mathematics test (Vernon and Miler, 1976), Numerical ability of differential aptitude tests (Bennet, Sashore, AND Wesman (1972) and questions sample of giftedness mathematics exam. Difficult coefficients of selected item were between 40 to 60 and discriminating power of to 40. Content validity of Test acknowledged by expert math teachers and statistics mathematics and psychometric professors of university. The reliability of these tests computed by 20 kuder Richardson methods and revealed confident of 0.81 . Subscales reliability coefficients was 0.83 for conceptual and 0.76 for strategically ability.

2.2.4 Self-regulation scale

Learning self-regulation: this was assessed using a scale designed by Boufard, et.al (1995). Which consists of 14 items. Responses were based on a 5-point Likert Type Scale ranging from strongly disagree to strongly agree.

2.2.5 Mathematics self-efficacy

16th item questionnaire including Arithmetic, vector, Liner Equation, Algebra, Geometry from the third grade Mathematic text book was apply accordance with Pajares (1995).

2.2.6 Mathematics attitudes scale

In this study we applied a copy mathematics attitude (Fenema, 2001)

3 Results

Data from lizrel 8.45 introduced covariance matrix as interance data. Table no.1.shows the matrix covariance between latent variables

Table 1 : Covariance matrix of latent endogenous and exogenous variables

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<td>Math. Performance</td>
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<td>Math. Self-efficacy</td>
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<tr>
<td>Self-regulation skills</td>
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<td>3</td>
<td></td>
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<tr>
<td>Math. Ability</td>
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<td>0/66</td>
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<td></td>
<td></td>
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<tr>
<td>Math. Attitude</td>
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<td>/78</td>
<td>0/33</td>
<td>0</td>
<td></td>
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<td>Sources of self-efficacy</td>
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<td>0/45</td>
<td>0/51</td>
<td>0</td>
<td></td>
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<td></td>
<td>0/08</td>
<td>/83</td>
<td>0/36</td>
<td>/35</td>
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<td>0</td>
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Based on the paths in the structural model (figure 4), the direct influence of independent variable (sources of self-efficacy) on subsequent variables except math performance is significant. The most influential effects of these variables are: math. Attitude \((\beta=0.97)\), self-regulation skills \((\beta=0.72)\), math. Ability \((\beta=0.36)\), and math. Self-efficacy \((\beta=0.22)\). The indirect effects are as follow: Math self-efficacy along with a direct and significant effect on math. Performance \((\beta=0.41)\), has a mediating effects in this model.
Figure 4.
4 Discussion

The main study focus was to determine the direct and indirect effects of self-efficacy beliefs and personal qualities (mathematics ability, mathematics attitudes, and self-regulation strategies) on mathematics performance and mathematics self-efficacy. Bandura (1997) advocates reciprocity among environmental, personal, and behavioral factors. The results of this study accordance with Hoffman and Spatariu (2008), emphasizes the triadic nature of motivational efficiency and it showed the influence of self-efficacy on problem solving. The educators should adapt methods to change both students' self-beliefs and implements Strategies to overcome problem solving limitations (Hoffman and Spatariu, 2008). The result of this study is also consistent with Pajares and Kranstel (1995) that showed the powerful contribution of self-efficacy in the prediction of mathematics performance. If we consider the causal models of the influence of mathematics self-efficacy on mathematics performance previously covered, and add the following model (Malpass et al 1999), it will be clearly obvious that the general massage of the models is the high ability of self-efficacy in predicting the changes of mathematics performance. However, one of the notable variables in regards to our research is self-regulation.

Malpass & et al (1999) in a structural model tried to determine the influence of gender, self-efficacy, goal orientation, self-regulation and worry on mathematics performance. Based on the following model students with higher self-efficacy use self-regulation strategies.

Malpass & et al (1999, p.77)

According to Zimmerman (1989), self-regulated learners are individuals who are meta-cognitively, motivationally and behaviorally active participants in their own learning process. In terms of meta-cognitive processes, learners who are self-regulated plan, set goals, organize, self-monitor and self-evaluate, at various points during the process of acquisition. In terms of motivational process, self-regulated learners report high self-efficacy, self-attributions and intrinsic task interest. With regard to the behavioral processes, these learners, select...
structure and create environments that optimize learning. From a social-cognitive point of view, self-regulation comprises three sub processes: self-observation, self-judgment and self-reaction (Bandura, 1986, Schunk et al. 1989, Zimmerman, 1989). The performance related to sub processes are not mutually exclusive, rather, they interact with one another in reciprocal fashion. Self-observation refers to the learner’s deliberate attention to his or her own performance, which usually involves systematic monitoring. (Schunk, Zimmerman 1994, Zimmerman, 1989). In the second process of self-regulation, or self-judgment, the learner compares present performance with his or her goal. A third process of the individual’s self-regulation involves self-reactions to one’s performance. Over all, the account of these sub processes highlights the role of goal setting and self-efficacy in individuals’ self-regulation. The result of the present study is also consistent with pajares and kranselt (1995) that showed the powerful contribution of self-efficacy in the prediction of mathematics performance. The educators should adapt methods to change both students’ self-beliefs and implements Strategies to overcome problem solving limitations (Hoffman and Spatariu, 2008).

5 References