

SOURCES OF SELF- EFFICACY IN MATHEMATICS: AN EXPLORATORY STUDY

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ABSTRACT

Individuals form their self-efficacy beliefs by interpreting information from four sources: mastery experience, vicarious experience, social persuasions and physiological or affective states (Bandura, 1986, 1997). Efficacy beliefs influence whether people think erratically or strategically, optimistically or pessimistically. Predictive power of academic self-efficacy is attested by ample researches (Locke, Frederick, Lee & Bobko, 1984; Schunk, 1984) but few efforts have been made to investigate sources underlying these beliefs (Pajares & Urdan, 2006). This study examined the heuristics students use as they form their mathematics self-efficacy from these and other sources. The study also made attempt to look into more about the factors relating to self-efficacy. Attempts were made to study the influence of the experiences students get in developing their self-efficacy beliefs. The questionnaire was administered to 100 students of 8th grade of both Sarvodaya Schools and Public Schools in Delhi. Results were analyzed quantitatively using t-test and correlation coefficient. Results suggested mastery experiences, to be the most powerful source in affecting self-efficacy beliefs whereas the physiological factors showed a negative correlation. The present study can be further extended to give implications for student's higher education and career choices in the future.

KEYWORDS: Self-Efficacy, Sources of Self-Efficacy, Mastery Experiences, Vicarious Experiences, Social Persuasions, Physiological State.

INTRODUCTION

Self-Efficacy

Unless people believe they can produce desired outcomes they have little incentive to act. Self-referent thought plays an important role in the psychological functioning of a human. People's conception of their personal efficacy is most influential in their everyday's life. Self-efficacy beliefs of a person have been identified as an important factor for performing tasks successfully (Bandura, 1986, 1997). According to Social Cognitive Theory - Self-Efficacy is "people's judgments of their capabilities to organize and execute courses of action required attaining designated types of performances" (Bandura, 1978, p.391). It is concerned not with the skills; one has, but with the judgements of what one can do with whatever skills one possesses. Bandura postulates that person's beliefs concerning his or her ability to successfully perform a given task or behavior are a major determinant of whether a person will attempt a given task, how much effort will be expended, and how much persistence will be displayed in pursuing the task in the face of obstacles. Efficacy involves a generative capability in which cognitive, social, and behavioural sub skills must be organized into integrated courses of action to serve innumerable purposes. Success is often attained only after generating and testing alternative forms of behavior and strategies, which requires perseverant effort. Self-doubters are quick to abort this

generative process if their initial efforts prove deficient. Different people with similar skills, or the same person on different occasions, may perform poorly, adequately, or extraordinarily. Collins (1982) did a study on children who perceived themselves to be of high or low mathematical self-efficacy, were given difficult problems to solve. It was found while mathematical ability contributed to performance, children who regarded themselves as efficacious were quicker to discard faulty strategies, solve more problems, reworked more of those they failed, and displayed a positive attitude towards mathematics. Another study showed perceived self-efficacy as a significant determinant of performance that operates partially independently of underlying skills (Locke, Frederick, Lee, & Bobko, 1984; Schunk, 1984). Bandura has drawn a distinction between the role of self-efficacy beliefs and that of outcome expectations. Self-efficacy is a judgement of one's capability to accomplish a certain level of performance whereas outcome expectation is a judgement of the likely consequence such behavior will produce. An outcome is consequence of an act, not the act. But outcome expectation is not a strong predictor of achievement as are self-efficacy beliefs. Thus self- efficacy predicts performance much better than expected outcomes in diverse activities like phobias, assertiveness, pain tolerance, etc. (Barling & Abel, 1983; Williams & Watson, 1985).

Mathematics is a subject wherein due to its abstract nature, language, mathematical discourse, societal persuasions, students generally tend to develop a phobia for it. Mathematics aims at developing problem-solving skills in a person. In becoming a successful problem solver one's own belief in mathematical competence plays an important role. In light of this, increasing mathematical self-efficacy will increase confidence to do more mathematics in everyday life. A person having negative attitude and expectations towards mathematics mostly have low performance at school or bad experiences in math classrooms, leading to an expectation of not being able to handle mathematics in general as well. A person with low mathematical self- efficacy will tend to avoid math task. Not only this, it will also lead to negative decisions about mathematics, e.g. he might not be interested in opting the course in future, will avoid doing everyday computations. It is thus far more important to increase mathematical self-efficacy than to only increase content knowledge. Person's own successful performance develops his positive self-efficacy beliefs. If a student accomplishes a task own his own with some feedback, he develops a positive attitude towards dealing with new situations.

Many researchers have been done to study the predictive power of self-efficacy beliefs and have even attested them, but there have been fewer efforts to investigate the sources underlying those (Pajares & Urdan, 2006). In the present study authors are concerned with sources of mathematics self-efficacy beliefs. Thus the present paper attempts to look at sources of self-efficacy and their relation to mathematics achievement.

Bandura (1997) hypothesized that self-efficacy beliefs are developed as individuals interpret information from four sources namely: Mastery Experiences, Vicarious Experiences, Social Persuasions, and Physiological State.

SOURCES OF SELF-EFFICACY

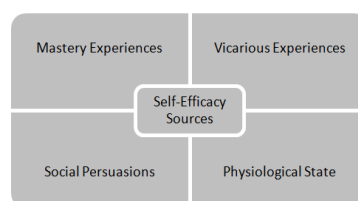


Figure 1: Sources of Self-Efficacy

- **Mastery Experiences** – Mastery experiences are the ones which they gain from their own previous attainments. Once the students complete an academic task, they interpret and evaluate the results obtained, and judgments of competence are created or revised on the basis of those interpretations. Bandura (1997) considered it to be the most powerful source as it is interpreted result of one's own previous attainments. These experiences prove powerful when individuals overcome obstacles or succeed on challenging tasks, especially those that are difficult for others (Bandura, 1997). Successful performances in a domain have lasting effects on one's self- efficacy. A student who accomplished a task in mathematics and was successful will be confident to perform similar and challenging task in future also.
- **Vicarious Experiences (Peers & Adults)** - Self-Efficacy beliefs are also influenced by vicarious experiences of others. Students can gauge their capabilities in relation to the performance of others. Students compare themselves to particular individuals such as classmates, peers and adults as they make judgments of their own capabilities. When a classmate succeeds in a challenging task he might convince others to do the task. Students may alter their beliefs following the success or failure of the model to an extent that they might feel similar to model in that task. Not only with others but self comparison is also vicarious experience wherein person compares own current and past experiences.
- **Social Persuasions** – Students receive encouragements from parents, teachers and adults whom students trust to boost their confidence in their academic capabilities. Supportive messages can serve to boost student's self confidence and effort, particularly when accompanied by conditions and instructions that help bring about success (Bandura, 1997).
- **Physiological State** – Students physiological state such as fatigue, stress also affect their self-efficacy beliefs. Students learn to interpret their physiological arousal as an indicator of personal competence by evaluating their own performances under differing conditions. Increasing student's physical and emotional well-being and reducing negative emotional states strengthens self-efficacy.

Self-efficacy expectations are task and domain specific (Pajares & Miller, 1995). This implies that self-efficacy expectations should be always fitted to related domain. Thus, mathematical self-efficacy is positively related to math performance (Pajares & Miller, 1995; Liu & Koirala, 2009). So higher is the rate of person on self-efficacy scale, better is the performance.

WHY THIS STUDY?

The above discussion has laid the emphasis on the importance of self-efficacy beliefs especially its relation and importance to Mathematics self-efficacy. This brings us to the discussion: why the present study was taken up? The researchers through review of the related literature came across many types of research which have established that self-efficacy is a strong predictor of behavior (Maddux, Norton & Stoltenberg, 1986). Still, there was a paucity of research in exploring the relationship between self-efficacy and academic performance in mathematics. There is a need to explore the relation between self-efficacy beliefs and performance in mathematics as it can influence the whole classroom scenario, the teacher's attitude towards students and their beliefs can change.

Also, there have been a fewer effort to investigate the sources underlying the self beliefs about performance in mathematics (Pajares & Urdan, 2006). The exploration of relation between each source of belief and performance in mathematics can help teachers, students and other stakeholders in the process to make mathematical learning meaningful.

The results of the relationship can help us plan specific strategies and take up certain measures in classroom or outside which can improve student's mathematics performance.

RESEARCH OBJECTIVES

Research objectives provide us with the direction to take any research forward after the initial inclination and work done by the researcher. The following research objectives were formulated:

- **To study mathematical self-efficacy of class 8 students.**
- **To explore the relationship between self-efficacy and achievement in mathematics.**
- **To study the relation between sources of self-efficacy and achievement in mathematics.**

SAMPLE

The population of the study was class 8 students of both Public and Sarvodaya Vidyalaya. Class 8 students were chosen as 8th standard forms a transitory phase for students in terms of studying mathematics before they move to secondary schooling. This highlights the importance of formation of mathematical self-efficacy beliefs at this level. 50 students were selected from each school – a Public school & Sarvodaya school in Delhi. Both schools and students were selected through random sampling. Thus, making a sample of total 100 class 8 students. During data collection due care was taken, that wording of the item statements does not hinder in the process of data collection for which meaning of the statements were explained to the students especially in Sarvodaya School.

TOOL USED FOR THE STUDY

Tool for data collection was adapted from Mathematics Achievement and Self- Efficacy tool by Usher & Pajares (2009). It was a 5-point Likert-type rating scale questionnaire. This tool had 30 items catering to four sources in which Vicarious experiences were further divided into two categories of peer and adult. Thus, on decomposing, making it 6 questions from each of 5 categories. All the items of the questionnaire were statements in the first person and each item was rated as Never(1), Seldom(2), Sometimes(3), Often(4) and Usually(5). All the statements were positive in nature. Some sample item statements from the tool are stated below, for more clarity:

- Mastery Experience – I got a high grade in last year's Math class.
- Vicarious (Peer) Experience – I had a close friend(s) whom I respected for Math achievement.
- Vicarious (Adult) Experience – My favorite teachers are usually Math teachers.
- Social Persuasions – My teacher often encouraged me by praising my math ability.
- Physiological – I often feel blue when I think of Math.

DATA ANALYSIS

The responses given to the questionnaire were analyzed quantitatively. For each respondent, a total score on self-efficacy beliefs was calculated. Scores for each respondent was calculated category wise – Mastery experience, Vicarious total score, Vicarious(Peer), Vicarious(Adult), Social persuasions score and Physiological state. The next step in data analysis is to find a pattern emerging from the given data. For that, data was analysed quantitatively by applying Pearson correlation & t-test of significance. Pearson coefficient was applied to establish the relation between 'Achievement Score

(AS)' and 'Self-Efficacy Score'. Similarly, the authors wanted to establish relation between AS and Self Efficacy - Vicarious Score (SEVS), Vicarious Peer Score (SEV Peer S), Vicarious Adult Score (SEV Adult S), Social Persuasions Score (SESS) and Self Efficacy Physiological State Score (SEPS) respectively. The t-test was applied to test the significance of the relationship between above mentioned factors and achievement score of the respondents.

Table 1: Results Obtained for Pearson Correlation Coefficient and T-Test

		SE Score	Master y Score	Vicarious Score	Vicarious (Peer) Score	Vicarious (Adult) Score	Social Score	Physiological Score
Achievement Score	Pearson Correlation	0.59	0.72	0.26	0.3	0.1	0.52	-0.12
	t-Test	2.77	8.04	5.07	5.97	1.16	3.73	4.17
	N	100	100	100	100	100	100	100

DISCUSSION OF RESULTS

The results of data analysis are discussed as follows:

- In conclusion, it indicates that the strength of association between AS and SES was high (0.59). This correlation coefficient was significant at $p < 0.1, 0.05$.
- The strength of association between AS and SEMS was high (0.72). This correlation coefficient was significant at $p < 0.1, 0.05$.
- The strength of association between AS and SEVS was low (0.26). This correlation coefficient was significant at $p < 0.1, 0.05$.
- Also, the strength of association between AS and SEV(Peer)S was moderate (0.3). This correlation coefficient was significant at $p < 0.1, 0.05$.
- It also indicates that the strength of association between AS and SEV(Adult)S was low (0.1). This correlation coefficient was not significant at $p < 0.1, 0.05$.
- Also, the strength of association between AS and SESS was high (0.52). This correlation coefficient was significant at $p < 0.1, 0.05$.
- The strength of association between AS and SEPS was low (-0.12) showing negative correlation. This correlation coefficient was highly significant at $p < 0.1, 0.05$

DISCUSSION OF FINDINGS

The following were the findings based on interpretation of the results to explain the established relationships:

- Mastery Self Efficacy has been shown to be the most consistent predictor of students' self-efficacy about mathematics achievement which is in support of the hypothesis as given by Bandura (1997) and is in support of

many findings (Usher & Pajares, 2009). This highlights the importance of mastery experience in the life of a student.

- Social persuasion was found as next most important factor too as it was also highly related to Mathematics achievement. This brings to our notice the effect of social persuasions in the student's beliefs about self. The attitude shown by the people closely related to student's life makes a difference in their beliefs.
- Vicarious peer experiences seem more important factor than vicarious adult experiences as students usually related to their peers more than the adults around. Students saw their peers performing or not performing which influenced their beliefs about whether they will be able to attain a given task or not.
- Physiological factor show low and negative correlation suggesting that physical conditions do not affect mathematical achievement score. For the given sample physiological state of the child does not have a considerable effect on the child. Many studies do not show a consistent relation between self-efficacy beliefs and other sources of these beliefs apart from mastery experience (Usher & Pajares, 2009). Thus this low and negative relation cannot be explained in detail.

IMPLICATIONS OF THE STUDY

The authors have drawn the following implications which can be important for teachers, students and classroom settings:

- Self-Efficacy theory may be a heuristic model for mathematics teachers attempting to organize activities that supplement traditional classroom instructions in mathematics and promote mathematical performance. This shift from traditional classroom settings will provide students with meaningful mastery experiences leading to positive effect on mathematics performance.
- Information about mathematics self concept may be useful to teachers concerned with monitoring students' self estimate of competence in mathematics. It can help teachers plan their pedagogy accordingly. The teachers can use the students' ability to estimate in their future planning of lessons.
- Exposure to mathematics with positive outcomes increases mathematics self-efficacy. Thus, students should be provided with many opportunities for positive outcomes. This can be done in schools, outside schools and at home etc. The experience of positive outcomes will enhance mastery experiences of the child, which in turn will improve mathematics achievement.
- The role of educator should be to do whatever is necessary to aid students in increasing their perception of actual ability.
- Encouragement and motivational statements help in increasing Self-Efficacy. So teacher should provide positive environment in Mathematics classroom. Mathematics classroom should be without fear and free, encouraging space to learn mathematics should be there.

- The self-efficacy beliefs also relate to the future choice of the students whether to pursue mathematics for higher learning or making mathematics as a career choice. Positive beliefs will lead to positive inclination towards mathematics not only in current situation but in future too.

EXTENSION OF THE GIVEN STUDY

No study is absolute in itself. Authors feel that the current study has a scope of further extension. It could be substantiated with interviews from teachers; narratives of students can also be studied. This will help in probing the reasons in the formation of self-efficacy beliefs. Not only this, physiological factors can be explored more deeply as low and negative correlation was seen among physiological factors and achievement. The reason for achieving this relationship could be probed further.

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