

A STUDY ON THE RELATIONSHIP BETWEEN SELF-EFFICACY BELIEFS IN MATHEMATICS AND ATTITUDE TOWARDS MATHEMATICS IN THE DISTRICT OF BANKURA

Dr. Arup Kundu

Assistant Professor in Mathematics (WBES), Government Training College, Hooghly,
West Bengal, India

ABSTRACT

This study investigated the relationship between attitude scores and self-efficacy scores in mathematics. Thus co-relational research has been done for the purpose of the study and convenience sampling method has been used. The investigation was conducted with 354 madhyamik passed students studying at Bankura district. Results show that significant differences have been found between Science and Social science streams with regard to Attitude towards mathematics and self-efficacy in mathematics. In investigating the relationship between mathematics attitude and self-efficacy beliefs in mathematics “Mathematics Attitude scale” and “Mathematics Self-efficacy Questionnaire” were used. The consequence of the study stated that madhyamik passed students’ attitude scores and self-efficacy scores towards mathematics are high. In addition, there is a strong positive relationship between mathematics attitude scores and self-efficacy beliefs scores in mathematics madhyamik passed students.

Keywords: Mathematics, co-relational, streams, attitude, self-efficacy, madhyamik passed, science, social science.

INTRODUCTION

Mathematics is one of the powerful instrument for conceptualization and application of science and technology. Mathematics stimulates creative thinking, logical reasoning, abstract or spatial thinking, problem solving skill, and effective communication skills also. It is an instrument that can be used in our day to day lives to overcome the obstacles or problem faced therein (Bishop, 1996). Geometry is one of the most vital branches of mathematics (Isil & Ubuz, 2004) and it is related with the properties and relationships of point, line, angles, curves and shapes, etc. Geometry boosts us to describe and judge the world rationally and systematically (Canturk-Guhan & Baser, 2007). In addition, NCTM (2000) strengthens the importance of geometry in schools

mathematics by stating “Geometry is a natural place for the development of students’ reasoning and justification skills” (p.40). In this motive mathematics has been considered as one of the most indispensable subjects in the school curriculum. More mathematics contents are likely to be taught in school and college throughout the world than any other subject (A. Orton, D. Orton and Frobisher, 2004).

LITERATURE REVIEW

Attitude

Attitude : A Brief Concept Note

Attitudes play an important role on students’ mathematics achievement. Phillips (2003) defined attitude as a “multi-faceted psychological construct based on the individuals’ feelings, beliefs and values”. Allport (1935) defined attitude as a “mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual’s response to all objects and situations with which it is related” (p. 810). This definition implies that an attitude is a response to certain experience and is formed through life’s experiences. Allport’s definition indicates the roles that experiences play an important role in implementing attitude. Thus, one’s repertoire of experiences can be regarded as the basic building blocks of his/her attitude.

Eagly and Chaiken (1993) define attitude as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (p.155). This definition appears to focus on the exposition of attitude.

The above definition implies that attitude represents one’s feeling and reactions to situations. The above definitions indicate that attitude illustrates one’s intuition and responses to situations. Some studies deal with learners’ attitudes towards mathematics. Choudhuary & Das (2012), Mahanta (2014) they show that attitude towards mathematics is affected by various factors like gender role stereotyping, belief & perceptions about mathematics and affect study habits of students.

Relationship between Attitude and Achievement

Plenty of research has been carried out on the relationship between attitude and achievement. Several researches in western countries show a link between positive attitude and achievement (Iben, 1991; Ma & Kishor, 1997; Tocci & Engelhard Jr, 1991). On the other hand, research carried out in Asia on Asian students showed that positive attitudes were not always present among students with high achievement scores (Leung, 2002; Stevenson, Chen & Lee, 1993). While student’s achievement does not always correlated with a positive attitude. Wilson (2008) recommends that maintaining positive attitudes can have long lasting beneficial effects. In a research by Reed, Drijvers & Kirschner (2010), it was concluded that positive attitudes towards

mathematics uplifted learning styles. The study also revealed that the attitude of students played a vital role in learning mathematics with computer based learning tools.

Attitude towards Mathematics

Attitude may therefore be simply considered as a positive or negative degree of intuition associated with particular experiences. Probably, it is manifest in a student's sentiment on certain subjects of study. Thus attitude towards mathematics may be observed as just a positive or negative emotional prognosis towards mathematics (Haladyna, Shaughnessy & Shaughnessy, 1983, McLeod, 1992).

Attitude may not be germinated in overt behaviour. In other words, behaviour notifying particular attitudes may not outwardly apparent. Thus, attitude towards mathematics may be a conglomeration of patterns of conceptions (Daskalogianni & Simpson, 2000).

The prior discussion points to the reality that attitude is multidimensional, having three components within it: emotional response, beliefs pertaining the subject, and behaviour associated to the subject. From this point of view, an individual's attitude towards mathematics is delineated by the emotions that he/she relates with mathematics, his/her beliefs towards mathematics, and by how he/she behaves (Hart, 1980). Thus attitudes can be positive or negative. Attitudes play a definite role on students' mathematics achievement. These may be expressed in liking, enjoying and showing interest in mathematics, or the opposite reactions. At worst, mathematics phobia (Ernest, 1989) may ensue. As attitude is attached with academic achievement, it is always regarded as a significant variable in educational research (Nkwe, 1985). Ma and Kishor (1997) expressed that there is a general conviction that children perceive more successfully when they are inquisitive about what they learn and that implies them to acquire better in mathematics. There are some research works that examine the role of attitude in Mathematics learning and achievement. Fogarty, et al., (2001) made a tool to measure attitudinal factors that play a role of technology in mathematics learning. Di Martino & Zan, (2010) stated that attitude is a multi-dimensional view and it is never too late to change the student's attitude towards mathematics. Learner attitude therefore plays a pivotal role in mathematics learning and achievement (McLeod, 1992). Researchers have also found a potent relationship between positive attitude and beliefs about mathematics and academic success in mathematics (Ashcraft & Kirk, 2001; Sandt, 2007; Schenkel, 2009; Sherman & Christian, 1999; Tapiia & Marsh II, 2004).

A learner's attitude towards mathematics can have a positive or negative influence on their education. This means that a learner's attitude could be the crucial factor behind his/her success or failure in the subject. Learners may develop either positive or negative attitudes towards mathematics from their educational perceptions. Positive attitude create optimism that is, imposing favourable exposition to activities and events (Gillham, Shatte, Reivich, & Seligman, 2000). For

learners, optimism can lead to persistence. Optimistic children are more likely to stay connected in learning tasks often resulting in enhanced achievement (Wigfield, 1994). In contrast, negative attitudes can enhance mathematics-anxiety (Trujillo & Hadfield, 1999) and may contribute to poor achievement in mathematics.

Self-efficacy

Self-efficacy: A Brief Concept Note

Self-efficacy is defined as an individual's beliefs about his/her capacity, to carry out a task or perform certain behaviours successfully. Bandura, Barbaranelli, Caprara, & Pastorelli (1996) contend self-efficacy can influence a person's life in diverse way (p.1206).

Self-efficacy and Academic Achievement

Researches indicate that self-efficacy influences achievement. Self-efficacy has been shown to be an exact predictor of success in academic achievement (Fast et al., 2010; Multan, et al., 1991). Pajarres (2006) in fact showed that twenty-five percent of student's academic success is based on Self Efficacy. Therefore, to assure students' developed academic achievement, their self-efficacy needs to be boosted. Bandura et al., (1996) state that parents with positive self-efficacy always transmit this to their children. According to Zimmerman (2000), students with high self-efficacy are eager to learn and are preserving and show more resilience to encounter problems (p. 86). The immediate family may also influence a child's self-efficacy. Bandura (1997) explained that self-efficacy is the primary construct in social learning theory and described it as the behavior of an individual that implies his/her to be successful in specific ventures. The four sources of self-efficacy are experience, like being successful or unsuccessful; emotional and physical conditions, like fear, excitement, observing others; experiencing, and witnessing success; and verbal conviction of family, friends and colleagues (Bandura, 1997). Self-efficacy beliefs are maintained from these sources and affect the achievement, enthusiasm of power and the individual's struggles to succeed (Kucukyilmaz and Dubun, 2006). Self-efficacy beliefs also affect individual learners' thinking practices and affective responses. Individuals with high self-efficacy levels feel less anxiety and can be more productive. Students showing certainty in their social skills expect success. Students who are unhesitating about their academic skills expect high standards in examinations and conjecture that the high value of their work will ensure personal and professional favour. Individual with low self-efficacy levels doubt their social skills and often anticipate rejection or ridicule even before establishing social contacts (Unlu, et al, 2010). Those who lack academic self-confidence, conjecture low marks even before sitting for an examinations or registering in a course. In some individuals with high self-efficacy levels tend to achieve academic success, and subsequently greater career options. On the other hand, individuals with low self-efficacy levels suffer social isolation and even compressed academic possibilities (Pajarres, 2002).

Influence of Self efficacy on Mathematical Achievement

Self-efficacy has been shown to influence learners' mathematical achievement (Bandura et al., 1996; Fast et al., 2010; Pajarres, 2005). An individual's mathematical self-efficacy beliefs has been defined as a situational, problem specific assessment of an individual's dependence in her or his expertness to successfully execute or attain a mathematical task (Betz & Hackett, 1994). Self-efficacy beliefs in mathematics have been shown to be a predictor of nature in choosing a vocation (Hackett (1985). Betz and Hackett (1994) investigated that mathematics competence can be a critical filter in vocation choices for both men and women. Hodge (1999) observed that mathematics examination scores is positively correlated with scores in self-efficacy in mathematics. Betz and Hackett (1994) viewed a moderate correlation between mathematics achievement and self-efficacy in mathematics. Handel (1980) investigated that mathematics self-efficacy, mathematics anxiety and mathematics achievement were highly correlated. In another study Hodge (1999) reported that the effect of mathematics anxiety, mathematics self-efficacy and achievement on a mathematics examination, it was found that small but significant relationships exist among these variables. Moreover, Fast et al., (2010) observed that learners with low Self efficacy give up easily when confronted with difficult mathematical problem. Research on self-efficacy beliefs of students has also been undertaken by e.g. Canturk-Gunhan, Baser, 2007; Saracaloglu, 2009; Usher, 2009; Yenilmez and Uygan, 2010. They show that high self-efficacy can enhance geometry learning and this can even be performed by interventions like creative activities.

Mathematics is indispensable for all academic discipline

Mathematics is one of the indispensable aid by means of which the other sciences, pure and applied are capable to forge ahead (Peter, 2011). Mathematics is a tool for universal understanding and communication. Mathematical tools and techniques are always manifested to changing needs of Science, Technology and social science. Among the sciences physics, engineering, chemistry most served by mathematics. Mathematical operations, measurement of distance, areas, volumes, masses and more advance mathematics is needed in the treatment of Collision problems, vibrating strings, motion of fluids, mechanics of continuous media, optics, electricity and thermodynamics etc. In biological science mathematical statistics is extensively used in simple biology, agricultural science and the medical sciences to execute statistical problems. The development of micro-organisms is an exponential function which can be illustrated using the method of calculus. In social science mathematics plays a vital role in understanding most of the concepts and theories as it applies in to day to day occurrences. In geography mathematics is used in the measurement of distances, areas, map projections also more advance astronomical ideas in heavenly bodies are mathematically deduced (Peter, 2011). The dependence of accounting, economics, business administration, data interpretation, quantitative compression and logical reasoning is such that for anyone to demand expertness in any of these areas, he must occupy a prime knowledge of

mathematics beyond the madhyamik level. In law, even though mathematics is not read in immediate forms as in other disciplines, the principles of mathematical reasoning forms the primitive for its understanding. The lawyer also depends on his mathematical skills. Mathematical skills also can be applied for practical judgment and important issues relating to a decision in a hypothetical business situation (Peter, 2011).

RATIONALE OF THE STUDY

It may be assumed that one of the main obstructions to achievement in mathematics is the attitude of students to the subject.

Students in the HS classes have been through the gamut of Madhyamik School education, and should be aware of mathematics as a discipline. They have developed certain attitudes towards the mathematics that are possibly colored by their achievements in it and these attitudes have probably influenced their achievement in mathematics.

Mathematics self-efficacy plays a large role in mathematics anxiety (Rozgonjuk, et al, 2020). In their research, they said that perhaps improving students' mathematics self-efficacy could also be helpful in reducing mathematics anxiety. They also stated it could also be that reducing students' mathematics anxiety could be helpful in boosting their mathematics self-efficacy (Rozgonjuk, et al., 2020). Lee (2009) investigated across 41 countries and found that the low performing countries displayed low mathematics self-efficacy and high mathematics anxiety; the high performing countries displayed high mathematics self-efficacy and low mathematics anxiety. Lee (2009) also viewed that the top performing nations displayed one of the lowest scores on mathematics self-efficacy and the highest scores in mathematics anxiety in Japan and Korea.

This study has attempted to find out the relationship between attitude towards mathematics and self-efficacy in mathematics of students. Further the study has aimed to discern any difference in attitude and self-efficacy between students in the different streams of study.

OBJECTIVES OF THE STUDY

- i. To find out the difference in attitude towards mathematics of science and social science class XI students.
- ii. To find out the difference between self-efficacy in mathematics of science and social science class XI students.
- iii. To find out the relationship between Attitude towards mathematics and self-efficacy in mathematics of class XI students.

METHODOLOGY

The purpose of the study is to determine the relationship between madhyamik passed students' mathematics attitudes scores and mathematics self-efficacy scores. Thus, a co relational research design was employed in the process of the study. The study also measures any mean difference in

mathematics attitude and mathematics self-efficacy between students in the different streams of study.

SAMPLE

The random sample consisted of 354 class XI (just pass out Madhyamik Examination) students drawn up from 12 schools of Bankura district in West Bengal, India. Formal approval from all the school Head Teachers were obtained in order to conduct this research. The sample is as follows:

Table 1A : Method of drawing Sample

<i>Sample State</i>	<i>Sample Districts/Cluster</i>	<i>Sample Sub-divisions/Clusters</i>	<i>Name of Blocks/Clusters</i>	<i>No. of Sample Schools</i>	<i>Number of students</i>
<i>West Bengal</i>	<i>1 Bankura</i>	<i>1 Bankura</i>	<i>1 Bankura</i>	<i>3</i>	<i>95</i>
			<i>2 Bankura II</i>	<i>3</i>	<i>93</i>
		<i>2 Bishnupur</i>	<i>1 Bishnupur</i>	<i>3</i>	<i>85</i>
			<i>2 Kotulpur</i>	<i>3</i>	<i>81</i>

Table 1B : Streams wise and Gender wise distribution of Students participated

Gender	Streams		Total
	Science	Social Science	
Boys	95	45	140 (39.55%)
Girls	122	92	214 (60.45%)
Total	217 (61.30%)	137(38.70%)	354(100%)

Source : School data obtained during field visit in 2014.

DELIMITATION OF THE STUDY

Sample was collected from school affiliated to West Bengal Council of Higher Secondary Education, in only Bankura district of West Bengal.

TOOLS

The following instruments are used in the study –

- Personal data sheet cum interview schedule it consisted of particular information about the participants that is Name, age, gender, stream of study, name of school, medium of instruction, marks obtained in madhyakmik examination, father's education level and mother's education level etc. The personal data sheet cum interview schedule was administrated on an individual basis in quiet and peaceful environments. The respondent was first put at light conservation and the interview schedule was gradually and orally administered.

- ii) 'Mathematics Attitude Scale' consisting of 47 likert type items, The Test-retest reliability coefficient of the scale is 0.94 (Kundu, 2018).
- iii) 'Mathematics Self-efficacy Questionnaire' consisting of 14 likert type items, The test retest reliability coefficient of the scale is 0.97 (Kundu, 2018).

DATA ANALYSIS

The researcher personally visited the schools for the collection of data. Quantitative techniques were used in the analysis of data generated by mathematics attitude scale and mathematics self-efficacy scale. The descriptive statistics and Pearson Product Moment correlation coefficient was calculated between mathematics attitude scores and mathematics self-efficacy scores. Independent samples t- tests were used to compare the responses to the mathematics attitude and mathematics self-efficacy between two streams Science and Social science if the mean responses were different. Data were analyzed by using the SPSS 23 statistics programme and presented in tables.

FINDINGS

Descriptive and inferential statistics results regarding Madhyamik passed students attitude towards mathematics are present in Table 2.

- i) To find out the difference between attitude towards mathematics of science and social science class XI students.

The null hypothesis in this purpose—

H_{0A} : There is no significant difference between attitude towards mathematics of science and social science class XI students.

Table 2 : Mean difference between attitude towards mathematics of Class XI science and social science students

Variable	Mean (N = 354)		Std. Deviation (N = 354)		t- Value	Df	Level of Significant
	Science N=217	Social Science N=137	Science N=217	Social Science N=137			
Attitude towards mathematics	194.27	161.62	17.389	23.370	15.001	352	.000 (Significant)

Table 2 represents the mean difference between class XI students with regard to attitude towards mathematics. The mean scores of science students and that of social science students with

regard to attitude towards mathematics were 194.27 and 161.62 respectively. The standard deviation of scores of science students and that of social science students with regard to attitude towards mathematics were 17.389 and 23.370 respectively. The calculated t-values between science and social science students with regard to attitude towards mathematics were 15.001, which is significant at 0.01 levels. Thus, H_{0A} is to be rejected, and there is a significant difference in attitude towards mathematics between science and social science students. Table-2 shows that science students show higher mathematics attitude than social science students. Hence it can be concluded that, there exists a significant streams wise difference in attitude towards mathematics in favour of Science students.

Descriptive and inferential statistics results regarding Madhyamik pass out students' Self efficacy in mathematics are present in Table 3.

- i) To find out the difference between self-efficacy in mathematics of science and social science class XI students.

The null hypothesis in this purpose—

H_{0S} : There is no significant difference between self-efficacy in mathematics of science and social science class XI students.

Table 3 : Mean difference between self-efficacy in mathematics of Class XI science and social science students.

Variable	Mean (N = 354)		Std. Deviation (N = 354)		t-Value	Df	Level of Significant
	Science	Social Science	Science	Social Science			
	N = 217	N = 137	N = 217	N = 137			
Self-efficacy in mathematics	58.424	44.618	8.314	11.196	13.252	352	.000 (Significant)

Table 3 represents the mean difference between class XI students with regard to self-efficacy in mathematics. The mean scores of science students and that of social science students with regard to self-efficacy in mathematics were 58.424 and 44.618 respectively. The standard deviation of scores of science students and that of social science students with regard to self-efficacy in mathematics were 8.314 and 11.196 respectively. The calculated t-values between science and social science students with regard to self-efficacy in mathematics were 13.252, which is significant at 0.01 levels. Thus H_{0S} is to be rejected, and there is a significant difference in self-efficacy in mathematics between science and social science students. Table-3 shows that science

students show higher mathematics attitude than social science students. Hence it can be concluded that, there exists a significant streams wise difference in self-efficacy in mathematics in favor of Science students.

The following table shows the descriptive statistics for the two variables attitude towards mathematics and self-efficacy in mathematics

The results are presented in the table-4 as follows-

Table 4 : Descriptive statistics results of attitude towards mathematics and self-efficacy in mathematics

Variables	N	Minimum	Maximum	Mean	Std. Division
Attitude towards mathematics	354	110	228	181.70	25.426
Self-efficacy in mathematics	354	16	69	53.119	11.638

Both variables, attitude towards mathematics and self-efficacy in mathematics were found to be continuous.

- i) To find out the relationship between Attitude towards mathematics and self-efficacy in mathematics of class XI students.

The null hypothesis for this purpose is-

H_{0AS} : There is no significant relationship between attitude towards mathematics and self-efficacy in mathematics of class XI students.

The Pearson product moment correlation technique was used to test the hypothesis.

Initially, a scatter plot between attitude towards mathematics and self-efficacy in mathematics was constructed.

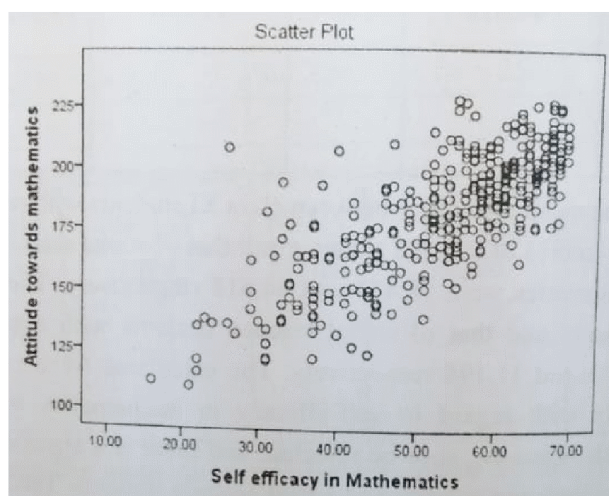


Figure 1 : The relationship between students' attitude towards mathematics and Self efficacy in mathematics.

Preliminary analyses were observed to ascertain no violation of the assumptions of normality, linearity and homoscedasticity. This figure 1 indicates a viable liner correlation between the two variables.

In order to examine the relationship between students' attitude towards mathematics scores and self-efficacy in mathematics scores Pearson product-moment correlation coefficient was calculated. The results are presented in table 3.

Table 3 : Pearson product-moment correlations between Attitude towards mathematics and Self efficacy in mathematics scores.

		Attitude	Self-efficacy
Attitude	Pearson Correlation	1	.782**
	Sig. (2-tailed)		.000
	N	354	354
Self-efficacy	Pearson Correlation	.782**	1
	Sig. (2-tailed)	.000	
	N	354	354

** Correlation is significant at the 0.01 level (2-tailed).

The relationship between attitude towards mathematics scores and self-efficacy in mathematics scores was investigated by using Pearson product-moment correlation coefficient. Table 3 shows that the strong positive correlation $r = 0.782$, $p < 0.01$ between attitude towards mathematics and self-efficacy in mathematics and highly significant. This shows that proper attitude towards mathematics can built self-efficacy in carrying out mathematical activities and solving problems, and thus enhancing mathematical competency.

CONCLUSION

The results of this study show that there is a significant difference between the attitude towards mathematics and self-efficacy of students attending science and social science streams. Kundu (2018), Avci et al., (2014) and Avci et al., (2011) have found similar results with this research. This may be due to the fact that students in social science generally do not have a strong mathematics background. Therefore, they do not understand the lesson easily.

This study, among class XI students of Bankura district, shows that self-efficacy in mathematics is strongly influenced by attitude towards the mathematics. A highly significant relationship between the students' attitude towards mathematics and self-efficacy in mathematics

was found in this study. The studies in the literature have shown a significant relationship between attitude and self-efficacy (Jameson 2013; Karadeniz 2014; Bariley 2012; Kundu & Ghose 2016). That is, the mathematics attitude and self-efficacy are not independent from each other. Learners whose attitudes are more positive towards mathematics have higher self-efficacy beliefs towards the subject. The research shows that positive attitude towards mathematics being higher self-efficacy appreciation, whereas negative attitude brings lower self-efficacy appreciation. Yavuz Mumcu & Cansiz Aktas (2015) have found similar to this research. Learners' mathematics self-efficacy could be developed by reducing their mathematics anxiety (Peters, 2013), which could be favorable to them in progressing their attitude and interest (Louis and Mistele, 2012). In order to get the learners to become more positive towards mathematics, a congenial learning ambience where they can nurture the sense of self efficacy should be provided.

Good achiever in mathematics is an important determinant for self-efficacy and attitude towards the mathematics (Yavuz Mumcu & Cansiz Aktas, 2015). Similarly, social science students are observed to have lower level of affective features compared to science students. Consequently, this study has managed the change of affective characteristics, a noticeable dimension in mathematics teaching learning, in students studying at different streams of studies, it has supported the hypothesis. This research has given answers to the question of why social science stream students lag behind in mathematics than science stream students.

REFERENCES

- Allport, G. (1935). Attitudes. In *The Hand book of Social Psychology*, 2, 798-844. Worcester, MA: Clark University Press.
- Altuna, F., Yazici, H. (2010). Learning Style of the Gifted Students in Turkey. *Procedia Social and Behavioral Sciences*, 9, 198-202.
- Ashcraft, M. H., & Kirk, E. P. (2001). The relationship among working memory, math anxiety, and performance. *Journal of Experimental Psychology. General*, 130, 224-237.
- Avci, E., Coskuntuncel, O., & Ynandi, Y. (2011). Ortaogretim on ikinci sinif ogrencilerinin matematik dersine karsi tutumlari [Middle Secondary School Student's attitudes towards mathematic], *Mersin Universitesi Egitim Fakultesi Dergisi*, 7(1), 50-58.
- Avci, E., Ozenir, O. S., Coskuntuncel, O., Ozcihan, H. G., & Su, G. (2014). Ortaogretim ogrencilerinin geometri dersine yonelik tutumlari, *Turkish Journal of Computer and Mathematics Education*, 5(3), 304-317.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bandura, A., Barbaranelli, C., Caprara, G. V, & Pastorelli, C. (1996). Multifaced impact of self-efficacy beliefs on academic functioning. *Chield Development*, 67, 1206-1222.

- Basturk, R. (2009). Egitim bilimlerinde youtem. In N. Saylan (Eds.), Egitim bilimine giris (3rd ed., pp. 170-184). Ankara: Ani Publishing.
- Baykul, Y. (1999). Istatistik metotlar ve uygulamalar. Ankara: Ani Publishing.
- Betz, N. E., & Hackett, G. (1994). Mannual for the mathematics self-efficacy scale Form A and B. *Mind Garden Press*.
- Bishop, A. J. (1996). International hand book of mathematics education. *Springer*.
- Canturk-Gunhan, B. & Baser, N. (2007). Geometriye yönelik oz-yetrlik olceginin gelistirilmesi. *Hacettepe University Journal of Education*, 33, 68-76.
- Choudhuary, R., Das, D. K. (2012). Influence of Attitude towards Mathematics and Study Habit on the Achievement in Mathematics at the Secondary Stage. *International Journal of Engineering Research and Applications*, 2(6), 192-196.
- Daskalogianni, K., & Simpson, A. (2000). Towards a defination of attitude: the relationship between the affective and the cognitive in pre-university students. In *Procedia of PME*, 2, 217-224. Hiroshima, Japan.
- Di Martino, P., & Zan, R. (2010). “Me and maths”: Towards a defination of attitude grounded on students’ narratives. *Journal of Mathematics Teacher Education*, 13, 27-48.
- Doepaken, D., Lawsky, E., Padwa, L. (1993). Modified Fennema Sherman Mathematics attitude scales. Retrive from <http://woodrow.org/teachers/math/gender/oscale.html>.
- Eagly, A H., & Chaiken, S. (1993). The psychology of attitudes (p. 794). *Harcourt Brace Jovanovich College Publishers*, Retrive from [http:// books.google.co.in/books/about/Thepsychologyofattitudes.html?id=oPYMAQAAMAAJ&pgis=1](http://books.google.co.in/books/about/Thepsychologyofattitudes.html?id=oPYMAQAAMAAJ&pgis=1).
- Ernest, P. (1989). The knowledge, belief and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching*, 15(1), 13-33.
- Fast, L. A., Lewis, J. L., Bryant, M.J., Bacian, K. A., Cardullo, R. A., Rettig, M., & Hammond, K. A. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance, *Journal of Educational Psychology*. doi: 10.1037/a0018863.
- Fogarty, G., Cretchley, P., Harman, C., Ellerton, N., & Konki, N. (2001). Validation of a questionnaire to measure mathematics confidence, computerconfidence, and attitudes towards the use of technology for learning mathematics. *Mathematics Education Research Journal*. doi. 10.1007/BF03217104.
- Fraenkel, J. R. & Wallen, N.E. (2005). How to design and evaluate research in education (3rd ed.). New York: McGraw-Hill.
- Gillham, J. E., Shatte, A. J., Reivich, K. J., & Seligman, M. E. P. (2000). Optimism, Pessimism, and Explanatory Style. In *Optimism & Pessimism: Implication for Theory, Research, and Practice* (pp. 53-75). doi: 10.1037/10385-003.

- Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling Psychology*. doi:10.1037/0022-0167.32.1.47
- Haladyna, T., Shaughnessy, J., & Shaughnessy, J. M. (1983). A casual Analysis of Attitude towards Mathematics. *Journal for Research in Mathematics Education*, 14, 19-29.
- Hart, L. (1989). Describing the Affective Domain: Saying what we mean. In D.B. McLeod & V. M. Adams (Eds.), *Affecting and Mathematical Problem Solving*. New York, NY: Springer New York. doi: 10.1007/978-1-4612-3614-6
- Handel, D. D. (1980). Experimental and Affective Correlates of Math Anxiety in Adoult Women. *Psychology of Women Quarterly*. doi:10.1111/j.1471-6402.1980.tb00958.x
- Hodge, M. B. (1999). Do Anxiety, Math self-Efficacy, and Gender Affect Nursing Students' Drug Dosage Calculations? *Nurse Educator*, 24(4), 36-41. doi:10.1097/00006223-199907000-00010
- Iben, M. F. (1991). Attitude and Mathematics. *Comprative Education*, 27(2), 135-151.
- Isil Ü., & Ubuz B., (2004). Geometrik kavramların geometer's sketchpad yazih programi ile gelistirilmest. Retrieved September 12, 2010 from <http://www.erg.sabanciuniv.edu/iok2004/bildiriler/Isil%20Ustun.doc>.
- Jameson, J. J. (2013). Contextual factors related to math anxiety in second-grade children. *The Journal of Experimental Education*, 82(4), 519-536.
- Karasar, N. (2005). Bilimsel arastirma yontemi. Ankara: *Nobel Publishing*.
- Karadeniz, Ý. (2014). Kirsal kesimdeki ortaokul ogrencilerinin matematige iliskin kaygilari ile matematik tutumlari arasindaki iliski [The relationship between rural secondary school students' respecting of math anxiety and their attitude towards math]. Unpublished master's thesis, Eskisehir Osmangazi Universitesi, Eskisehir.
- Kuchkyilmaz, A. & Duban, N. (2006). Smif ogretmeni adaylarinm fen ogretimi oz-yeterlik inanclarinm artiri labilmesi icin alacak onlemlere iliskin gorusleri Yuzuncu Yil University. *Journal of Education*, 3(2), 1-23.
- Kundu, A, & Ghose, A., (2018). Van Hiele levels of geometry conceptualization among classXI students and its relation to their attitude towards and self efficacy in mathematics. *Shodhganga:a reservoir of indian theses@Inflibnet Depertment of Education, University of Calcutta*, <http://hdl.handle.net/10603/317455>
- Leung, F. K. S. (2002). Behind the high achievement of East Asian students. *Educational Research and Evalution*, 8, 87-108.
- Louis, R.A., & Mistele, J. M. (2012). The differences in scores and self-efficacy by student gender in mathematics and science. *International Journal of Science andMathematics Education*, 10(5), 1163–1190.

- Ma, X., & Kishor, N. (1997). Assessing the relationship between attitude towards mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education*, 28(1), 26-47.
- Mahanta, D. (2014). Impact of Attitude and Self-Concept of the Students towards Mathematics upon their achievement in Mathematics. *International Journal of Theoretical & Applied Science*, 6(1), 20-35.
- May, D. (2009). Mathematics Self-efficacy and Anxiety Questionnaire. Athens: *University of Georgia*. Retrived from http://libs.uga.edu/pdfs/maydiana_k200908phd.pdf
- McLeod, D. (1992). Research on affect in mathematics education: A reconceptualization. In *Handbook of research on mathematics teaching and learning* (pp. 575-596). doi: New York
- Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology*. doi.: 10.1037/0022-0167.38.1.30
- NCTM (2000). *Principles and standards for school mathematics*. Reston, VA: NCTM Publications.
- Nkwe, D. T. (1985). Teachers attitude, with special reference to mathematics teaching. Unpublished master's thesis, University of Witwatersrand, Johannesburg, South Africa.
- Orton, A., Orton, D., & Frobisher, L. J. (2004). Insight into teaching mathematics. *Continuum International Publishing Group*.
- Pajares, F., Miller, M. D. (1994). The role of self efficacy and self concept beliefs in Mathematics Problem-solving. A path analysis. *Journal of Educational Psychology*, 86, 193-203.
- Pajares, F. (2006). Self-efficacy beliefs during adolescence: Implications for teachers and parents. In F. Pajares & T. Urdan (Eds.) *Adolescence and education. 5: Self-Efficacy Beliefs of Adolescents*, 339-367. Information Age: Greenwich, CT.
- Pajares, F. (2002). Overview of social cognitive theory and self-efficacy. Retrived September 12, 2010 from [http:// www.emory.edu/mfp/eff.html](http://www.emory.edu/mfp/eff.html)
- Peter, E. E., (2011). Mathematics: Indispensable tool for successful and balance human existence on this planet, *Advance in Applied Science Research*, 2011, 2(5), 449-456.
- Peters, M. L. (2013). Examining the relationships among classroom climate, self-efficacy, and achievement in undergraduate mathematics: A multi-level analysis. *International Journal of Science and Mathematics Education*, 11(2), 459– 480.
- Phillips, S. (2003). Contributiong factors to music attitude in sixth-, seventh-, and eighth-grade students, PhD dissertation, University of Iowa, Iowa City. Retrived October 15, 2010, from ProQuest Dissertations & Theses database. (Publication No. AAT 3097568).

- Thompson, K. M. (1993). Geometry students' attitude towards mathematics: an emirical investigation of two specific curricular approches. Unpublished master's thesis California state University Dominguez Hills, USA.
- Reed, H. C., Drijvers, P., & Kirschner, P. A. (2010). Effect of attitude and behavoiurs on learning mathematics with computer tools. *Computer and Education*, 55, 1-15.
- Rozgonjuk, D., Kraav, T., Mikkor, K., Puurand, K. O., & That, K. (2020). Mathematics anxiety among STEM and social sciences students: the roles of mathematics self efficacy, and deep and surface approach to learning, *International Journal of STEM Education*, 7(46), 1-11.
- Sandt, S. Van Der. (2007). Research Framework on Mathematics Teacher Behaviour: Koehler and Grouwns' Framework. *Eurasia Journal of Mathematics, Science andTechnology Education*, 3, 343-350.
- Saracaloglu, A. S. & Yenice, N. (2009). Investigating the self-efficacy beliefs of science and elementry teachers with respect to some variables. *Journal of Theory and Practice in Education*, 5(2), 244-260.
- Schenkel, B. D. (2009). The Impact of An Attitude towards Mathematics on Mathematics Performance. Retrived from https://etd.ohiolink.edu/ap/10?0::No.:10:P10_ETD_SUBID:55523.
- Sherman, H. J., & Christian, M. (1999). Mathematics attitudes and globel self-concept: An investigation of the relationship. *College Student Journal*, 33, 95-101. Retrieved from [http://eserv.uum.edu.my/login?url=http://search.ebscohost.com/login.aspx?direct=true & db = psych & AN = 1999-10984-009 & site + ehost-live & scope = site](http://eserv.uum.edu.my/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psych&AN=1999-10984-009&site+ehost-live&scope=site)
- Stevenson, H. W., Chen, C., & Lee, S. Y. (1993). Mathematics achievement of Chinese, Japanese, and American children : ten years later. *Science (New York, N.Y.)*, 259, 53-58.
- Stramel, J. K. (2010). A naturalistic inquiry into the attitude towards mathematics and mathematics self efficacy beliefs of middle school students. PhDdissertation, Kansas State University, Kansas, USA. Retrive from ProQuest Dissertation & Theses database. (Publication No. AAT 3419596).
- Tapiia, M., & Marsh II, G. E. (2004). An Instrument to Measure Mathematics Attitudes. *Academic Exchange Quarterly*, 8(2). Retrieved from <http://www.rapidintellect.com/AEQweb/cho25344.html>
- Tocci, C. M., & Engelhard Jr., G. (1991). Achievement, Parential Support, and Gender Difference in Attitude towards Mathematics. *The Journal of Educational Research*, 84(5), 280-286. Retrieved from <http://www.jstor.org/stable/40539696>
- Trujillo, K. M., & Hadfield, O. D. (1999). Tracing the Roots of Mathematics Anxiety through In-Depth Interviews with Pre-service Elementary Teachers. *College Students Journal*, Retrieved

- from <http://www.questia.com/library/journal/1G1-62839422>. tracing-the-roots-of-mathematics-anxiety-through-in-depth
- Unlu, M., Avcu, S., Avcu, R. (2010). The relationship between geometry attitude and self efficacy beliefs towards geometry, *Procedia Social and Behavioral Sciences*, 9, 1325-1329.
- Usher, E. L. (2009). Source of middle school students' self-efficacy in mathematics: A qualitative investigation. *American Educational Research Journal*, 46(1), 275-314.
- Wigfield, A. (1994). The role of children's achievement values in the self-regulation of their learning outcomes. In D. Schunk & B. Zimmerman (Eds.), *Self Regulation of Learning and Performance: Issues and Educational Application* (pp. 101-124). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Wilson, P. (2008). Promoting Positive Attitudes. *Mathematics Teaching Incorporating Micromath*, Retrieved from <http://eric.ed.gov/?q=promoting+positive+attitudes&id=EJ815090>
- Yavuz Mumcu, H., & Cansiz Aktas, M. (2015). Multi-program high school students' attitudes and self-efficacy perceptions toward mathematics. *Eurasian Journal of Educational Research*, 59, 207-226 <http://dx.doi.org/10.14689/ejer.2015.59.12>
- Yenilmez, K. & Uygan, C. (2010). Yaratici drama yonteminin ilkogretim 7. Sinif ogrencilerinin geometriye yonelik oz-yeterlik inanclarna etkisi Kastamonu. *Education journal*, 18(3), 931-942.
- Zimmerman, B. J. (1995). Self-efficacy and educational development. In A. Bandura (Ed.), *Self-efficacy in changing societies* (pp. 46-68). New York: *Cambridge University Press*.
- Zimmerman, B. (2000). Self-Efficacy : An Essential Motive to Learn. *Contemporary Educational Psychology*, 25, 82-91. doi : 10.1006/ceps. 1999.1016.