ISSN No:-2456-2165

Psychological/Perceptual Inhibitors to the Teaching/Learning of Mathematics

Ashwannie Harripersaud
Canje Secondary School,
Ministry of Education,
Guyana.

Abstract:- This paper does not seek to identify and analyze the reasons for the frequent trepidation many students feel towards Mathematics. Rather, its scope is limited to recognizing the signals of that fear being manifest in students. This paper explores the complex and varied ways that students unconsciously or instinctively demonstrate that often debilitating fear of Math. The paper suggests pedagogical strategies which teachers of the subject can use to recognize and assist in the amelioration of that fear. Some of these strategies may be generally applicable to any or all disciplines; some are specific to Math.

Keywords:- *Motivation, Math-Anxiety, Education, Teaching, Learning.*

I. INTRODUCTION

The Science of Education is an area of expertise formed on the basis of two notions: "Education" and "Instruction" (Karsli, 2007). Education is the activity that aids new generations to obtain the necessary information; critical ability; attitude and understanding in order that they develop their character while preparing them for communal life (Karsli, 2007: 9). Teaching, on the other hand, is "the process in which the individual develops talents in proportion to their capacity" (Karsli, 2007: 17). The most important factor in education and teaching activities is the teacher. A teacher, in the most general term, is a person working in educational institutions who enables students to reach cognitive, sensory and behavioral aims and gains within the range determined by the educational system (Gundogdu, Silman, 2007: 259). The role of the teacher has gone beyond just teaching class, giving lectures, and assessing students; the teacher also takes on the roles of organizing, managing, counseling, observing and evaluating. The teacher also has an important role in influencing the society, creating a sound foundation towards the future of society, and ensuring the continuation of such actions. The multiple roles of the contemporary teacher become all the more challenging when it comes to exploring and conveying concepts in mathematics. All too often, students enter the math classroom with perceptual inhibitions about mathematics.The teacher of mathematics, therefore, must begin by addressing and resolving these hindrances by employing innovative motivational strategies that would facilitate ease of learning on the part of students.

Motivation

PMBOK defines motivation as "Powering people to achieve high levels of performance and overcoming barriers in order to change." The word motivation is derived from the Latin term *motivus*- "moving cause". "The concept of motivation is linked closely to other constructs in education and psychology such as constructs of attention, needs, goals, and interests which all contribute to stimulating students' interest in learning… Motivation enables students to engage in particular activities and achieve various goals" (Krause, K.L., Bochner, S., & Duchesne, S., 2003). A motivator is an energizer of action. Motivation is a state that impels an action or behaviour. It is something extrinsic or intrinsic that causes people to want to do something or to want to behave or perform in a certain way. A motivator makes people want to do or to continue doing something or to work harder at doing something. It makes them willing to work. People must see the intrinsic and extrinsic benefits of what they are doing in order that they are motivated.

Motivation in Mathematics

There are several strategies that may be employed by teachers to develop and maintain positive attitudes in students towards Mathematics. We need necessarily to keep in mind that the subject of mathematics brings with it unique perceptual impediments to learning. And yet, in order that students are assisted in the over-coming of these inhibitions, our approaches as teachers can employ both subject-specific as well as more general strategies.

Teachers can encourage students to be responsible for their own learning. Let them have ownership in the teaching-learning process by being actively involved in the lesson. This may be done by having students make and manipulate materials and by having them make meaningful decisions about their own learning. Learning aids must be stimulating and student-manipulative to engage students in fun hands-on learning. Teachers may use praise, commendations, encouragement and appropriate gestures when students give correct responses or nearly correct responses. However, avoid being hyperbolic with praises. Encourage those who give incorrect responses to think positively.

Emphasize that mathematical processes (i.e. mental reasoning and solution steps) are just as important as are the final answers to questions or problems. Some mathematical psychologists may even argue that mathematical processes are much more important than final answers. Ensure that students understand the reasoning behind mathematical rules.

Rules without reason can be de-motivating. "To divide 4 by 2/3, you multiply by 3/2." Why? Search your memory to find out whether you have ever been given a good reason for this; or, alternatively, seek an explanation from a school child of suitable age to discover whether he or she has received any good reason. The reason: how many 2/3 are there in 4? Answer: 6.

It is important to value children's own methods of working and problem solving. After they have fully understood a concept using concrete materials, then you can show them a more efficient and quicker abstract mathematical short cut to solve the problem. While the classroom environment must be stimulating to learning, we should also have a mathematics friendly classroom.Convey your affinity for mathematics in order to pass on your liking of mathematics to the children. Make mathematics enjoyable so that children develop positive perceptions of mathematics and of themselves in relation to mathematics. Use games, puzzles, mystery math activities, investigations, projects, etc., to make math fun.

Show that mathematics is useful in careers and everyday life by using practical examples: filling in bank forms; writing cheques; doing domestic budgets; keeping track of income and expenditure, etc. It is useful to adapt instructions to students' needs, interests, and abilities. Always consider socio-economic backgrounds, and establish short-term goals that students have a reasonable chance of attaining.Provide experiences designed to help students be successful in mathematics. Remember success breeds success. It brings self-satisfaction at a task achieved.

Additionally, it is useful to provide contextual background by exposing students to the historical and cultural aspects of mathematics (ethno-mathematics).Show the relationship between mathematics and art, mathematics and music, mathematics and language, mathematics and sports, etc. Children learn mathematics in concert with other subjects.

Some Demotivators in the Mathematics Classroom

We have offered some motivational strategies above, but we also need tokeep in mind some demotivational factors in teaching and learning generally, and with regards to mathematics especially. Humiliation is the foremost inhibitor to learning, and it leads frequently to life-long complications. Students are humiliated either because of failure or because of the teacher's harshdisapproval or because their peers laugh at them. Given the extra cargo that comes with mathematics, teachers of math need be extra vigilant in guarding against such humiliation.

Students feel demotivated when certain mathematical ideas are foisted upon them that they are not yet ready to learn; when they are forced through a mathematics curriculum for which they do not have the prerequisite knowledge; when they are struggling with new concepts that do not make any practical sense; when they are pressured to memorize hundreds of unrelated mathematical facts; and when they are subjected to over-aggressive questioning in front of their peers.

Math Anxiety

Math Anxiety has been a matter of concern in education for a long time and refers to the state of fear, tension, and apprehension when individuals engage with math (Ashcraft, 2002; Ashcraft and Ridley, 2005). The negative Math Anxiety-performance link has been found in many empirical studies. These studies establish that Math Anxiety leads to poor performance when individuals deal with math reasoning or attempt to solve math problems (Bandalos et al., 1995; Ashcraft and Kirk, 2001; Ashcraft, 2002; Cates and Rhymer, 2003; Ma and Xu, 2004; Miller and Bichsel, 2004). Individuals who exhibit such anxiety do not enjoy doing mathematics, particularly in public. They agonize over mental arithmetic, apologize for their lack of skill, and avoid activities associated with mathematics. In short, they are dysfunctional in mathematics. Children need to be free from math anxiety and to feel secure in order to be confident learners of mathematics. Furthermore, based on the studies from 2000 to 2018, a range of potential moderators, including gender, grade level, geographical region, measurement of Math Anxiety, and measurements of math performance may influence the Math Anxiety-performance (Yaratan and Kasapoglu, 2012; Vukovic et al., 2013a; Hill et al., 2016; Gunderson et al., 2018).

How to Make Children Feel More Secure In Mathematics

Teachers should accept their own mistakes in front of children ("I goofed!"). If a teacher makes a mistake when working on the chalkboard/whiteboard and a student points it out, the teacher has to unhesitatingly correct it. Show children how failure is useful in learning and *unimportant in determining one's worth.* Thomas Edison tried thousands of materials and failed thousands of times before he finally found a material that succeeded in making a workable filament bulb. Gregor Mendel failed his trained teacher's examination repeatedly and never passed, but his experiments with peas gave us Mendel's Laws of Heredity and laid the groundwork for modern genetics.

Allow for failure and treat it as a natural part of the learning process. When children make mistakes let them learn from their mistakes. Never treat mistakes as something unnatural or abnormal or evil that must be avoided at all costs. Avoid embarrassing them for making mistakes. Erasers, correction fluid and the delete button were invented because we humans are prone to make mistakes. [By the way, why do children have to stand when answering questions? Wouldn't they feel more secure when seated while answering questions?]

Provide opportunities for children to succeed. Develop their confidence through success to the extent that they will maintain confidence when they do not succeed. When questioning students, initially ask questions that they can answer in order to reduce anxiety and build up confidence, thereby improving their performance.

Avoid blaming children who do not meet adult expectations. Expect high quality performance within the capabilities of the children. Do not let group prejudice cloud your expectation of children's capabilities.

Accept children as individuals who are worthy of respect. Believe that children deserve respect. Listen when they wish to share ideas and feelings. Respond in a warm manner and do not be judgmental. Provide opportunities for children to make decisions that affect their lives within the school setting. Make sure the decisions are real and the children can and will abide by the logical consequences of their decisions.

Discuss failure with individuals and with the class group. Come to agreements about how failure will be dealt with. Live up to those agreements. Teachers may feel a duty to point out all mistakes, but it is far healthier to look for strengths and assets. Teachers should not ignore incorrect mathematical concepts, but they should teach concepts and correct misconceptions without destroying children's egos.

Dealing with Failure

Children, particularly the young ones, seem to cope naturally with failure. Gaining an initial understanding of life, including learning about the environment and roles within the family and society, involves trial and error; failure in this context is used as a springboard for future success. The healthy use of mistakes can provide a foundation for growth.

On the other hand, failure may be harmful to the child if that failure is perpetually re-called and re-emphasized. When teachers or parents teach that failure should be avoided at all costs, children develop sophisticated mechanisms to avoid failure. A hysterical but caused fear of failure is a formidable barrier to success. There are many reactions or strategies that children develop to avoid being perceived as weak or as having failed to understand. Children are quite adept at devising strategies of such avoidance. For instance, they employ the Wave Hand Strategy; that is, when a teacher asks a question, some children excitedly wave their hands when they really do not know the answer but know that the teacher will call on the children who look apprehensive.

Children also give an Answer and Watch the teacher's reaction. They begin to give a response and closely observe the teacher for signs or "tells" - usually non-verbal, that the response they have begun is correct. They tailor their responses to meet the teacher's approval by watching the teacher for non-verbal cues. They may also use the "'Mumble' Strategy": they mumble unintelligibly trying to make it sound like an appropriate mathematical answer and hope that the teacher will supply the answer. The teacher usually does so.

They may say anything that seems intelligent sounding, but the response is totally unrelated to the question asked. They hope for the teacher to supply the answer and, of course, the teacher usually does so.

Students sometimes use the "Silent Strategy". They simply do not say a word when asked a question (even a very easy question) but only wait for the teacher to give the answer or ask another student. [Children might not know the answers to questions, but they do know how to get us to answer our own questions.]

Students sometimes employ the "Wise Look Strategy". They wear an expression of profound wisdom on their faces as if they know the answer to the question when in fact they have little or no idea of the answer and they hope that the teacher does not ask them the question. The teacher usually does not ask them, but asks some other student or answer his/her own question. Conversely, they may employ the "Terrified Look Strategy". They wear an expression of total and complete fear on their faces so that the teacher will pity them and won't ask them the question.

It is important to remember that children do not consciously and deliberately decide to adopt these strategies. They adopt them out of anxiety and fear of failure. Teachers need to reduce anxiety and the fear of failure in children when questioning them.

Teachers' Attitudes about Children

The teacher's beliefs about children will inevitably affect the children's performance in many academic subjects, including mathematics. The even-handed and fair treatment of children includes some combination of *laissez-faire* and strict direction. The overall degree of teaching success relies more on *what teachers believe about children than on how they organize to teach them*. In the final analysis, teachers' underlying philosophical beliefs about children cause teachers to interact with children in ways that reflect the teacher's beliefs. Ultimately, this affects the effectiveness of teaching and depth of learning.

When teachers believe children are low achievers, the children tend to receive marks indicating low achievement. When teachers believe comparable children are high achievers, the children tend to receive marks indicating high achievement. This is an example of a self-fulfilling prophecy: *your very belief about something that is non-existent can bring it into existence because you unconsciously behave in ways and interact with your environment in a manner designed to bring the non-existent into existence.* [The self-fulfilling prophecy is also known as the *Pygmalion Effect*, after Pygmalion, in Greek mythology, a king of Cyprus who fell in love with a statue of the goddess Aphrodite. The Roman poet Ovid, in his *Metamorphoses*, invented a more sophisticated version: Pygmalion, a sculptor, made an ivory statue representing his ideal of womanhood and then fell in love with his own creation; the goddess Venus brought the statue to life in answer to his prayer.]

Teachers are often unaware that they treat children according to their personal beliefs about children. They do so through both verbal and non-verbal interaction. As beliefs about children become more positive, a greater amount of the children's potential can be realized. It seems imperative that in the course of their teacher training, they must be asked

to articulate in writing their respective teaching philosophies.

II. CONCLUSION

This remains true: Teachers may serve to motivate students to learn; it is also true that teachers may unwittingly demotivate those in their charge. This is true generally, but it is especially so in mathematics since this subject area carries certain negative burdens. Teachers of mathematics must lighten that burden. The teacher should devise a variety of strategies to allow students to appreciate math. Teachers should also have an in-depth subject matter knowledge and be able to convey that depth in ways that would enable students to find learning to be joyful and practical. Clarity and simplicity in the conveyance of mathematical concepts are important for students. The responsibilities that fall upon teachers are many; those responsibilities increase exponentially for those of us who teach mathematics.

REFERENCES

[1]. Ashcraft, M.H. (2002). ***Math anxiety: personal, educational, and cognitive consequences. Curr. Direct. Psychol. Sci***. 11, 181-185. doi: 10.1111/1467-8721.00196 Google Scholar

[2]. Ashcraft, M.H., and Kirk, E.P. (2001). ***The relationships among working memory, math anxiety, and performance. J. Exp. Psychol. General*** 130, 224-237. doi: 10.1037/0096- 3445.130.2.224Google Scholar

[3]. Ashcraft, M.H., and Ridley, K.S. (2005). **"Math anxiety and its cognitive consequences: a tutorial review," in *Handbook of Mathematical Cognition***, eds J. I. D. Campbell .(New York, NY, NY: Psychology Press) Google Scholar

[4]. Bandalos, D. L., Yates, K., and Thorndikechrist, T. (1995). ***Effects of math self-concept, perceived self-efficacy, and attributions for failure and success on test anxiety. J. Edu. Psychol.*** 87, 611-623. doi: 10.1037/0022-0663.87.4.611Google Scholar

[5]. Cates, G. L., and Rhymer, K. N. (2003). ***Examining the relationship between mathematics anxiety and mathematics performance: an instructional hierarchy perspective. J. Behav. Educ.*** 12, 23-34. doi: 10.1023/A:1022318321416 Google Scholar

[6]. C. Chua, 2005, ***Perception of Quality in Higher Education***, School of Business Management, Ryerson UniversityGoogle Scholar

[7]. Gunderson, E.A., Park, D., Maloney, E.A., Beilock, S.L., and Levine, S.C. (2018). ***Reciprocal relations among motivational frameworks, math anxiety, and math achievement in early elementary school. J. Cogn. Dev***. 19, 21-46. doi: 10.1080/15248372.2017.1421538 Google Scholar

[8]. Gundogdu, K., Silman, F. (2007) ***Teaching as a profession and effective teaching. Introduction to education: Handbook of basic concepts***, 259-292. Ankara: Grafiker Google Scholar

[9]. Hill, F., Mammarella, I.C., Devine, A., Caviola, S., Passolunghi, M. C., and Szucs, D. (2016). ***Maths anxiety in primary and secondary school students: Gender differences, developmental changes and anxiety specificity. Learn. Indiv. Diff***. 48, 45-43. doi: 10.1016/j.lindif.2016.02.006 Google Scholar

[10]. Karsli, M.D. (2007) ***Introduction to education.*** Ankara: Pegem A Google Scholar

[11]. Ma, X., and Xu, J. (2004). ***Determining the causal ordering between attitude toward mathematics and achievement in mathematics. Am. J. Edu***. 110, 256-280. doi: 10.1086/383074 Google Scholar

[12]. Miller, H., and Bichsel, J. (2004). ***Anxiety, working memory, gender, and math performance. Personal. Indiv. Diff.*** 37, 591-606. doi: 10.1016/j.paid.2003.09.029 Google Scholar

[13]. Richard S.(2012).***The Psychology of Learning Mathematics***, Taylor & Francis Google Scholar

[14]. Vukovic. R.K., Keiffer, M.J., Bailey, S.P., and Harari, R.R. (2013a). ***Mathematics anxiety in young children: concurrent and longitudinal associations with mathematical performance. Contempor. Edu. Psychol***. 38, 1-10. doi: 10.1016/j.cedpsych.2012.09.001 Google Scholar

[15]. Yaratan, H., and Kasapoglu, L. (2012). ***Eighth grade student's attitude, anxiety, and achievement pertaining to mathematics lessons. Proc. Soc. Behav. Sci***. 46, 162-171. doi: 10.1016/j.sbspro.2012.05.087 Google Scholar