The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2019

Volume 14, Pages 34-40

ICEMST 2019: International Conference on Education in Mathematics, Science and Technology

Mathematics Anxiety among Secondary Level Students in Nepal

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Abstract: This paper explores the association between the perceived classroom environment and mathematics learning and test anxiety among secondary level students in Nepal. Categorizing the students in three dominant variables- gender, ethnicity and previous schooling, and selecting sample students with respect to higher mathematics anxiety from five heterogeneous classes, the research explores disparities in student's mathematics cognition and reveals the nexus between classroom environment and mathematics learning and test anxiety. This research incorporates social learning theory and social development theory as interpretive tools for analyzing themes through qualitative data. Focusing on interviews with highly anxious students learning mathematics, the study sheds light on how mathematics anxiety among the targeted students is interlinked with multiple factors. The research basically exposes the students' lack of mathematical passion, their association with other students and participation in classroom learning, asymmetrical content and their lack of preparedness for tests, as the caustic factors behind such anxieties. The study further reveals that students' lack of foundational knowledge and the complexity of the mathematical content have jointly contributed to mathematics anxiety. Admitting learning as a reciprocal experience, the study points out that the students' gender, ethnicity and disparities in previous schooling in the context of Nepal has very insignificant impact on students' mathematics anxiety. It finally recommends that those students who get trapped into the vicious cycle of mathematics anxiety require a positive and supportive classroom environment along with inspiring comments/compliments and symmetrical course contents.

Keywords: Anxiety, Asymmetry, Cognition, Habitus, Pedagogy

Introduction

A remark made by a grade-seven student named Sita regarding mathematics learning about 20 years back still reverberates in the mind of the researcher. By then, the researcher was a Lower Secondary Mathematics teacher in his home town Pokhara, Nepal. One day, after receiving a below-average final exam result only in mathematics, she approached her teacher and frustratingly uttered, "I can't solve any problems of mathematics; it is not for me, it is others' work". As a teacher, the researcher offered words of comfort and advised her to practice well for improved performance; however, the statement left the researcher feeling restless and thinking about why and how students, even those with high intellectual capability, descend into mathematics learning and test anxiety.

Sita's difficulty in understanding mathematics was not an isolated case, there are many others who face this situation but hesitate to speak out. While the student showed a willingness to share her feelings on learning mathematics, the researcher could not anticipate that so many other students feel the same but do not show it due to the socio-cultural context of learning in Nepal. During his 20 years of teaching, the researcher has reckoned the situation has remained unchanged, as students continue to struggle and show such problems in his classes, which has motivated him to explore this problem further in the context of classroom learning in Nepal and to come up with certain findings. This research, "Mathematics Anxiety among Secondary Level students", studies an ongoing problem in the heterogeneous classroom context of the teaching/learning process in Nepal, and explores the issue with empirical data analysis from the classroom environment perspective.

Literature Review

Mathematics anxiety has been perceived in various ways in the literature. While early researches suggested mathematics anxiety to be a possible symptom of anxiety in general [1], contemporary researches suggest it is a much more complex phenomenon. Hunt describes mathematics anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" [2]. While Hunt's definition emphasizes the emotional aspects of mathematics anxiety, other researchers focus on the effect of mathematics anxiety on mathematical performance [3]. Richardson and Suinn [4], for example, defined mathematics anxiety as involving "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations". This definition is consistent with the description given by [5] of the process of math anxiety, which suggests that mathematics-anxious people may experience physical and mental symptoms of anxiety which results in poor performance in mathematics, avoidance of mathematics, and irresistible feelings of failure.

Both Richardson and Suinn's and Arem's definitions of mathematics anxiety are consistent with a classic psychological theory of arousal. This theory states that people perform best when they are at an intermediate level of arousal. If an individual is over aroused, as with people who are experiencing high levels of anxiety, then he or she will have difficulty focusing and sustaining attention which will result in decreased levels of performance [6].

Some definitions describe other possible symptoms and effects of mathematics anxiety. For instance, [7] defines mathematics anxiety as involving "debilitating test stress, low self-confidence, fear of failure, and negative attitudes towards mathematics learning" (as cited in [8]). Furthermore, research suggests that mathematics anxiety may be particularly apparent when an individual is under evaluation (Brush, 1981, as cited in [9]). Uusimaki and Nason reported that over one-third of pre-service elementary teachers that participated in a study cited mathematics practicum situations as causing significant anxiety due to "insecure feelings of making mistakes or not being able to solve it correctly" [1].

Mathematics learning anxiety and mathematics test anxiety are largely linked with the classroom environment. In this regard, Murray [10] referred to the perceptions of the environment by participants as beta press, the view of the inside observer, as opposed to alpha press, the view of the outside observer. Wood notes the lack of agreement among researchers about the definition and measurement of mathematics anxiety. He proposes that mathematics anxiety may not be a distinct construct because it has been found to be highly related to test anxiety [3]. Other researchers, however, suggest that test anxiety and mathematics anxiety are not synonymous despite the similarities in many ways [11]. According to Hembree, test anxiety and mathematics anxiety are separate constructs. He notes that "only 37 percent of one construct's variance is predictable from the variance of the other" [12]. He states that mathematics anxiety is comprised of a "general fear of contact with mathematics", including, but not limited to classes, homework, and tests [12].

Regardless of the precise definition, it is generally agreed that mathematics anxiety can potentially interfere with learning and performance in mathematics [13]. Mathematics anxiety can occur in all levels of education from primary school to higher education, and once established, can persist in life, interfering with every day activities involving numeracy and further learning of mathematics. Mathematics anxiety usually comes from negative experiences in working with teachers, tutors, classmates, parents or siblings [14].

Many students who pass through mathematics anxiety have little confidence in their ability to do mathematics and tend to take the minimum number of required mathematics courses, greatly limiting their career choice options. This is unfortunate, especially as society becomes more reliant on mathematical literacy [15]. As stated by [16], mathematics anxiety could be caused by a number of factors: unpleasant past experiences with mathematics in the classroom, a parent conveying the message to their children that mathematics is boring and useless, or from the attitudes of the teachers themselves. The aforementioned review reveals that mathematics anxiety is both the cause and the effect in itself and is connected to many other factors. In the Nepalese context, however, the classroom environment seems to be one of the dominant factors behind it.

Theoretical Foundation

Mathematics anxiety is often termed to be a learned behavior. Social learning theorists opine that learning occurs within a social context. It considers that people learn from one another. Reference [17] states that

mathematics anxiety can be influenced by any of the following factors: the school system, gender, socioeconomic status, and parental history and prejudices. This implies that mathematics anxiety could be a learned behavior.

Bourdieu's (as cited in [18]) notion of social practice focuses on habituated activities of ordinary living that people acquire through socialization. Habitus is not fixed or permanent and can be changed in unexpected situations or over a long period of time [19]. Reference [20] views habitus as neither a result of free will, nor determined by structures, but created by a kind of interplay between the two over time.

With this backdrop, this research incorporated Lev Vygotsky's 'Social Development Theory' and Albert Bandura's 'Social Learning Theory' to see how students perceive mathematics anxiety; how it affects their learning; and, how they fall in a vicious cycle of anxiety unless proper stimulation or comments/compliments are not provided to them. By using Vygotsky's theory, this research has explored how learning would be a reciprocal experience for the students and instructors. By using Bandura's theory on social learning, this research has studied students' learning in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

Methodology

This study adopted qualitative research methods to examine the complex world of perception of students in mathematics learning and manifestation of mathematics anxiety they felt through various factors like the asymmetrical nature of the syllabus in different grades, insufficient classroom motivation and improper instructional practices.

Qualitative data texts were taken for looking at variables in the natural setting in which they are found. Detailed data were generated through open-ended questions that provided direct quotations. As stated by [21], the interviewers were an integral part of the investigation. Reference [22] called this method the "narrative approach" for generating qualitative data. This research adopted purposive sampling method regarding it as the most common sampling strategies in qualitative research. Through purposeful sampling, information-rich cases were sought to make in-depth analysis [23].

Twenty students with extremely high levels of mathematics anxiety were selected to be involved for the research purpose. Each of the interviews was recorded with the participant's permission and then transcribed verbatim. Following the qualitative research approach, similar themes were investigated from transcripts and individual perspectives were considered. The unit of analysis from the qualitative data involves verbatim quotations from the students. A total 70 quotes were used as raw data for the analysis. The higher level themes, composed of combinations of the lower level themes, were generated from the quotes derived through the interviews. Quotes with common themes were clustered together and labeled. Level I themes were derived by common theme of direct quotes, level II by level I, and level III by level II themes.

Findings

The figure mentioned below reflects content analysis using inductive approach. As shown in the figure, the emergent themes from the interviews were connected to qualitative factors including students' mathematics learning and evaluation anxiety.

A new avenue that opened up from the interview with the students was the theme of the structure of mathematical content and students' familiarity with it. While talking to the students, they confessed that the complexity of the mathematics content and their lack of fundamental mathematics knowledge caused anxiety in learning mathematics. As a result, they failed to perform well in the exam, thereby causing test anxiety. Once a student conceived test anxiety, it further invited complication in learning mathematics and trapped them into a vicious cycle. The two themes mentioned above, drawn through representative quotes, are concerned with students' perception of mathematics learning. The remarks made by students regarding mathematics learning show that mathematics learning anxiety is proportional to content complexity. Few of the responses of students regarding this factor are mentioned below as testimonies:

I really get annoyed when I to try to solve mathematical problems in class as well as in an exam. I can barely concentrate in the classroom learning, and I don't perform well in exams, and so I keep asking

myself why I have to learn these formulas by heart since I'm unlikely to conceptualize the matter and forget these things quickly anyway. I can't understand how these mathematical problems are connected to life. (Neha, a XI grader).

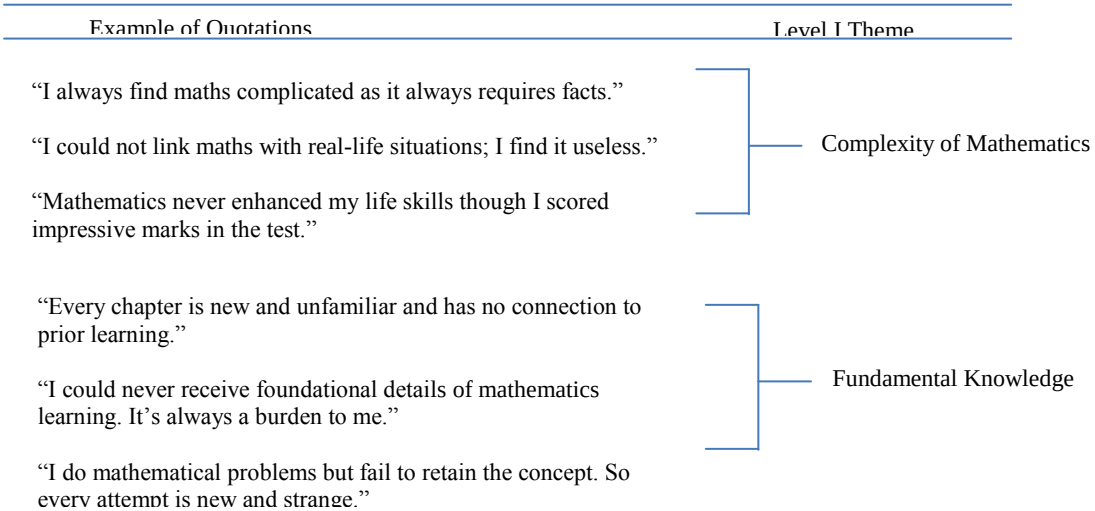

Figure 1. Quotations cluster and first level themes

Other students also reacted to mathematical problems as Neha did. These feelings revealed that some students have greater mathematical anxiety and show less interest in mathematical activities, which in turn caused test anxiety. As Joshan, another XI grader, said:

I get lost as soon as the teacher begins a new chapter at the start of a new week. As long as he is in the class I seem to understand the things. As he leaves, I simply wonder what I was learning in the class. Everything vanishes and I get stuck up at every step of problem solving. It really bothers me. Consequently, I can't perform well in the exam.

These representative student narratives revealed that learning mathematics anxiety coincided with test anxiety and vice versa. The cluster of quotes of the students mentioned above resulted in the first level of themes. On the basis of those themes, different levels of themes, as mentioned in the figure below, are generated.

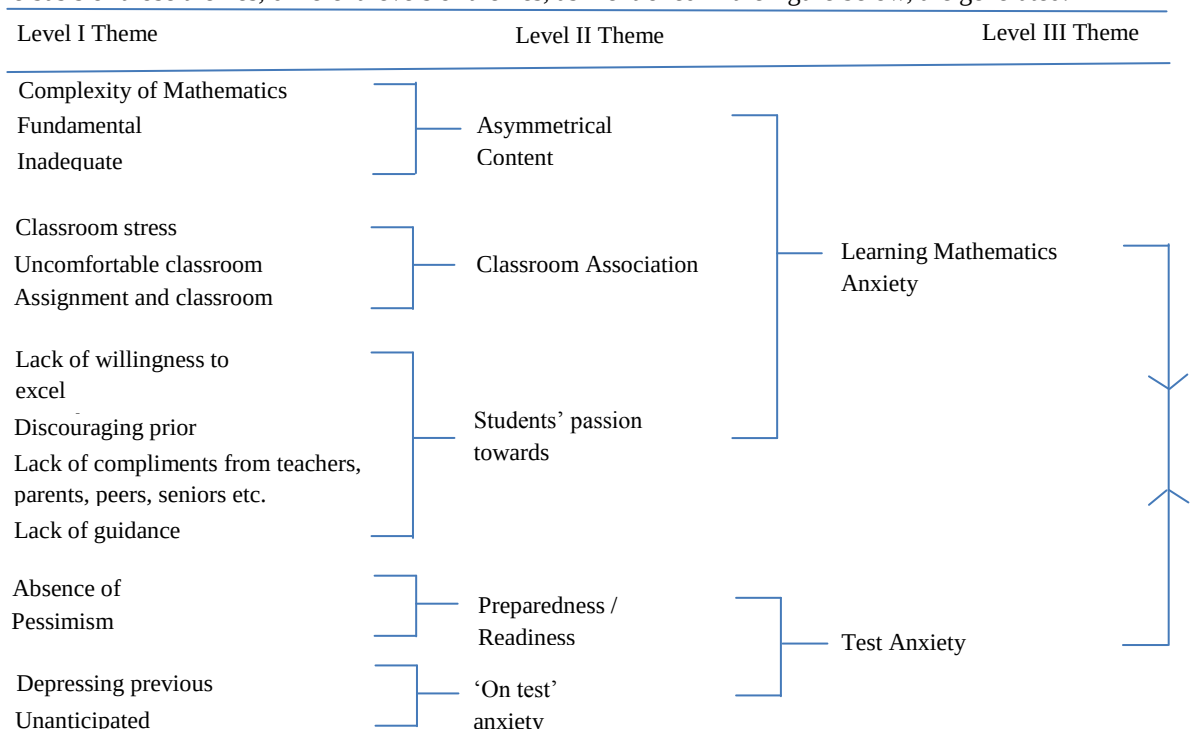

Figure 2. Nexus of three level themes

The table shows that learning mathematics anxiety and test and evaluation anxiety are connected to their passion for mathematics, their readiness and preparedness for the tests, asymmetrical content and classroom association. Some students get lost due to classroom stress, vastness of content and inadequacy of illustrations. Some, on the other hand, get frustrated by the classroom environment; they do not get much help from their peers, find assignments and classroom practices hectic and lack willingness to excel in mathematics. Other students, similarly, lack prerequisite content knowledge, become discouraged by previous results and frustrated by the announcement of exams, and remain pessimistic about mathematics learning. The narratives also revealed that students' gender, previous schooling and ethnic background do not necessarily coincide with learning mathematics anxiety and test anxiety. The responses of representative students mentioned below further substantiate the theme:

Sometimes, I think, I was not born to study mathematics. It's no longer entertaining to me. It bores me all the time. I generally lack mathematical concepts and get troubled when I have to perform a task. (Sachin XI: A Male Student)

Thinking about exam results upsets me terribly. I keep scoring low marks in mathematics though I perform well in other subjects. This is indeed discouraging me to study further. Can't I get rid of it? (Anupa XI: A Female Student)

The responses of students towards mathematics perception reveal much about their mathematics learning. In the interviews, they expressed not only their worries, but also made some insightful remarks to address teaching learning complications. Mentioned below are responses that reveal these facts:

If the teacher gives me more opportunity to ask questions I would overcome my difficulties, and I can also learn as per the pace of the class. (Sammy Tamang, XI: Ethnic Group)

Is there any relationship between two units or among units of the content which can help me in understanding mathematics better? (Apekshya Sharma, XI: Non-ethnic Group)

What is the use of my mathematics learning and the real life situation? I get nothing. (Raisa Khatun, XI: Rural Schooling)

I think I can study well in all subjects if I get the proper guidance from my teachers and support of my friends. Guidelines before exams really motivate me do better in every exam. (Shreya Shrestha, XI: Urban Schooling)

These representative responses are not just the bundle of problems. They replicate the reality of mathematics learning classroom in Nepal and also bear the answers within themselves. These responses indicate that the students who are trapped in the vicious cycle of mathematics learning and test anxiety need to be helped to overcome the problem.

Discussion

The qualitative data analysis mentioned above revealed that mathematics anxiety is both acquired and learned behavior. Some students lack a mathematics foundation and cannot learn the subject well, where as others find problem with mathematics learning due to various factors like classroom environment, lack of willingness to excel in mathematics, lack of preparedness etc. As a result, the students perceive mathematics learning and test anxiety.

As viewed by Albert Bandura, habitus is not fixed or permanent and can be changed in unexpected situations or over a long period of time (as cited in [24]). On the other hand, in his social learning theory, Bandura views that the learning ability of students who perceive mathematics anxiety is affected and that they fall into a vicious cycle of anxiety, and therefore, require proper guidance, necessary stimulation or comments/compliments.

As perceived by Vygotsky, social interaction precedes development; consciousness and cognition is the end product of socialization and social behaviour (as cited in [25]). His theory shows connections between people and sociocultural context in which they act and interact in shared experiences. This theoretical modality helped in identifying the fact that the students' perceptions of mathematics is influenced and sometimes shaped by peer activities or pressure. On the basis of this theoretical foundation and empirical observation of the study, it has been revealed that students' mathematics anxiety is the product of interaction between cognitive, behavioral, and environmental influences, not by their gender, ethnic background or previous schooling.

Conclusion

The study explored whether mathematics anxiety is acquired, created or something else. Based on the lived experiences of students' mathematics anxiety framed within social learning theories and social development theory, the research exposed that the problem of mathematics anxiety among students was basically caused by the students' lack of a solid foundation and the complexity of the mathematical content. Also, the research indicated that students' ethnic background, gender and varied previous schooling are not caustic factors in learning mathematics anxiety and test anxiety. It further revealed that learning mathematics anxiety and test anxiety are deeply embedded with students' passion towards mathematics, classroom association, asymmetrical content and their preparedness for the tests. As a result, the students experienced learning anxiety as well as test anxiety. The study further revealed that practical classroom strategies, explanations of mathematical principles, motivational practices, hands-on activities, use of different models, and positive and supportive learning environments would change students' attitudes toward mathematics; otherwise, the vicious cycle of learning mathematics anxiety and test anxiety is sure to continue.

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