Student Perceptions and Experiences in Mathematics Classrooms: A Thematic Analysis

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Abstract

Classroom experiences contribute to learners' perceptions and interest in a particular subject. The present study aims to understand students' perception of mathematics learning by exploring their classroom experiences. The study sample consisted of 17 eighth-grade students in English-speaking urban schools in South India. The data was collected through a semi-structured interview schedule. The thematic analysis presents five themes – student personal factors, teacher-related, content-related, classroom environment and utility value. Teachers' characteristics and mathematics content were the essential factors contributing to students' perceptions and experiences. The study highlights the utility value of the content to help students see the application of the subject in real-world situations. Understanding students' perception of mathematics learning would help to choose appropriate content and teaching methods in the curriculum. The study highlights the need for educational and psychological interventions, focusing on student-teacher engagement and curriculum development to enhance mathematics learning.

Keywords: Mathematics learning, Classroom experiences, Student perception, Thematic Analysis

Introduction

Mathematics is one of the foundational subjects in the school curriculum. Studies reveal that mathematics learning becomes complex at higher grade levels (Gafoor & Kurukkan, 2015a; Wang & Goldschmidt, 2003). Students' views and attitudes towards mathematics learning may change as they move to higher grades. A longitudinal case study by Attard (2011) found decreased teacher-student interactions in mathematics learning among students transitioning from primary to high school. Classroom learning experiences are crucial in forming student perceptions (Furukawa, 2018). Rukavina, Zuvic-Butorac, Ledic, Milotic, & Jurdana-Sepic (2012) found that different classroom learning experiences help create a positive attitude towards mathematics. Adverse experiences may cause mathematics anxiety and poor performance (Mutodi & Ngirande, 2014; Bekdemir, 2010).

Understanding students' perceptions about mathematics learning would help us to realise why children like or dislike mathematics learning (Mapolelo, 2009). Teachers' and students' perceptions about the subject may be varied. Gafoor and Kurukkan (2015b) reported that teachers perceived students' poor prior knowledge as a factor influencing learning, but students perceived mathematics as a very complex subject. Teachers' effectiveness and communication play a key role in student learning. Classroom culture promotes students' attitudes and beliefs about learning mathematics (Angier & Povey, 1999). Traditional mathematics classroom teaching involve limited active learning (Kyriacou, 1992). Hence there is a need to build strategies help to improve student learning and achievement (Boyer, 2002; Martins & Teodoro,

2016). Engaging in mathematical communication would motivate students and help them to develop creativity (Cooke & Buchholz, 2005; Huang and Normandia, 2009). Such communication helps to reduce anxiety and improve achievement (Lomibao, Luna, & Namoco, 2016). Tiffany, Surya, Panjaitan, & Syahputra (2017) found that students' mathematical communication is less in traditional classrooms.

Most students need to be made aware of the need for mathematics learning (Young-Loveridge, Taylor, Sharma & Hawera, 2006) as children tend to learn the subject mechanically. For example, many children memorise multiplication tables and use them mechanically without understanding the principles or meaning behind it. These issues mount as they move to higher grades. Children think about the subject through a reflective experience (Swan, Bell, Philips, & Shannon, 2000). They need engaged classrooms with active instructional strategies (Pawa, Laosinchai, Nokkaew, & Wongkia, 2020). Thinking about mathematics increases their ability to understand concepts and problems (Arzarello, Robutti & Bazzini, 2005). Grootenboer (2003) found that school experiences are the antecedents for students' views regarding mathematics learning. Students' opinions towards mathematics depend on their classroom's emotional experiences (Martinez-Sierra & Garcia Gonzalez, 2014). Positive and negative affect is crucial in education (Frenzel, Goetz, Ludtke, Pekrun, & Sutton, 2009; Nardi & Steward, 2003). Teaching methods and instructional styles strongly influence their emotions (Bieg, Goetz, Sticca, Brunner, Becker, Morger, & Hubbard, 2017; Meyer & Turner, 2002). Classroom experiences shape students' attitudes towards mathematics (Rukavina et al., 2012; Walls, 2007). Nasir and Hand (2008) reported that students' engagement is low in mathematics classrooms, and students focus only on getting good grades. Students' perceptions can determine how students use the subject in and outside their classrooms (Masingila, 2002).

Studies show the connections between learning experiences and perceptions of mathematics learning (Huang & Normandia, 2009; Masingila,2002; Stodolsky, Salk, & Glaessner, 1991). Mathematics perception influences emotions and views and how they feel and think about learning the topic (Daud, Adnan, Aziz, & Embong, 2020). Students' perception of mathematics depends on their classroom learning experiences (Kong, 2008; Kurepa, Roop, & Edoh, 2019), and thereby influence their likes and dislikes to the subject.

Learners struggle with problem-solving in mathematics classrooms due to several reasons. A major issue is that they cannot connect the problems with the content they learn and lack a logical, contextual approach to teaching learning mathematics (Tambychik & Meerah, 2010). Mathematics education poses challenges in Indian schools. The educational system requires students to memorise and rote-learn concepts (Brown & Roy, 2014). High school students take mathematics as an essential subject, as science and mathematics are highly regarded, and careers such as medicine and engineering are greatly respected (Pruthi, Pandey, Singh, Aggarwal, & Goel, 2013). Scores in mathematics would determine their admissions to prestigious institutions. Hence, parents and teachers put academic pressure on students to score highly. The present study aims to understand students' perceptions of mathematics learning. The paper explores student-mathematics-teacher relationships and the value and application they see in concepts they have learnt. The article additionally explores student feelings associated with mathematics classroom experiences.

Method

Research design

Qualitative research methods help explore participant experiences, views or perspectives (Hammarberg, Kirkman, & Lacey, 2016). The present study adopts a qualitative approach using a phenomenological paradigm. Phenomenology helps understand the participants' experiences (Neubauer, Witkop, & Varpio, 2019), as in the study, students' classroom learning experiences are captured. It accurately describes the problem and experiences. Phenomenology has been widely used in educational research to gather experiences, views, and beliefs regarding teaching-learning, curriculum, pedagogical approaches and school environment (Abakpa, Agbo-Egwu, & Abah., 2017). Hence the students' experiences, and emotions while learning in mathematics classrooms can be well understood using a phenomenological lens.

Semi-structured interviews informed by phenomenological concepts help understand participants' voices (Sholokhova, Bizzari, & Fuchs, 2022). Semi-structured interviews help researchers explore the research questions with the help of structured open-ended questions and prompts (Creswell, 2007). The method helps elicit information from children and adolescents and avoid biases. The Braun and Clarke thematic analysis model (2006) can be applied in studies that follow a phenomenological paradigm. It helps arrange the data in themes and helps the readers understand the study's findings more simply (Javadi & Zarea, 2016).

Participants

The participants were 17 eighth-grade students from various schools in South India. There were nine male and eight female participants, aged between 13 and 14. All the students were enrolled in urban, private-funded, English-speaking schools. None of the participants had any record of disabilities or severe illness. The sample size was determined based on saturation (Bartholomew, Joy, Kang, & Brown, 2021; Sandelowski, 1995). The researcher observed that no new information emerged from the interviews and stopped collecting data with 17 participants. The purposive sampling method was used to collect data (Palinkas, Horwitz, Green, Wisdom, Duan, & Hoagwood, 2016).

Research tool

A semi-structured interview is a powerful tool for obtaining participants' reflective personal experiences (Dearnley, 2013). The interview questions sought to understand the students' perception of mathematics learning via exploring their classroom experiences. The sample questions were: What do you think about mathematics? How do you feel mathematics learning experiences in your classrooms can benefit your life? What type of learning activities are involved in your classrooms? While developing the questions, the Indian school culture was considered, and a few questions were taken and modified from past studies (Dobie, 2009; Huang & Normandia, 2009; Martinez-Sierra, 2014). The tool was reviewed and validated by two experts in educational psychology, and their comments were incorporated into the questions.

Data collection procedure

The researcher approached school authorities and took prior permission to collect data. The study objectives and ethical considerations were shared with the school authorities and parents of potential participants. The researcher explained the study objectives and participant rights to the participants and obtained their consent before starting the interview. A rapport was built to help the student feel comfortable and safe. The interviews were audio recorded and notes were taken during the interviews with permission from school authorities, parents and

participants. Each interview was approximately 30 minutes and was conducted in a room provided by the school authorities. Participants could withdraw from the study if they felt any discomfort. All interviews were conducted in English. All participants and school authorities were thanked for their participation and support to the study. The study was approved by the ethics committee of Christ University, Bengaluru, India (Reference number: - CU: RCEC/00036/1/19).

Data analysis

The audio recordings were transcribed by the researcher into a Word document. Participants were named Student 1, 2, 3… 17 to ensure anonymity. All identifying information were masked and only the researchers had access to the data. The transcribed data is saved in password protected files on a computer. Braun and Clarke's (2006) six-step thematic analysis approach was used to analyse the interview transcripts. It is a widely used, flexible analysis method for qualitative data (Maguire &Delahunt, 2017; Xu & Zammit, 2020). The data's trustworthiness was confirmed using the approach (Nowell, Norris, White, & Moules, 2017). The method is an iterative and reflective data analysis process in six steps (As cited in Nowell, Norris, White, & Moules, 2017).

In the first step of familiarising oneself with the data, the data was read multiple times to understand the participants' views. Generating initial codes was the second step of the analysis. Initial codes were developed from the data transcription. Codes included: "Mathematics is the study of numbers; mathematics is used daily; higher education and career in mathematics is interesting". Colour coding techniques were used to categorise the data. Codes were rechecked, and themes and sub-themes were generated using the codes in the third step of the analysis, searching for themes. A detailed description of the themes and sub-themes was given in the results section. The fourth stage involved reviewing the themes to understand whether the codes were categorised under the appropriate themes and sub-themes. In the next step, defining and naming themes, they were identified and named according to the nature of codes. For example, students' opinions of their teacher, such as "teacher is kind," were included in the sub-theme of teaching styles and teachers' characteristics. The themes and sub-themes with supporting extracts from the interview are presented in Table 1. The final phase of the analysis helped to produce the report. The scholarly writing was conducted, using the examples of original extracts from the interview. The results are discussed with the support of relevant literature.

Results

Students collectively shared their experiences in mathematics classrooms. Their perception of mathematics learning largely depended on their classroom experiences related to the teacher and the content. The teacher and the complexity of the subject determine their perception of mathematics learning. For example, if the students feel that their teacher helps them when they have difficulty solving problems, they are most likely to show interest in the subject. Table 1 presents the themes and sub-themes representing student perceptions and experiences in mathematics classroom developed after data analysis. It includes extracts from the interview.

Table 1. Themes and sub-themes representing student perceptions and experiences in mathematics classroom

Themes	Sub-themes	Extracts from interviews
Student attributes	Positive emotions	"…I think it's really a fun subject" "…I just enjoy math!"
	Negative emotions	"…I don't have so much interest towards maths…. which is like I give it my least priority." "... it's really confusing, so I end up not doing it."
	Self-efficacy	" …If you get a mistake, you have to just correct that..." "…If we make mistakes, we will do better in the next assessments."
	Achievement	".... ma'am gives us internals." "...we have five marks for activities also."
Teacher-related	Teaching style and teachers' characteristics	" …ma'am usually encourages us…asks us again and again whether or not we understood the whole thing and that encourages the pupils to ask questions." "...most of the time she ignores my question so I have to ask my friend."
Classroom environment	Shared emotions	"… I will be like doing the sums and listening to ma'am…." "…most of them feel maths is a little boring...so whenever someone come to teach maths we too feel like we are not happy."
	Interaction between teacher and students	".. we don't understand; we can ask if or how did you solve this or how did you get this answer?" "I am hesitant to ask questions; in front of everyone I am hesitant, but if ma'am comes to our place, I will ask."
Content related	Make simple mistakes	"Silly mistakes..if I copy a question that has a plus sign, I might put a minus sign instead of that.." "I make basic calculation errors…."
	Studying numbers	"Maths is the study of numbers…." "…studying different types of numbers…."
	Understanding the concept	"Algebra, constructions, simple interest… because I feel those are easy to understand." "Usually when everyone understands, I don't understand, however much I try…."
	Activities are needed	"Sometimes, we have hands-on activities… ah… to help or understand the concepts better…." "Ma'am, makes us do physical, hands-on activity, so that it is easier to visualise and understand the stuff..."
Utility value	Higher education and career	"... if you wanted to become a charted accountant… the architecture, you need maths. So, it depends on what you want to pursue in your life…."
	Related to daily life	"…for everything we require maths like for shopping…transactions…competitive exams." "…I know the value of maths because in daily life you need maths… But I feel that a few concepts are not necessary in life or in math … because they have no use later …"
	Relations with other subjects	" …in bio also, like some mathematics…in chemistry reactions, we should balance only with mathematics calculations." "...even economics is math … you have to calculate the growth of a country."

Theme 1: Student attributes

Student attributes indicate their feelings that lead to several behaviours in mathematics classroom learning. It includes positive and negative emotions, anxiety and self-efficacy among students. Table 1, shows that positive emotions depend upon the content studied. At the same time, some of them expressed their negative emotions toward mathematics. The extract shows some participants' disinterest in mathematics learning. A few participants felt they would not follow the sums and get tense or confused at the end. Some participants perceived that they needed to improve in mathematics. Participants sometimes show their self-efficacy in different situations in the mathematics classroom. The extracts related to self-efficacy reflect the importance of being positive in adverse situations. Many students concentrate on performing well in assessments. They look at any activity in terms of getting good marks. Some view classroom activities as achievement-related tasks. Some students think classroom activities help them remember the concepts well for assessments and exams. Participants are worried about losing marks in exams. Some students feel that tests and exams help them perform better in future.

Theme 2: Teacher attributes

As shown in Table 1, participants expressed their opinions about the teacher by quoting incidents that took place in the mathematics classroom. Teachers' teaching attitudes are essential factors. Student learning depends on how the teacher imparts the content. Many students reported that the teacher instructs by explaining and solving sums on the boards. Some participants feel the teacher is kind and encouraging, while others think the teacher scolds and intentionally ignores them.

Theme 3: Classroom environment

The environment is essential to develop students' perceptions of mathematics learning. Many factors in the classroom environment may positively or negatively affect them. Participants show shared emotions in the classroom. Some like the class and actively participate in learning. Some do not like it and make interruptions. Interaction between students and teachers is essential, making the class vibrant. Active participation of students in classroom learning is necessary. Some students feel free to ask questions, but some do not, as they need to catch up on the concepts or for other reasons.

Theme 4: Content-related

The content studied is essential in determining students' perception of mathematics learning. Participants shared their mistakes in the classrooms, mostly simple calculation errors. They think of mathematics learning as studying numbers and that solving problems with numbers is vital. Extracts show their opinions on understanding the concept, reflecting that they feel it is easy and they like the concept when they know it. They think it is difficult and sometimes tedious if they need help understanding the concept, which is one of the determinants of their perceptions. Participants believe activities make the concept understandable, and they can remember them later also. They feel activities are enjoyable and help them to remember concepts.

Theme 5: Utility value

Understanding the utility value of a subject is an essential aspect of learning. It helps students in many ways. Participants learn mathematics to pursue their careers. Many want to choose their higher education and career according to their favourite subject. They think mathematics learning is essential and beneficial for their lives depending upon their higher education and career.

Participants identify where mathematics can be applied in everyday life. Most of them say it is used for shopping and banking. Some pointed out that mathematics is used in competitive examinations and measuring height or weight to understand how much they gain or increase. Participants say they can associate the gap between the classroom and real-world mathematics, even though some feel that a few content features need to be more relevant and helpful. Some participants believe that advanced math is needed to pursue a career in mathematics. Participants think that mathematics related to other subjects like chemistry, physics and economics.

Discussion

Student attributes include mixed positive and negative emotions towards mathematics (Utha, Subba, Mongar, Hopwood, & Pressick-Kilborn, 2021). Some participants think mathematics is interesting and fun, which reflects their positive emotions toward the subject (Zan & Martino, 2007). Some participants enjoy problem-solving in the classroom. Contrary to this, some consider it boring (Pepin, 2011) and prefer to avoid solving sums. However, the content and complexity of the subject play a role in creating positive and negative emotions in mathematics learning (Brown, Brown, & Bibby, 2008; Utha et al., 2021). Mathematics anxiety is one of the primary negative emotions concerning participants' learning. The present study's findings on mathematics anxiety revealed that participants are confused between concepts and lack understanding. Concerning these findings, Kaba and Sengul (2018) found a positive relationship between students' understanding of the concept and mathematics anxiety.

The current study's findings indicate that mathematics self-efficacy is another prevalent factor obtained from participants' experiences. Some are confident that they are good at the subject (Darragh, 2015) and are usually relaxed about making mistakes (Heinze, 2005). Participants study to get marks on achievement tests. Many think grades are essential and help them in higher education (Hernandez-Martinez, & Vos, 2017). Also, they are happy when they get good grades in the test. Participants like activities (Celik, 2018; Oribhabor, 2020; Kaur &Sankhian, 2017) and some said they like to pursue graded activities. Participants consider performance in tests as one of the crucial factors in learning.

Teachers' attitude is prominent in every mathematics classroom (Tok, Bahtiyar, & Karalok, 2015). Generally, the instructor explains the concept, solves sums on the blackboard and helps students with their doubts. Lecturing or explaining the concepts is the usual way of teaching mathematics in classrooms (Mapolelo, 2009). The present study revealed that mathematics classrooms follow traditional rather than activity approaches. This is consistent with the results of past studies (Dogruer, Isiksal, & Koc, 2015). Participants' attitudes toward mathematics teachers depend on their teaching and behaviour (Martinez-Sierra, 2014). Teachers' affirmative nature creates interest in mathematics among participants (Tarmizi, Tarmizi, & Mokhtar, 2010). The participants' responses show that if they feel the teacher is kind and encouraging, they focus more on learning (Kislenko, 2011; Mapolelo, 2009). If the teacher shouts or scolds, students dislike them and thereby the subject the teacher handles (Etuk, Afangideh, & Uya, 2013; Kislenko, 2011).

Students' emotion in the mathematics classroom is an essential determinant of their perception. Children's disruptive behaviour affects the learning environment in mathematics (Abeygunawardena & Vithanapatirana, 2019). Peer relationship is another factor. Helping others is a crucial personal factor. Participants' willingness to help depends on whether they

know the concepts correctly. Newman and Schwager (1993) reported that middle school students are comfortable learning in small groups with their peers. The present study's results indicate that the interaction between the teacher and students is an essential factor in the classroom environment (Mamolo & Sugano, 2020). Teacher-student interaction influences participants' perceptions of mathematics learning (Barksdale, Peters, & Corrales, 2021).

Content has a vital role in mathematics learning. Most considered mathematics to be about studying or revolving around numbers (Young-Loveridge et al., 2006). Participants would like to learn the subject based on the content. They engage with the concept if it is easy and dislike it if it is difficult (Yilmaz, Altun, & Olkun, 2010). Participants enjoy the content if they understand it and dislike it if they do not (Breiteig, Grevholm, & Kislenko, 2005). They make simple errors while solving sums (Heinze, 2005) and like to pursue classroom activities (Baki & Cakiroglu, 2010), enjoy them and believe that they help them learn better.

The utility value of a subject is another vital aspect of participants' perceptions of mathematics learning. Participants like to choose their higher education and career streams based on their favourite subjects (Takeuchi, Towers, & Martin, 2016). They think mathematics is essential to become professionals (Dobie, 2019; Gokalp, 2020; Martínez-Sierra & Miranda-Tirado, 2015) such as chartered accountants, engineers and architects. Many of them think about the real-life uses of mathematics (Martinez-Sierra, & Miranda-Tirado, 2015), whose typical examples include buying and banking (Altay & Yeltekin, 2017). Participants are not interested in learning mathematics if they feel the content is not helpful. Some students think content like algebra, exponents and factorisation is complex (Wong, Lam, Wong, Leung, & Mok, 2001) and unnecessary, because they cannot find the real-life applications of such content (Kislenko, 2011). Another important fact related to the utility value is mathematics associated with other subjects (Gebremichael, 2014), such as chemistry, biology and economics.

Conclusion and Implication

The study emphasises the importance of understanding students' perception of mathematics learning, which determines its absorption in classrooms. What students think about mathematics learning is essential and creates interest in the subject. Teachers and instructional methods also play a role. Implementing new strategies in teacher education programs would be helpful for teachers to give better learning experiences. Pre-service and in-service teacher training should be modified to incorporate methods that respond to students' needs, particularly connecting emotions and mathematics learning in classrooms. Equal importance should be given to teaching content in a classroom and combining it with its utility value and the outside world (Abril, 2022). Teachers should be trained to teach mathematics from a socio-cultural and socio-emotional perspective. Students like mathematics based on the topic and their understanding of the concept. Teacher interaction plays a crucial role.

The content's utility value helps pupils to connect to the subject in many situations. Classroom experiences are the best ways to understand students' perceptions and would help design, plan and modify curriculum and pedagogical practices. Various educational and psychological intervention programs are needed, which would help us gauge the current classroom scenario. Understanding their perception of mathematics learning helps make necessary changes in the learning environment, especially teacher interaction, so appropriate strategies can adapt to students' needs. Teachers can understand the cognitive and affective aspects of students'

learning, which would help to change the content-teaching-learning elements and lead to active involvement and enjoyment in learning.

Limitation and Recommendation for Future Study

The study has some limitations which may have impacted the findings. As a qualitative study, the findings give an understanding of the phenomenon and cannot be generalised to a larger group. The study findings should be considered within the socio-cultural and geographic location. The current study was conducted in India, having participants who are from urban and middle-class families studying in an English-speaking school. The aspects of social desirability may have impacted students to give more positive responses, though the researchers established rapport and created a safe space for students to share their views.

Future research can further extend the study findings and overcome the limitations. The themes from the study findings could be further tested and validated using quantitative measures with larger representative sample with varied backgrounds. Such models can be tested and the impact of socio-cultural factors can be explored. Experiments and interventions with mixed method designs could be developed to enhance student mathematical wellbeing and learning. The experiences of educators could be explored to identify the challenges in teaching mathematics.

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