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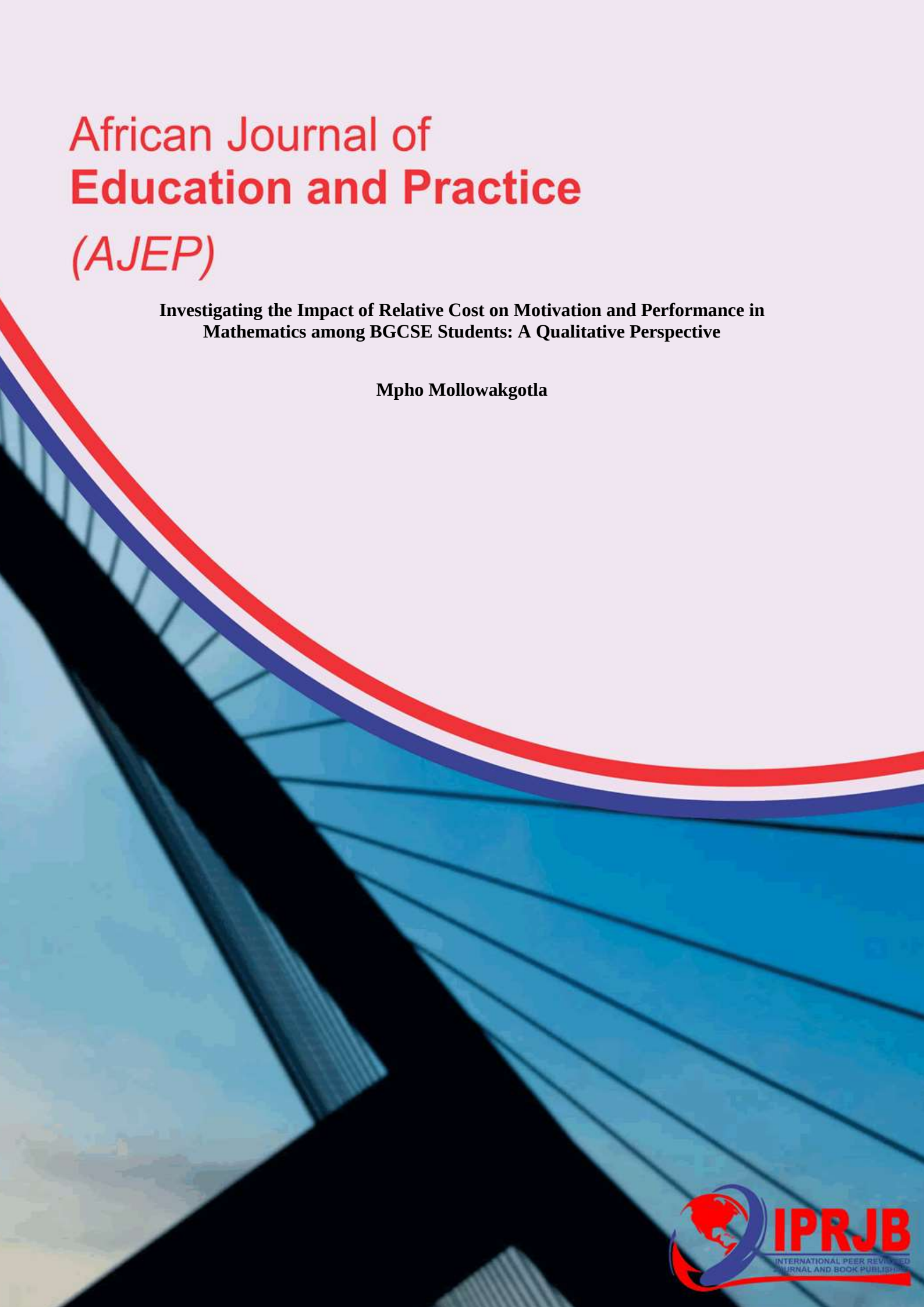

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Abstract

Purpose: This study investigated the impact of 'relative cost', a component of the Expectancy-Value Theory, on the performance of Botswana General Certificate of Secondary Education (BGCSE) mathematics. It also investigated the impact of social influences (parents, teachers, and peers) on students' mathematics perceptions.

Methodology: In this qualitative research study, focus groups were conducted with a purposive sample of 40 students selected based on their performance from 10 randomly sampled secondary schools. The primary aim was to gain a comprehensive understanding of the students' experiences and perspectives.

Findings: The results indicate that when engaging with mathematics, students perceive costs in the form of effort, stress, loss of time, and loss of preferable alternatives. Additionally, the study shows that teachers come in third after parents and peers in terms of influence on students' mathematics perceptions.

Unique Contribution to Theory, Practice and Policy: Based on these findings, it is suggested that strategies be developed to mitigate these perceived costs and assist students in dealing with mathematics more effectively. This may include techniques for stress management, time management, or alternative teaching methods that make learning mathematics more pleasurable and less time-consuming.

Keywords: *Expectancy Value Theory (EVT), BGCSE, Performance, Relative Cost*

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INTRODUCTION

The Botswana General Certificate of Secondary Education (BGCSE) students' mathematics performance has remained below expected benchmarks for the past decade. As reflected in Figure 1, for the past ten years, BGCSE mathematics grades have remained below 35% for students attaining Grade C or better (Botswana Examinations Council, 2019,2020, 2022). Many research studies have explored the reasons behind this underperformance and blamed a litany of factors, such as resource constraints in schools, students' indiscipline, and ineffective pedagogy, just to mention a few (Masole et al., 2016; Monyaku & Mmereki, 2012). However, one area that has been widely neglected is student motivation.

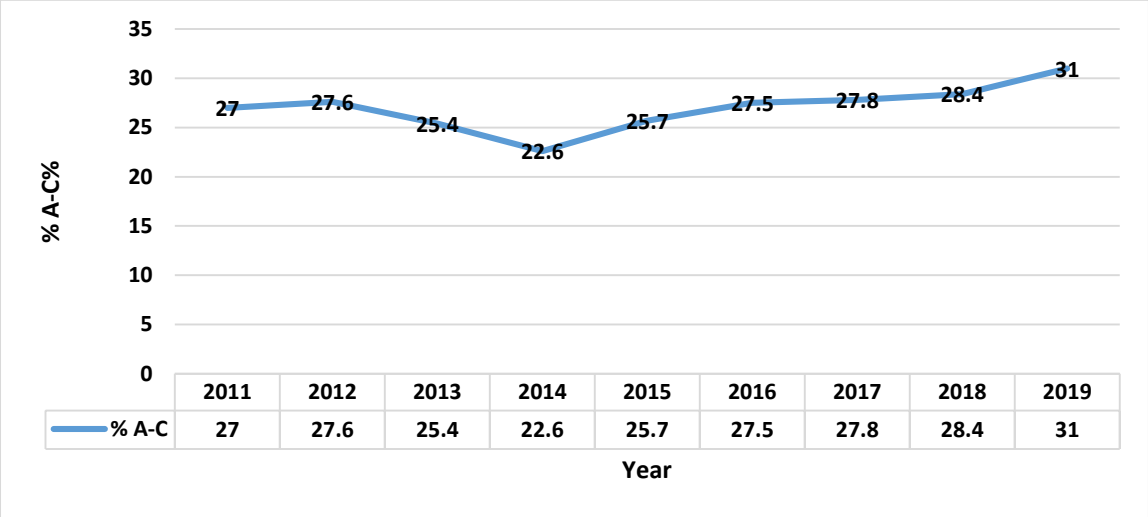

Figure 1: BGCSE Mathematics Performance (Grades C or Better)

The Expectancy Value Theory (EVT) has been widely employed as a comprehensive model for exploring the motivation, achievement, and engagement of learners in an array of educational contexts (Eccles, et al., 1983; Wigfield & Eccles, 2000).). EVT postulates that the behaviours and choices of individuals are predominantly influenced by their expectancies for success and the subjective value they attach to a task (Eccles et al., 1983). Most previous studies in the literature have primarily concentrated on examining attainment, intrinsic, and utility values, while relatively neglecting the exploration of the component of task value known as relative cost. Relative cost refers to the perceived negative aspects associated with engaging in a task.

As such, a study focused on relative cost is crucial to fully exploring the array of factors that influence the motivation of students and its relation to their achievement across various subjects. The EVT value component of relative cost encompasses various factors such as required effort, potential loss of time, emotional stress, and opportunity costs associated with engaging in an activity (Eccles et al., 1983; Wigfield & Eccles, 2000). Regarding BGCSE students' performance, studying the influence of relative cost may provide crucial insights into the attitudes and beliefs of students related to mathematics and their subsequent engagement and performance in the subject.

The existing literature on EVT in mathematics education has predominantly explored the components of expectancy beliefs and task values, giving insufficient attention to the influence that relative cost has on students' motivation and achievement (Wigfield & Cambria ,2010).

Moreover, the influence of social milieu, particularly parents, teachers, and peers, has remained unexplored within the Botswana educational system. Therefore, there is a clear research gap in understanding the dynamics of relative cost and its influence on students' motivation and mathematics achievement within Botswana's secondary schools (Wigfield & Eccles, 2000).

The current study aims to address this gap by examining Botswana General Certificate of Secondary Education (BGCSE) students' perceptions of relative cost in the context of mathematics proficiency and performance, with a focus on the qualitative understanding of students' experiences. This study also explores social influences (parents, peers, teachers) on students' mathematics perceptions. This study therefore seeks to illuminate the hitherto neglected EVT component of relative cost and contribute to the literature on students' motivation and mathematics education.

Problem Statement

Despite numerous efforts to improve mathematics performance among BGCSE students, their grades continue to fall below expectations. Various contributing factors have been identified as reasons for the unsatisfactory results, but students' motivation has received little attention. The contribution of relative cost as a motivational component of EVT has not been studied among Botswana students. Relative cost refers to the negatives of engaging in an activity, such as effort, time, stress, and opportunity costs. Existing research has frequently overlooked relative cost and its potential impact on student motivation and success, notably in mathematics education. The exclusion of cost is briefly mentioned in various papers such as Eccles & Wigfield (1995), Wigfield & Eccles (2000), and Wigfield & Cambria (2010), yet insufficient explanation is provided regarding the rationale for its neglect in these studies. In addition, social influences from parents, teachers, and peers and their influences on students' mathematics perceptions remain unexplored. This research gap necessitates a need for a comprehensive study on students' perceptions of relative cost and social variables that affect their motivation and ability in mathematics.

Purpose

The purpose of this study was to identify and examine the impact of relative cost on the motivation and performance of BGCSE students in mathematics. Additionally, this study investigated the role of parents, teachers, and peers, in shaping students' perceptions associated with mathematics within the Botswana educational context.

Research Questions

1. What is the relationship between relative cost and the engagement and performance of BGCSE students in mathematics?
2. How do the contributions of parents, teachers, and peers impact students' perceptions of the costs of studying mathematics?

LITERATURE REVIEW

Studies on EVT and Mathematics Education

Expectancy Value Theory has been widely applied in mathematics education research to understand students' motivation, engagement, and achievement (e.g., Meece, Glienke, & Burg, 2006.; Trautwein, et al. 2012; Simpkins, Davis-Kean, & Eccles, 2006). Numerous studies (e.g., Gaspard et al., 2015) have shown that students' expectancy beliefs and task values are strong determinants of their interest, perseverance, and achievement in mathematics studies. Research

has shown that students who believe they will succeed at a task and who view the task as significant or valuable for their future endeavours study more and attain better grades. Further, researchers have found that social influences such as parental involvement and peer norms may influence students' expectancy beliefs in mathematics (Simpkins et al., 2015; Upadyaya & Eccles, 2014).

Studies on Relative Cost

While most EVT research in mathematics education has focused on the roles of expectancy beliefs and task values, the component of relative cost has received comparatively less attention. Relative cost represents the perceived negative aspects of engaging in a task, such as the required effort, emotional stress, and opportunity costs associated with the activity (Eccles et al., 1983). Few studies have examined the role of relative cost in mathematics education, and the existing research has produced mixed findings. Some studies have found that relative cost negatively predicts students' engagement and achievement in mathematics (e.g., Jiang et al., 2018; Perez et al., 2014), while others have reported weak or nonsignificant associations between cost and mathematics outcomes (e.g., Conley, 2012; Luttrell et al.,2010).

The Role of Social Influences on Students' Perceptions of Mathematics

The influence of social factors, such as peers, parents, and teachers, on students' motivation and achievement in mathematics has been well-established in the literature (Grolnick, et al., 2013; Martin, 2017; Peterson, et al., 2011). However, the impact of these social influences on students' perceptions of mathematics cost has been underexplored. Understanding the role of social factors in shaping students' perceptions of relative cost is essential, as these perceptions may directly or indirectly influence students' engagement and achievement in mathematics.

METHODOLOGY

This study used a qualitative research design that focused on focus group discussions to gather rich, detailed, and in-depth data from participants and encouraged interaction among them. Focus group discussions provided a suitable platform for participants to share their experiences, opinions, and insights about the research topic, enabling a comprehensive understanding of the phenomenon.

Participants

A purposive sampling technique was employed to select a sample of 40 students from 10 senior secondary schools across five educational regions, ensuring representation of students with grades A to C and D to G. Each school was equally represented in the sample, with four students selected from each school. The sample was intentionally diverse in terms of gender and performance in mathematics, allowing for a comprehensive range of perspectives and experiences to be gathered, thereby enhancing the overall validity of the study's findings.

Data Collection

Focus group discussions were used to collect data for this study. Each of the 10 participating schools hosted one focus group, which consisted of four students. The discussions were facilitated by the researcher who ensured that the discussions remained on-topic and that all participants had an equal opportunity to contribute. The focus group discussions were audio-recorded and transcribed verbatim to ensure accurate data analysis.

Data Analysis

The data analysis process followed Saldana's (2009) multi-phase coding approach, which involved manual coding of the focus group transcripts. The transcripts were read multiple times to gain a thorough understanding of the content. Next, open coding was conducted, which allowed the researcher to identify recurring themes, patterns, and ideas. After the open coding phase, axial coding was performed to establish relationships among the emerging themes and grouped them into broader categories. Finally, selective coding was undertaken to integrate the categories and themes into a coherent and comprehensive framework, capturing the essence of the participants' experiences.

Ethical Considerations

The study was conducted in accordance with the ethical guidelines for conducting research with human subjects. Ethical approval was obtained from the institutional review board prior to data collection. Informed consent was obtained from all participants and their legal guardians (for those under 18), which included information about the study's purpose, procedures, potential risks and benefits, and confidentiality. Participants were assured of their right to withdraw from the study at any time without penalty. The confidentiality and anonymity of the participants were maintained throughout the research process by using unique identifiers in place of their names and keeping all data securely stored.

RESULTS

The results of the study are organised into three main themes: mathematics and various costs, differences in perceptions of mathematics costs between students with lower and higher grades, and the impact of social influences on students' perceptions of mathematics costs.

Theme 1: Mathematics and Various Costs

The analysis revealed that students consistently associated mathematics with several costs. These costs included stress, excessive effort, boredom, and time taken away from preferred activities. Many participants shared that mathematics induced stress due to the subject's complexity, difficulty in understanding concepts, and pressure to perform well in examinations. They also highlighted the excessive effort required to grasp mathematical concepts, which often led to frustration and a feeling of inadequacy. Boredom was another cost mentioned, as some students found the subject monotonous and uninteresting. Lastly, participants expressed concerns about the amount of time devoted to studying mathematics, which took away from their preferred activities and hobbies. For example, Booker (LG), said:

The daily homework from our math teacher makes it difficult for us to give other subjects enough time and effort. I am lagging in biology because I always spend time on math. It's stressful.

Doris (LP) remarked: How are we supposed to earn decent grades when the material is so difficult? They load us down with an excessive amount of assignments, quizzes, and examinations. There is no breathing space…

Theme 2: Differences in Perceptions of Mathematics Costs between Students with Lower and Higher Grades

The study discovered that students with lower grades perceived mathematics differently from students with higher grades. Students with lower grade point averages (LG) were more likely to emphasise the stress and unnecessary work involved with mathematics, frequently

attributing their difficulties to a lack of intrinsic ability or intellect. Students with higher grades (HG) were more likely to emphasise the importance of mathematics in their lives and professions, as well as to see it as a task that they were prepared to overcome. According to the findings, students' perceptions of the cost of mathematics can have a major influence on their academic progress. *Montle (LG) stated, "Every time I think about math lessons, I become stressed." I simply hate the subject, and I absolutely hate the teacher even more. I wish I could be allowed not to do the subject.*

Students with higher grades recognised the difficulties of mathematics but saw them as attainable via constant practice, excellent study methods, and perseverance. These students were less likely to express boredom or time taken away from preferred activities since they frequently appreciated or found the subject enjoyable. "Math is really demanding," Blake (HG) commented. I adore the topic and enjoy difficulties."

Theme 3: Social Influences and Students' Mathematics Costs Perceptions

Social influences form peers, parents, and teachers, were found to play a significant role in shaping students' perceptions of mathematics. Peers often influenced participants' attitudes towards mathematics, as students tended to adopt the beliefs and feelings of their friends. Positive peer influences encouraged a more favourable view of mathematics, while negative peer influences reinforced the perception of mathematics as stressful, difficult, and time-consuming. *As Martin (LG) said:*

My crew and I are extremely close. It makes no difference to us at all. We're all bad at math. We never discuss the reasons for our poor performance because we know it is impossible to pass.

Dintle (HP) acknowledged that her friends motivated her to love and study mathematics. She admitted to spending most of her time studying with her friends.

If it weren't for my friends, I wouldn't be getting such good grades in math. They motivate me to study hard, even when I want to procrastinate. They all enjoy math, and I suppose it has rubbed off on me. It was different in junior secondary, where I kept bad company and got a grade D in math…

Parents' attitudes and expectations were also found to be impactful on students' perceptions of mathematics. Supportive and encouraging parents helped alleviate some of the stress and pressure associated with mathematics, while overly demanding or critical parents exacerbated these feelings.

Dintle: My parents always tell me how important math is. They pay for my tuition so I can take extra math classes. I know how important math is because of my parents. So, I spend time getting better at math. (A-C in Group 3,)

Teachers play a crucial role in shaping students' experiences with mathematics. According to the participants, effective and engaging teachers could reduce the perceived costs of mathematics by making the subject more enjoyable, comprehensible, and accessible. Conversely, less effective teachers could contribute to increased stress, boredom, and frustration. For instance, LG participants used phrases such as 'unsupportive', 'strict' and "judgmental" to describe their teachers.

Overall, the study findings indicate that mathematics has numerous costs and that socialisers have a profound influence on student perceptions. Teachers, parents, and policy makers can

benefit from understanding these aspects to improve the mathematical experiences and performance of their children.

DISCUSSION

The findings of this study support Expectancy-Value Theory (EVT), which suggests that students' motivation and achievement are influenced by their expectations of success and the subjective value they place on academic tasks. The participants in this study identified various costs associated with mathematics, including stress, excessive effort, boredom, and missed opportunities, which are components of the relative cost aspect of EVT.

In line with Luttrell et al. (2010), the differences in perceptions of mathematics cost between students with lower and higher grades can be explained by the expectancy component of EVT. Students with lower grades, who may have lower expectations of success, tended to emphasize the costs associated with mathematics, such as stress, excessive effort, boredom, and time taken away from preferred activities. On the other hand, students with higher grades, who may have higher expectations of success, viewed the costs as more manageable.

Consistent with Martin (2017), the results of this study support the notion that social factors have an impact on students' perceptions of mathematics costs, aligning with the principles of Expectancy-Value Theory (EVT). Peers, parents, and teachers all play significant roles in shaping students' expectations and values regarding mathematics, ultimately influencing their motivation, engagement, and academic achievement in the subject.

Overall, this study demonstrates the relevance of EVT in understanding students' perceptions of mathematics costs, highlighting the importance of expectancies and subjective values in shaping their experiences and outcomes in the subject.

Implications for Mathematics Education and Intervention Design

The findings of the study have several implications for mathematics education and intervention design. Firstly, educators should be cognizant of the various costs that students associate with mathematics and work to address these concerns. Strategies may include simplifying complex concepts, providing additional support for struggling students, and creating engaging and enjoyable learning experiences to reduce boredom and increase motivation.

Furthermore, interventions aimed at improving students' expectancies for success and subjective task values can potentially reduce the perceived costs of mathematics. Such interventions may involve fostering a growth mindset, setting realistic yet challenging goals, and providing timely and constructive feedback.

Lastly, the influence of socialisers on students' perceptions of mathematics emphasises the significance of creating a supportive learning environment that includes not only teachers but also parents and peers. Encouraging positive peer interactions, promoting parental involvement in the education of learners, and providing educators with ongoing professional development may lead to a more favourable perception of mathematics and improved student achievements.

Limitations of the Study

Despite the helpful discoveries made, there are a few limitations that need to be mentioned. The first limitation is that the study's sample size was low, limiting how widely applicable the results will be. Although care was taken to ensure that the sample was representative of a wide range of demographics, it is possible that the small sample size does not accurately reflect the

population of interest. To increase the internal and external validity of future studies, researchers should work to increase the size of their samples.

Second, the study's cross-sectional design might make it difficult to draw conclusions about causation. A better understanding of the factors driving the adoption of relative cost and EVT may be attained by a longitudinal research design, which would provide an assessment of changes over time.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

In conclusion, this study reveals the substantial impact of cost on students' mathematics performance, motivation, engagement, and perception of mathematics' value. Various cost factors, including effort, opportunity costs, anxiety, and fear of failure, have been identified as significant influences on mathematics achievement. These findings hold implications for educators and policymakers seeking to improve mathematics performance by addressing these cost-related barriers. The study highlights the need for further research on cost issues and the development of evidence-based interventions to mitigate their influence on students' mathematics performance.

Recommendations

To address the concerns of students with low grades who associate mathematics with excessive effort, stress, and lost opportunities, several recommendations can be implemented. Firstly, teachers should adopt differentiated instruction strategies to cater to the diverse learning needs of these students. Providing additional support and resources, along with personalised instruction, can help alleviate their perceived barriers and enhance their understanding and engagement with mathematics.

Additionally, creating a supportive classroom environment that focuses on emotional well-being is crucial. Teachers should offer resources and strategies to manage stress and anxiety related to math, fostering open communication channels where students feel comfortable expressing their concerns and seeking guidance. Furthermore, it is recommended that teachers and policymakers enhance student engagement in mathematics by implementing innovative and interactive teaching methods. By incorporating real-life examples, practical applications, and technology integration, educators can make mathematics more enjoyable and relevant, thus reducing the perceived costs associated with the subject.

Providing academic support through tutoring programs, peer mentoring, and targeted interventions can also aid students in developing their foundational math skills and boosting their confidence. Parental involvement plays a significant role as well, as collaboration between teachers and parents can create a supportive home-school partnership. Educating parents about mathematics-related challenges and equipping them with resources to support their child's learning at home fosters a cohesive approach to addressing math costs.

Additionally, policymakers should review and revise curriculum and policies to promote inclusivity, equity, and flexibility in assessment methods, ensuring that students are not limited by perceived lost opportunities but instead encouraged to reach their full mathematical potential.

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