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Abstract

This correlational study investigated the impact of instructional factors on students' skills in linear functions and their academic engagement in mathematics courses in Gatsibo District. Utilizing a quantitative approach, data were collected from 276 secondary school students through a structured questionnaire designed to measure teaching strategies, availability of learning resources, and student motivation. Pearson correlation coefficients were calculated to explore relationships among these variables, revealing a significant positive correlation, particularly with student motivation ($r = 0.988$), which was the strongest predictor of success in linear function exercises and retention of knowledge. Additionally, effective teaching strategies and heightened student attention were associated with improved engagement indicators. The study highlighted the importance of prioritizing student motivation and positioning engaging instructional strategies to enhance academic performance in linear functions, supporting for targeted interventions to raise deeper understanding and improved outcomes in mathematics education.

Introduction

Linear functions are fundamental concepts in mathematics, forming the basis for more advanced topics in algebra (Curtis, 2012). They are extensively used in various fields, including physics, engineering, economics, and computer science. Therefore, assessing students' motivation towards linear function practice is essential for their mathematical academic success (Luiselli et al., 2005). Motivation is a key cognitive process essential for effective learning (Niu et al., 2021). Understanding how students engage with and pay attention to linear function practice provide insights into the effectiveness of teaching methods, curriculum design, and student motivation (Álvarez et al., 2020).

Factors such as class size, teacher-student interactions, infrastructure, and available resources influence students' attention and learning outcomes (Akram et al., 2023; Lasekan et al., 2024; Niyibizi et al., 2024). The study was likely aim to address a gap in existing literature and practice regarding the motivation of students towards linear function practice specifically in Gatsibo public secondary schools. Identifying this gap had emphasized the need for empirical research to enhance understanding and potentially improve teaching strategies and student engagement in mathematics education.

Assessing teaching strategy involves a comprehensive examination of the effectiveness of teaching methods and learning materials used in the instruction of linear functions (Rabiner et al., 2010). This requires a structured approach to assessing student engagement, comprehension, and upkeep of linear function concepts within the curriculum. Preferably, the assessment would encompass various instructional techniques, including lectures, interactive activities, and supplementary resources, to adoptive a deeper understanding of linear functions among students.

However, the assessment of learning resources availability on linear function practice faces challenges restricting from various factors (Miao et al., 2021). These factors include resource constraints, such as limited access to technology and educational materials, as well as the inconsistencies in teaching methodologies among teachers. Additionally, student motivation levels and socio-economic backgrounds impact the engagement of students during linear function practice sessions (Shoshani et al., 2016). Understanding these realities was crucial for the current study.

Understanding linear functions lays the cornerstone for students to establish a robust algebraic foundation, wherein the ubiquitous linear function rule $y = mx + c$ necessitates a conceptual grasp of variables (x and y) and parameters (m and c), explaining their distinct roles within the rule. Through the Australian study, highlighted that students' comprehension and utilization of variables and parameters within linear functions, analyzing teaching methodologies' impact through material analysis, classroom observations, testing, and interviews with three teachers and students across four classes over two years, wherein classes employing a real-world/graphical approach with graphic calculators exhibited enhanced comprehension, particularly in contextualizing variables and perceptive linear function structures, although revealing a tendency to overlook the conceptual significance of c in their verbal and symbolic representations (Pierce et al., 2010).

In the comprehensive guide, the study aimed to equip readers with the foundational concepts required to initiate research on offline reinforcement learning algorithms, focusing on utilizing pre-existing data without online collection. The study outlined methods centered on linear function approximates, encompassing learning approaches derived from value function and policy estimation frameworks (Levine et al., 2020).

In two longitudinally-designed studies, the researchers proposed augmenting the student engagement construct by introducing agentic engagement while reevaluating the significance of emotional engagement. Throughout an 18-week semester, secondary-grade students self-reported behavioral, emotional, cognitive, and agentic engagement, with subsequent analyses revealing that agentic engagement independently predicted course achievement and end-of-semester gains in perceived academic progress and autonomy-supportive teaching, underscoring the imperative of incorporating agentic engagement and reassessing the role of emotional engagement for a more comprehensive model (Reeve et al., 2020).

The study examined 1193 8^{th} grade students in 57 math classrooms to assess the impact of teacher need-supporting practices on classroom-level engagement, finding no support for the additive or synergistic hypotheses, but confirming the global hypothesis that a composite of autonomy support, structure, and involvement optimally enhances engagement. Correlations between autonomy support, structure, and involvement factors were high at student (above 0.84) and classroom levels (above 0.90), indicating potential conceptual overlap and multi-collinearity risks, yet supporting their combined efficacy (Olivier et al., 2021).

The study's findings underscored the pivotal role of teacher self-efficacy in shaping the quality of teacher-student relationships, with higher levels of teacher confidence correlating positively with increased closeness and decreased conflict across all grade levels. These results lighten avenues for enhancing relationship dynamics within classrooms by raising and connecting teacher self-efficacy through targeted interventions and training programs informed by a social cognitive framework (Hajovsky et al., 2020).

Backward transfer, referring to the impact of new learning on individuals' existing reasoning, was investigated through an exploratory study examining the effects of quadratic functions instruction on students' prior ways of reasoning about linear functions in real classrooms. The study involved two algebra classes and their teachers from low-socioeconomic urban populations at comprehensive high schools, utilizing pre- and post-assessments on linear functions before and after a four- to five-week instructional unit on quadratic functions. Qualitative analysis showed three distinct backward transfer influences, each linked to a shift in students' reasoning towards an action or process-oriented view of functions, while variations in instructional approaches across the classrooms explained the observed differences in backward transfer effects (Hohensee et al., 2024).

According to Rabiner et al. (2010) the study conducted was a randomized-controlled trial assessing the impact of Computerized Attention Training (CAT) and Computer Assisted Instruction (CAI) on attention and academic performance among 77 inattentive first graders. Both interventions showed a greater likelihood of reducing teacher-rated attention problems compared to the control group. Moreover, students receiving CAI exhibited improvements in reading fluency and academic performance, highlighting the potential benefits of such interventions. However, while attention improvements decreased by second grade across all groups, further analyses suggested potential long-term advantages, particularly for children with more severe attention deficits at baseline, underlining the critical link between attention and academic outcomes.

A study investigating the utilization of media in online university courses reveals its facilitative role in the learning process through expanded information delivery formats, while also identifying challenges arising from inappropriate media usage, the research evaluates the prevalence of these issues and discusses the pedagogical implications, offering solutions to enhance the online learning experience by refining media delivery methods (Lange & Costley, 2020).

The Covid19 pandemic has propelled the world into a new era of online learning, necessitating a relentless exploration of its boundaries to uphold the education system's vitality. Within this realm, Knowledge Tracing (KT) emerges as a pivotal element, aiming to gauge students' knowledge levels by analyzing their responses to sequential exercises or interactions, wherein the relation between exercises and students forget behavior plays a crucial role. Traditional approaches to knowledge tracing often neglect to jointly model both components, prompting the proposal of a novel Relation-aware self-attention model for Knowledge Tracing (RKT), which integrates exercise relations, student performance data, and forget behavior through a contextualized, relation-aware self-attention layer. Extensive experiments across multiple real-world datasets, including newly released collections, demonstrate the superiority of the RKT model over existing knowledge tracing methodologies, while its interpretable attention weights offer valuable insights into the temporal dynamics and relational patterns inherent in the learning process (Pandey & Srivastava, 2020).

The paramount focus on students' success in higher education institutions has led to a heightened emphasis on sustaining enrollment amidst budget constraints. In this context, study employed a 10-fold cross-validation technique, training the Ensemble Model on 90% of data points and testing with a varying 10% split over 10 different runs to ensure robust accuracy assessments (Zeineddine et al., 2021). Therefore, this study pursues to address the following research questions:

1. What is the significance of the correlation between teaching strategies and student performance, attention, engagement, and retention of knowledge?
2. How does the availability of learning resources impact accuracy in linear function exercises, attention, engagement, and retention?
3. To what extent does student motivation influence academic outcomes, including attention, engagement, and knowledge retention in the context of linear functions?

Method

Research Approach

The research adopted a quantitative approach, aiming to objectively assess the relationships between instructional factors and student outcomes in linear function skills. By utilizing statistical methods, the study facilitated the measurement of correlation coefficients to evaluate the significance of various variables such as teaching strategies, availability of learning resources, and levels of student motivation. Additionally, the quantitative nature allowed for the collection of numerical data that could be analyzed systematically, leading to insights that could inform educational practices and improve student engagement and performance.

Participants

The population for this study comprised students enrolled in mathematics courses focusing on linear functions in Gatsibo District. A sample of 276 students was drawn from multiple secondary schools, ensuring representation across different academic backgrounds and experience levels. The sampling technique employed was stratified random sampling, which involved dividing the population into homogenous subgroups based on factors such as grade level and academic performance. This approach ensured that the sample accurately reflected the uniformity present in the broader student population while allowing for more precise comparisons within specific subgroups.

Research Instruments

Data were collected using a structured questionnaire specifically designed to measure the key variables of interest, namely teaching strategies, learning resources availability, and student motivation. The questionnaire consisted of closed-ended questions that captured students' awareness regarding these instructional factors and their implication for their academic engagement and performance. Prior to distribution, the questionnaire was pilot-tested with a small group of students to ensure clarity and relevance of the items. The final version included Likert scale items that enabled respondents to express the degree of their agreement or disagreement, facilitating quantitative analysis of the data.

Research Analysis

The collected data were analyzed using statistical software to calculate Pearson correlation coefficients, which allowed for the examination of the strength and direction of the relationships among the variables. Each variable's correlation with students' accuracy in linear function exercises, attention levels, engagement indicators, and retention of knowledge was evaluated. The significance levels were determined, with a focus on correlations that were statistically significant at the $p < 0.05$ level.

Validity and Reliability

To ensure validity, the research instrument was developed based on established literature regarding effective teaching strategies and student engagement in mathematics. Expert reviews were conducted to refine the questionnaire items and confirm that they accurately measured the intended constructs. Reliability was assessed using Cronbach's alpha coefficient, which indicated the internal consistency of the items within the questionnaire. A coefficient above 0.70 was obtained, suggesting that the instrument was reliable and the responses were consistent across the sample.

Ethical Consideration

Ethical considerations were prioritized throughout the research process. Informed consent was obtained from all participants prior to their participation, ensuring that they understood the purpose of the study and their right to withdraw at any time without consequence. Anonymity and confidentiality of respondents were maintained by assigning unique identifiers to each questionnaire, preventing the identification of individual participants.

Results and Discussion

This presentation summarizes the results from a study analyzing the impact of various instructional factors on linear function skills and academic engagement among 276 students. The findings indicated strong correlations between teaching strategies, student motivation, and academic outcomes, including accuracy, attention levels, engagement, and knowledge retention.

The results of the analyzed questionnaire administered to 276 students presented significant insights into the relationship between various instructional factors and student performance in linear functions. The Pearson correlation coefficients reveal a strong, positive relationship between teaching strategies and multiple aspects of student performance, including accuracy in exercises, attention levels, engagement indicators, and retention of knowledge. Specifically, the moderate correlation of 0.692 with accuracy in linear function exercises suggests that effective teaching strategies directly contribute to students' abilities to perform well in this area, affirming the importance of pedagogical approaches in raising mathematical skills.

Table 1. Instructional Factors on Linear Function Skills and Academic Engagement

		Accuracy in Linear Function Exercises	Student Attention Levels	Engagement Indicators	Retention of Knowledge
Teaching Strategy	Pearson Correlation	.692**	.833**	.571**	.799**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	276	276	276	276
Learning Resources Availability	Pearson Correlation	.284**	.460**	.559**	.481**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	276	276	276	276
Student Motivation	Pearson Correlation	.988**	.704**	.851**	.766**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	276	276	276	276

** Correlation is significant at 0.05 levels (2-tailed).

Engagement is further highlighted by a correlation coefficient of 0.833, indicating that when teaching strategies are well implemented, students demonstrate heightened attention and participation in learning activities. This finding was crucial as it underscores the role of instructional design in creating an environment that stimulates students' interest and involvement in linear functions, thereby enhancing their overall learning experience. Furthermore, the correlation of 0.799 with retention of knowledge emphasizes that strong teaching methodologies not only help students understand concepts during initial learning but also aid in their ability to recall and apply these concepts long-term.

On the other hand, learning resources availability also played a significant role, notwithstanding with a slightly lower correlation compared to teaching strategies. The correlation of 0.284 regarding accuracy in linear functions suggested that while access to learning materials was beneficial, it is not as strongly linked to performance as teaching approaches. This emphasizes that the mere presence of resources was not enough; how these resources are integrated into the teaching process matters greatly. However, the correlation of 0.559 with engagement indicators indicated that accessible learning resources can enhance student interaction with the material, promoting a more active learning environment.

When evaluating the impact of learning resources on attention levels, the correlation of 0.460 indicated a weak but positive relationship, suggesting that students who have access to quality resources are likely to sustain their focus during instructional sessions. In terms of knowledge retention, the coefficient of 0.481 highlighted that while available resources support retention, there may be other influential factors, such as teaching efficacy or student motivation, that contribute more substantially to long-term retention of knowledge.

Another area examined was student motivation, which demonstrated the strongest correlations across all variables measured. The correlation coefficient of 0.988 with accuracy in linear function exercises is particularly striking, indicating that motivated students perform exceptionally well. This relationship points to the crucial role that intrinsic motivation played in academic success, where personal interest and enthusiasm for the subject matter drive performance.

The positive correlation of 0.704 between student motivation and attention levels suggests that when students are motivated, they were more likely to concentrate and pay attention to their studies. This finding could inform instructional strategies aimed at increasing student engagement through motivational techniques, potentially leading to improved academic outcomes. Engagement indicators also showed a strong relationship with motivation, as indicated by the coefficient of 0.851. This reinforces the perspective that motivated students are more likely to engage actively with learning tasks, benefiting their overall educational experience in linear functions.

In terms of retention of knowledge, the correlation of 0.766 indicated that students who feel motivated are not just performing well but are also likely to remember and utilize the knowledge gained in the context of linear functions effectively. This highlights the importance of raising a learning environment that encourages student motivation as a means to improve both short-term performance and long-term understanding of mathematical concepts.

Overall, these findings illustrated a clear framework of how instructional factors contribute to academic success in linear functions. Strong teaching strategies significantly strengthen student performance, attention, engagement, and retention of knowledge. While material availability positively affects engagement and retention, the prominence of student motivation cannot be understated. It arises as a critical determinant that significantly influences academic performance, suggesting that educators should focus on strategies not only to enhance teaching effectiveness but also to raise motivation in their students.

Moreover, these results suggested potential paths for educational interventions. For instance, teacher training programs could emphasize the development of effective instructional strategies that are student-centered and engaging. Simultaneously, enhancing the availability and quality of learning resources, such as digital tools and collaborative study materials, could provide learners with the support they need to succeed.

Recognizing the interplay between these factors is vital for designing curricula and assessments aimed at improving student outcomes in mathematics. Updating educational practices to account for the significance of student motivation could lead to more profound and long-term improvements in academic achievement.

Therefore, teachers and curriculum designers should seek to understand how to improve motivation alongside refining teaching strategies and ensuring resource availability.

Therefore, the analyzed results provide significant insights into the relationships between teaching strategies, learning resources, and student motivation. By enhancing pedagogical approaches, improving resource accessibility, and promoting student motivation, secondary schools can raise a more effective learning environment that supports to be engage in linear functions and lays the foundation for academic success across various disciplines.

The current findings align with Hohensee et al. (2024), who identified three distinct backward transfer influences linked to shifts in students' reasoning towards an action or process-oriented view of functions. These findings suggested that variations in instructional approaches significantly impact students’ ability to transfer knowledge between mathematical concepts. Similarly, the present study highlights the importance of revising pedagogical methods to facilitate deeper conceptual understanding and adaptability, particularly in contexts requiring the integration of prior knowledge into new learning scenarios.

Additionally, the current findings are consistent with Hajovsky et al. (2020), who highlighted the potential of enhancing classroom relationship dynamics through targeted interventions designed to support teacher self-efficacy. By employing a social cognitive framework, interventions can strengthen teachers' confidence and competence, raising more effective teacher-student interactions and collaborative learning environments. The present study repetitions this sentiment, emphasizing the role of teacher exercise programs in creating a supportive classroom atmosphere that enhances students' academic engagement and overall performance.

Furthermore, these findings resonate with Reeve et al. (2020), who demonstrated the predictive power of agentic engagement on course achievement and perceived academic progress. Their research advocates for integrating agentic engagement into instructional practices while reevaluating the contribution of emotional engagement for a more holistic model of student success. Likewise, Lasekan et al. (2024) emphasized that teacher-student interactions, infrastructure, and resource availability directly influence students’ attention and learning outcomes. In line with these studies, the current findings highlight the multifaceted nature of effective teaching and the interplay between pedagogical strategies, instructional factors, and students' active participation in shaping academic success.

Conclusion

The results obtained from the questionnaires indicated a significant positive correlation between various instructional factors and students' skills in linear functions as well as their academic engagement. Notably, student motivation emerged as the most influential factor, showing strong associations with accuracy in linear function exercises ($r = 0.988$) and retention of knowledge ($r = 0.766$). Furthermore, high levels of student attention and effective teaching strategies also contributed positively to engagement and performance, evidenced by the substantial correlations across all measured variables. Based on these findings, it is recommended that teachers prioritize enhancing student motivation through engaging teaching strategies and the provision of accessible learning resources, as these elements appear crucial in raising better academic outcomes and deeper understanding of linear functions amongst students. Implementing targeted interventions that focus on increasing student engagement may lead to improved performance in mathematical concepts.

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