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Exploring Junior High Students' Perceptions and Barriers in Implementing the Flipped Classroom Model for Mathematics in Ghana

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ABSTRACT

Purpose – The flipped classroom model is increasingly recognized as an innovative approach to enhance student engagement and understanding in mathematics education. However, its implementation and effectiveness in low-resource settings, such as Ghana, remain underexplored. This study investigates junior high school students' perceptions of and challenges with the flipped classroom model in the context of mathematics instruction.

Methodology – A descriptive survey design was employed involving 31 junior high school students in Ghana. Data were collected using a structured questionnaire that assessed students' experiences, perceptions, and barriers associated with the flipped learning approach.

Findings – The results showed generally positive perceptions of the model. A total of 61.3% of students agreed that pre-class videos enhanced conceptual understanding, while 83.9% reported increased engagement during in-class activities. Nonetheless, substantial challenges were identified, including data exhaustion (51.6%) and lack of access to personal digital devices (58.1%), which limited students' ability to fully engage with pre-class materials.

Novelty – This study offers a unique contribution by examining the flipped classroom model in a low-income educational context. Unlike previous research focused on high-resource environments, this study addresses the practical realities of digital inequality and provides learner-centered insights into adapting flipped learning in under-resourced settings.

Significance – The findings highlight the potential of flipped learning in improving mathematics instruction, while also underscoring the infrastructural and technological barriers that must be addressed. These insights can guide educators and policymakers in designing inclusive, context-appropriate strategies for effective technology integration in education.

Keywords: Active learning; Digital learning; Flipped classroom; Mathematics education; Student perceptions.

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1. Introduction

The integration of technology into education has revolutionised student learning, making knowledge more accessible and interactive. Digital devices such as smartphones, tablets, and laptops serve as essential tools for research, collaboration, and engagement with educational content. However, the impact of these technological resources largely depends on their implementation. When used strategically, they can foster engagement, critical thinking, and problem-solving skills, helping students develop the competencies necessary for navigating the digital world responsibly. Educators play a pivotal role in ensuring that students maximise the benefits of digital learning tools through thoughtful integration into the learning process.

One widely recognised approach to technology integration in education is the flipped classroom model, which has garnered significant attention in higher education (Lee & Choi, 2019; Steen-Utheim & Foldnes, 2018). This pedagogical method redefines traditional learning by encouraging students to engage with instructional materials before attending class, promoting independent learning and deeper classroom discussions (Bergmann & Sams, 2012; Bishop & Verleger, 2013). The flipped classroom model enables students to take greater ownership of their learning, increasing autonomy and engagement (Cevikbas & Argun, 2017; Merisi, Oteng & Kusi, 2022). Shifting content instruction to pre-class activities allows valuable classroom time to be dedicated to collaborative work, reinforcing knowledge acquisition and skill development (Bergmann & Sams, 2012). By delegating foundational instructional tasks to homework, students can focus on more complex concepts during class, fostering deeper comprehension and improving academic performance. This blended approach enhances collaboration and reflective learning, equipping students with stronger knowledge construction and critical thinking abilities (Aldaka, 2020; Boateng, Twum & Asare, 2022).

Studies examining flipped classroom implementation in teacher education have yielded valuable insights. Since students' learning experiences are crucial in evaluating instructional effectiveness, most research focuses on their perceptions. Literature suggests that students generally view the flipped classroom positively, appreciating its flexibility and the ability to control their learning pace (Garcia-Ponce & Mora-Pablo, 2020; Merisi, Oteng & Kusi, 2022; Sointu, Kaarakainen, Tondeur, & Kankaanranta, 2022). Moreover, flipped instruction has been found to improve students' understanding of scientific concepts and enhance academic achievement (Kaya & Yildirim, 2022). Instructional videos play a key role in facilitating student learning (Cukurbasi, 2022), while practical in-class activities contribute to increased self-autonomy (Schwichow, Croker, Zimmermann, Höffler, & Fischer, 2022).

Despite global advancements in technology-driven education, research on the flipped classroom model in Ghana remains limited, particularly at the basic education level. A pre-test and post-test study conducted by Oppong, Asare, & Nyarko (2022) involving 45 pre-service teachers demonstrated improvements in naming and drawing organic compounds, alongside enhanced teamwork and self-directed learning. Similarly, Aidoo, Mensah, & Armah (2022) explored pre-service chemistry teachers' experiences, reporting that they viewed the flipped classroom model as an effective instructional strategy. Cabı (2018) found that students had a generally positive perception of the flipped classroom, emphasising its role in preparing them ahead of class and fostering collaborative learning. Akuffo, Okae-Adjei, and Dzisi (2019) highlighted students' favourable views on the model's ability to facilitate cooperation,

adaptability, and motivation. Additionally, a study conducted at Koforidua Technical University by the same researchers revealed high student satisfaction, with a mean score of 4.8 for classroom environment and 4.74 for flexibility.

While the integration of technology in education, particularly through the flipped classroom model, has shown promise in enhancing student engagement and learning outcomes, there remains a significant gap in research focused on its implementation in basic education settings in Ghana. Yeboah, Ampadu, Ahwireng, and Okrah (2020) noted that many teachers in Ghana lack extensive knowledge of the approach. Most existing studies have concentrated on higher education and specific subjects such as Science and Leatherworks, leaving mathematics education underexplored (Mensah, Yeboah, & Adom, 2017; Quansah, Donkoh, & Osei, 2018). Additionally, the limited adoption of the flipped classroom approach in Ghanaian basic schools underscores the need for more comprehensive investigations. Many educators lack familiarity with this instructional strategy, which may hinder its effective implementation. Moreover, previous research primarily highlights positive perceptions without adequately addressing the specific challenges faced by students in this context, such as technological barriers, limited access to resources, and the impact of household responsibilities on learning.

The present study seeks to fill this gap by examining junior high school students' perceptions of the flipped classroom model in mathematics education and identifying the challenges they encounter. This research aims to provide insights that could inform the development of targeted strategies to enhance the effectiveness of the flipped classroom approach, ensuring it meets the unique needs of students in Ghanaian schools. By exploring students' perceptions and the challenges they face, the research enhances existing literature on educational technology integration, particularly in underrepresented regions and subjects. It also underscores the importance of adapting pedagogical strategies to local contexts, thereby enriching the theoretical frameworks surrounding active learning and student engagement.

Beyond its theoretical contributions, this study offers practical insights for educators and policymakers. By identifying key challenges such as technological barriers and resource accessibility, the research can inform the development of interventions and support systems to facilitate the successful implementation of the flipped classroom model. Strengthening educational technology integration will help create a more inclusive and effective learning environment, equipping students with the skills necessary for academic success and lifelong learning. To achieve the objectives of this study, the researchers seek to address the following key questions:

1. What are students' perceptions of the flipped classroom model in mathematics learning?
2. What challenges do students encounter when using the flipped classroom model?

2. Methods

The study adopted a descriptive survey design to explore students' perspectives, experiences, and challenges associated with the flipped classroom approach. This design enabled a comprehensive understanding of the approach's effectiveness, its impact on student engagement, and learning outcomes. The research also examined challenges such as students' adaptability to self-directed learning, technological barriers, and the influence of the approach on academic performance. These factors were considered to provide meaningful insights that could inform the enhancement of pedagogical practices and the development of effective

support systems. The study was conducted in Cape Coast using a convenient sampling technique to select a school within the Metropolis. This sampling method was chosen to address logistical challenges arising from the varying academic schedules and institutional activities in the region. The selected school met the logistical and academic requirements of the study, ensuring the research was feasible.

Participants in the study were Junior High School (JHS) Form Two students, considered suitable due to their developmental stage and receptiveness to innovative teaching strategies. An intact class of 31 students was used to minimise disruption to the normal learning environment and to provide a manageable yet representative sample. Data collection was carried out using a questionnaire adapted from Ackah (2021). To ensure the content validity of the instrument, it was reviewed by experts. The original questionnaire reported a reliability coefficient of 0.87, indicating a high level of reliability. The instrument consisted of 34 items, measured on a 4-point Likert scale: Strongly Agree, Agree, Disagree, and Strongly Disagree. Data were collected after the students had been exposed to the flipped classroom approach for one week. The responses were analysed using frequency counts and percentages.

3. Results and Discussion

This section examines the findings related to students' perceptions of the flipped classroom model in mathematics learning, as well as the challenges associated with its implementation. The findings of this research provide insights into students' use of pre-class materials, their engagement in hands-on learning and problem-solving during class, and their participation in mathematics. The research also presents the consumption of pedagogical media by students that complemented their learning. This subsection also highlights the challenges faced by learners, including limited access to digital resources, difficulties in time management, the need for flexibility in self-paced study, and issues with comprehending pre-class content in the absence of immediate tutor support.

3.1 What are Students' Perceptions of the Flipped Classroom Model in Mathematics Learning?

This research question seeks to explore and understand how students view and experience the flipped classroom approach, specifically in the context of mathematics education. The study delves into aspects such as the effectiveness of the model and the benefits they perceive concerning their learning outcomes, engagement, and understanding of mathematical concepts. Table 1 presents the students' perspectives on the flipped classroom approach.

Table 1 - Perception of Students towards the Flipped Classroom Approach

Statement	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)
I feel that trying my hand at the exercises posed in the videos helps my learning	13(41.9)	14(45.2)	3(9.7)	1(3.2)
The practical problems I solve in class after watching videos at home contribute to my learning	10(32.3)	19(61.3)	1(3.2)	1(3.2)
I become attentive while watching a video or reading any material assigned to me by my teacher, and that contributes to my learning	9(29)	19(61.3)	2(6.5)	1(3.2)

Statement	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)
The videos or materials that I watch or read before coming to class help me to ask practical questions	16(51.6)	11(35.5)	4(12.9)	0(0)
When I solve problems in class with my friends, I get enough time at home to do my assigned tasks	16(51.6)	8(25.8)	5(16.1)	2(6.5)
I wish all subjects would use this form of learning	14(45.2)	7(22.6)	8(25.8)	2(6.5)
I try my best to watch all or more than half of the videos	4(12.9)	20(64.5)	6(19.4)	1(3.2)
I think I learn Mathematics better in a flipped classroom than in a conventional classroom	14(45.2)	8(25.8)	9(29.0)	0(0)
I get the opportunity to pause, rewind and become clear on concepts in the videos before I proceed	19(61.3)	12(38.7)	0(0)	0(0)
My interest in Mathematics has changed for the better because I can now reason along the ideas obtained from the videos, I watch at home	11(35.5)	15(48.4)	2(6.5)	3(9.7)
Doing homework in class is better because I can ask my friends or my teacher for clarification on questions, I am not clear	15(48.4)	11(35.5)	3(9.7)	2(6.5)
I only enjoy the flipped classroom when materials are prepared by my teacher himself	13(41.9)	10(32.3)	8(25.8)	0(0)
The teacher has enough time to explain issues to me when I approach him for clarity	20(64.5)	9(29)	1(3.2)	1(3.2)
Flipped classroom exposes me to relevant educational media that help me to study Mathematics	15(48.4)	15(48.4)	1(3.2)	0(0)

Students generally perceived the flipped classroom as an effective and engaging strategy for learning Mathematics. This perception was particularly evident in their engagement with pre-class materials. A significant majority (61.3%) strongly agreed that being able to pause, rewind, and revisit lesson videos enhanced their understanding of mathematical concepts, while 38.7% reported improved enjoyment and comprehension. These findings support earlier research by Drozdikova-Zaripova and Sabirova (2020) and Ekmekçi (2017), who emphasised the benefits of flexible, self-paced learning enabled by digital instructional content. The accessibility of pre-lecture videos was viewed as crucial by 87.1% of students, who felt that these materials empowered them to ask more practical and insightful questions during classroom discussions. This echoes Cabı's (2018) conclusion that the flipped model facilitates deeper cognitive engagement and better preparation for interactive learning sessions.

In-class activities, particularly those involving problem-solving and assignments, were also praised for their instructional value. About 61.3% of students reported an improved grasp of mathematical concepts through hands-on problem-solving tasks, while 83.9% agreed that completing assignments in class fostered richer peer-to-peer and student-teacher interactions. These outcomes align with González-Gómez et al. (2016), who found that flipped classroom

environments enhance student collaboration and participation, reinforcing positive emotional and cognitive engagement.

The flipped classroom approach significantly influenced students' academic interest and performance. A large proportion of students (83.9%) reported enhanced concentration during lessons, and 71% indicated that the flipped model was more effective than traditional lecture-based instruction. Additionally, 93.5% noted that teachers provided more elaborate explanations of contextual concepts during flipped lessons, further boosting engagement. These results corroborate earlier research asserting that flipped classrooms not only increase content retention but also foster meaningful classroom interactions (Cabı, 2018; Lo & Hew, 2017). Students also valued the ready access to relevant study resources, with 96.8% agreeing that the flipped model expanded their knowledge base and improved their academic performance. This supports Ekmekçi's (2017) findings that comprehensive access to instructional content strengthens understanding and allows learners to revisit materials as needed, contributing to sustained academic growth.

Regarding the potential of the flipped model in other subject areas, opinions were mixed. While 45.2% strongly agreed and 22.6% agreed that the approach could be beneficial across subjects, a notable minority (25.8%) disagreed, and 6.5% strongly disagreed. This variation mirrors previous findings that the flipped model's effectiveness can depend on subject-specific characteristics and the nature of student engagement in different disciplines (González-Gómez et al., 2016). The findings from this study indicate a generally positive attitude toward the flipped classroom strategy among students in the Cape Coast Municipality. The observed benefits—including self-paced learning, improved understanding through interactive videos, and more active in-class participation—align with constructivist learning principles, which emphasise student-centred, active knowledge construction. These outcomes reinforce the conclusions of prior studies that the flipped classroom fosters critical thinking, autonomy, and learner engagement (Chen, Wang, & Chen, 2014; Cabı, 2018). As such, the flipped model appears to be a promising instructional strategy for Mathematics education and potentially for other subjects when carefully implemented.

3.2 What Challenges do Students Encounter when Using the Flipped Classroom Model?

This research question aims to investigate the obstacles and difficulties students face when engaging with the flipped classroom approach in their educational journey. It seeks to identify challenges related to various aspects, such as adapting to the structure of flipped learning, managing the increased responsibility for self-directed study, and accessing necessary resources or technology outside the classroom. Additionally, the research explores how students navigate issues like time management and comprehension of pre-assigned materials, along with their ability to effectively collaborate in the in-class activities. Table 2 presents students' challenges with the flipped classroom.

Table 2 - Challenges of Students Towards the Flipped Classroom

Statement	SA	A	D	SD
In some instances, I exhaust data midway through the watching of online videos	16(51.6)	11(35.5)	0(0)	4(12.9)
Some of the videos are too long and make me lose focus.	8(25.8)	13(41.9)	6(19.4)	4(12.9)
Pre-class activities are too much and become a burden when I add to my household duties	9(29)	8(25.8)	10(32.3)	4(12.9)

Statement	SA	A	D	SD
I do not get the opportunity to ask questions immediately when I am not clear on some issues.	9(29)	10(32.3)	9(29)	3(9.7)
Watching videos are boring and passive	2(6.5)	5(16.1)	14(45.2)	10(32.3)
I do not get enough time to do other tasks assigned by different subject areas teachers.	4(12.9)	11(35.5)	10(32.3)	6(19.4)
I do not enjoy watching the videos	2(6.5)	5(16.1)	15(48.4)	9(29)
I do not have a good network to access the internet sites given by my teacher	3(9.7)	4(12.9)	10(32.3)	14(45.2)
Some of the words in the reading materials assigned to me are difficult to understand.	2(6.5)	12(38.7)	10(32.3)	7(22.6)
I am not given extra money to buy data for my online activities	8(25.8)	8(25.8)	6(19.4)	9(29)
I find it difficult to take notes when watching videos or reading material.	2(6.5)	4(12.9)	18(58.1)	7(22.6)
Frequent light-outs in my village prevent me from watching videos most of the time.	7(22.6)	4(12.9)	8(25.8)	12(38.7)
My parents always complained whenever I watched videos**.**	2(6.5)	6(19.4)	12(38.7)	11(35.5)
I find it hard to stay motivated to complete the pre-class activities on my own.	3(9.7)	10(32.3)	13(41.9)	5(16.1)
The videos do not always provide enough examples for me to fully understand the concepts.	9(29)	13(41.9)	5(16.1)	4(12.9)
I prefer learning directly from my teacher rather than watching videos before class	10(32.3)	11(35.5)	5(16.1)	5(16.1)
I struggle to manage my time effectively when I have to complete pre-class activities.	5(16.1)	11(35.5)	10(32.3)	5(16.1)
I do not have a personal device (e.g., smartphone, tablet, or laptop) to watch the videos.	4(12.9)	4(12.9)	5(16.1)	18(58.1)
Some of the video explanations are too fast, making it difficult to understand	7(22.6)	12(38.7)	8(25.8)	4(12.9)
I feel isolated when I study alone using the flipped classroom method	2(6.5)	8(25.8)	16(51.6)	5(16.1)

Students encountered significant barriers while engaging with digital learning environments, particularly within the context of flipped classrooms. Consistent with findings by Lo and Hew (2017), technological challenges emerged as a dominant issue. Approximately 51.6% of students reported that unstable internet connections frequently disrupted online video sessions, hindering their ability to complete assigned class activities. In line with Van Niekerk and Delport (2022), high internet data costs further exacerbated these issues, with 25.8% of students indicating they received no financial support to purchase data for online learning. In addition, electricity outages posed a major obstacle, affecting the learning routines of 35.5% of participants similar to challenges cited in previous studies on infrastructural barriers in digital education (Chen, Wang, & Chen, 2014).

The lack of essential digital devices, such as laptops or tablets, was another persistent problem, affecting 58.1% of students. This is consistent with earlier research that highlighted insufficient access to ICT tools as a major limitation in implementing flipped classroom models (Lo & Hew, 2017). Moreover, cognitive overload and poor time management were widespread. A considerable portion of students (29% strongly agreed; 25.8% agreed) reported that domestic responsibilities interfered with pre-class learning. These findings corroborate

Van Niekerk and Delport's (2022) observations that external responsibilities often disrupt the preparatory phase of flipped learning. Increased academic pressure stemming from the wide subject coverage within flipped classrooms added another layer of difficulty. About 35.5% of students cited stress due to content volume, echoing concerns in earlier studies that identified the flipped model as potentially overwhelming, particularly when students are unprepared for the required autonomy (Chen et al., 2014). Poor organisation and challenges in completing pre-class activities led to reduced preparedness for in-class engagement, a phenomenon widely reported in flipped learning literature (Lo & Hew, 2017).

Students also expressed dissatisfaction with the design of pre-class materials. A notable 45.2% found the videos unengaging, and 16.1% regretted the lack of enjoyment in the process. These sentiments resonate with prior research suggesting that uninteresting or monotonous content can demotivate learners (Chen et al., 2014). Furthermore, 32.3% of students reported low motivation during independent study, reinforcing earlier findings that students with weak self-regulation skills struggle in flipped settings. Comprehension issues further impeded learning. Nearly 41.9% of students stated that video lessons lacked sufficient examples to clarify mathematical concepts, while 38.7% found the vocabulary in reading materials challenging. The fast pace of certain video explanations also hindered understanding for 38.7% of students, requiring them to re-watch content multiple times. These difficulties align with existing research that underscores the importance of scaffolding and clarity in digital instructional materials (Lo & Hew, 2017).

Another concern was the lack of real-time support: 32.3% of students reported being unable to seek clarification during self-paced learning. Feelings of isolation were also prevalent, with 25.8% experiencing loneliness during independent work, a finding that aligns with previous reports on the socio-emotional impact of technology-mediated learning (Chen et al., 2014). Moreover, 19.4% of students experienced parental disapproval of the flipped classroom model, reflecting broader societal challenges in adapting to non-traditional learning environments. Although the flipped classroom model is designed to enhance active engagement and foster 21st-century learning through the integration of digital tools and collaborative in-class activities, students in this study often viewed it as burdensome. As Van Niekerk and Delport (2022) noted, students frequently do not complete out-of-class preparation, which diminishes their in-class participation and overall academic benefit. Many respondents in this study perceived an increased workload associated with reading and viewing materials prior to class. This mirrors earlier findings by Lo and Hew (2017), who reported that students often feel overwhelmed by the volume and complexity of pre-class tasks, especially in the absence of sufficient self-regulatory strategies.

Chen, Wang, and Chen (2014) further emphasized that students with underdeveloped self-management skills are more likely to perceive flipped classrooms negatively, as they struggle to meet the autonomous demands of this approach. While the intent behind flipped learning is to create more interactive and student-centred learning experiences, the findings of this study suggest that without adequate support structures, students may interpret the model as an additional academic burden rather than a pedagogical enhancement. The challenges stemmed from the researcher's requirement that students watch a specific video online—an activity central to the flipped classroom model. However, accessing and engaging with such pre-class materials requires reliable devices and internet access, which are not universally available. Moreover, parents may become concerned about their children spending excessive time on screens, particularly when they associate screen use with entertainment activities like gaming or social media rather than learning. These issues are not merely technological; they reflect deeper structural, economic, and cultural factors that intersect with

the design and implementation of flipped classrooms. Without addressing these contextual barriers, such as by providing devices, offering digital literacy training to parents, subsidising internet access, or adapting instructional expectations, the flipped classroom model risks reinforcing, rather than reducing, educational inequalities.

Despite encountering significant infrastructural barriers, such as unstable internet, limited access to digital devices, and frequent electricity outages, many students still expressed positive perceptions of the flipped classroom model. This seemingly paradoxical response can be better understood when examined through a contextual and psychological lens. For students accustomed to traditional, lecture-dominated instruction, the flipped model introduced a refreshing pedagogical shift—one that promoted flexibility, engagement, and student-centred learning. Even if not all students could consistently access pre-class materials, the model itself was often appreciated for its intent and potential. The idea of learning at one's own pace, revisiting video content, and arriving in class prepared for active, collaborative work resonated with students who saw this structure as more aligned with meaningful learning.

Moreover, students may have viewed flipped learning positively because it reflects modern educational trends. In many contexts, access to digital education represents not just a tool for learning but a gateway to broader opportunities, including technological literacy and global competitiveness. Thus, students may interpret the flipped classroom as aspirational—an approach that, despite its current limitations, offers a pathway to future-ready skills. In this way, their optimism may be grounded not in current conditions but in the model's perceived relevance and potential impact. These nuanced perceptions suggest that, when adequately supported, even students in under-resourced settings are capable of embracing innovative instructional models—not because the context is ideal, but because the possibilities are compelling.

4. Conclusions

The findings showed that students generally viewed the flipped classroom positively, appreciating its impact on their understanding, engagement, and problem-solving skills. They valued the ability to review instructional videos at their own pace alongside active class participation. However, challenges such as technological barriers, time management, and comprehension issues were significant. Limited internet access, high data costs, power outages, and a lack of personal devices hindered participation in pre-class activities. Researchers to explore the long-term effects of this model on students' mathematical performance and engagement. Researchers recommend that teachers consider students' overall workload, including household responsibilities and other subjects, and ensure that pre-class tasks are manageable and meaningful, rather than overwhelming.

Despite its strengths, the study's method has several limitations. First, the use of a descriptive survey design restricts the ability to establish causal relationships between the flipped classroom approach and observed learning outcomes. Second, the reliance on self-reported data may introduce response bias, as students may provide socially desirable answers. Third, the use of a convenience sample from a single school limits the generalisability of the findings to other contexts or regions. Finally, the short duration of the intervention (one week) may not have been sufficient for students to fully adapt to the flipped classroom model or for long-term impacts to be observed.

Conflict of Interest

The authors declare no conflicts of interest

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