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Original Article

Perception of Flipped Classroom Strategy for Physics Instruction in Secondary Students in Kauma Sub-County Kilifi County, Kenya

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Keywords:

Flipped Classroom Strategy, Physics Instruction, Student Perception, Active Learning, Secondary Education in Kenya.

ABSTRACT

The flipped classroom strategy (FCS) has emerged as an innovative pedagogical approach that enhances active learning, particularly in science subjects like physics. This study investigated the students' perception of the strategy towards physics instruction. The study adopted mixed research methods, incorporating both qualitative and quantitative data collection techniques. The targeted population of this study was 870 Form One students in secondary schools in Kauma Sub-County. Random sampling was used to sample the schools and students that were involved in the study. The research explored how FCS influences student engagement, conceptual understanding, and achievement in physics. Perception questionnaires were administered to the students after they had undergone the treatment. The questionnaire consisted of closed-ended statements and open-ended questions. The closed-ended section had two sets of statements. The first set was a general statement asking students to indicate whether they perceive the flipped classroom to be a good strategy for physics instruction. The second set consisted of statements that were framed into a Likert-scaled format with five choices illustrating the extent of their agreement with the statements provided. These statements acted as factors that helped to determine the learners' perception of the flipped classroom towards physics instruction. A total of 84 students answered the questionnaire. MANOVA test was conducted between the perception responses of the students and the students' responses on the Likert-scaled statements with the help of SPSS 16 and a confidence level of 0.05 to test H03. From the results, the significance level of the MANOVA test was 0.000 for Wilks' lambda and Roy's largest root. Since 0.000<0.05, H01 was rejected and the study concluded that students perceived flipped classrooms as an effective strategy for physics instruction. The findings provide insights into the effectiveness of FCS in enhancing physics instruction and offer recommendations for its integration into the Kenyan secondary school curriculum.

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INTRODUCTION

Physics is a fundamental subject in secondary education, yet students in Kenya often struggle with its concepts, leading to poor performance in national examinations (KNEC, 2022). Traditional lecture-based teaching methods have been criticized for their passive learning nature, which limits students' engagement and deep understanding of physics concepts (Wambua & Karanja, 2023). The flipped classroom strategy, an instructional model where students engage with content before class and apply knowledge during face-to-face sessions, has gained attention for its potential to improve learning outcomes (Mwaniki & Ochieng, 2021). Studies indicate that FCS fosters active learning, improves student motivation, and enhances conceptual understanding, particularly in science subjects (Kimani & Njoroge, 2023). However, limited research exists on students' perception of FCS in Kenyan secondary schools, particularly in rural areas like Kauma Sub-County, where access to technology may be a challenge. This study seeks to bridge this gap by examining how students perceive the flipped classroom strategy in physics instruction and its impact on their learning experience.

Additionally, a study on the flipped classroom strategy in China by Hew et al. (2021) showed that the flipped classroom strategy led to moderate improvements in student achievement, particularly in STEM subjects. Following this, several studies on the Flipped Classroom strategy have been done in different fields of study. For example, Cho et al. (2021) on active learning through a flipped classroom in mechanical engineering of FCS to change in perception of concepts, used mechanical engineering students to collect evidence. The results showed that most of the learners changed their perception towards the course, and they concluded that the FC has a positive impact on learners' perceptions of concepts. In the mathematics field, Fornons, Palau & Campión (2021) examined high school students' perceptions of the flipped classroom in mathematics. The findings of the study indicated that students accepted the strategy. Learners accredited it as an effective strategy for learning due to its self-centred characteristic and the collaborative aspect. Also, Cevikbas and Kaiser (2022) in their study about student engagement in flipped secondary mathematics, concluded that the strategy has the potential to play a positive role in behavioural, cognitive, and emotional engagement as it provides learners with opportunities to learn mathematics on their own. Furthermore, in the medical field, Bawane et al. (2020) conducted research on the impact of FC strategy on optimizing the understanding of medical concepts among undergraduate students. They employed a quasi-experimental methodology. They found out the learners in the FC showed a significant statistical difference in motivation towards learning compared to those in the conventional, traditional classroom.

Bawang and Prudente (2018) did a study on Students' understanding of physics concepts and perceptions in a flipped classroom environment. Their study findings showed overall good results after the flipped classroom intervention. The results of a study on the effect of the flipped classroom method on physics courses done in two

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German secondary schools indicated that the strategy has a positive effect on learning gain as well as on motivation and self-concept (Finkenberg & Trefzger, 2019).

Ndiji, Elejere and Ungwanyi (2020) conducted a study to determine the effect of FC strategy on student achievement and retention of concepts in public senior secondary schools in Nigeria. Their results showed a superior achievement improvement as well as improved concept retention ability by the learners in the FC. (Doğan, Batdı & Yaşar, 2023) studied the effectiveness of flipped classroom practices in teaching science subjects. The results were positive and concluded that it was an effective strategy for teaching sciences. Also, Bawaneh, & Moumene (2020) researched the impact of FCS on student achievement and concept retention in medical physics and the implication of the strategy to teaching science subjects, and recommended that FC can be used to teach other science subjects. Though the strategy is seen to have of great impact on learners, some learners reported it to be challenging as out-of-class activities are time-consuming and overwhelming Fornons et al (2021).

Students from secondary schools in Kauma Sub County in Kilifi had been taught using the traditional, conventional strategy that is teacher-centered. According to Wafukho, Kafu, and Murunga (2022), this strategy leads to passive learning and results in lower student achievement. This approach also struggles with maximizing learning opportunities, rendering it less effective for teaching STEM subjects (Murithi & Yoo, 2021). Following this, students in Kilifi County have been achieving dismally in physics, as evidenced by the secondary schools in the county recording low KCSE mean grades in seven consecutive years from 2016, as documented in the 2022 KCSE report. Strategies that optimize learning and engagement opportunities can help in addressing the low achievements. The flipped classroom has been stated as one of these strategies. While numerous studies report positive perceptions of flipped classrooms by students worldwide, there is little documented information in the Kenyan context, especially in physics education. Nevertheless, the available literature on flipped classrooms and physics education in Africa mainly focuses on higher education settings, creating a knowledge gap on how the flipped classroom strategy is perceived in physics instruction by secondary school students in the African rural secondary schools. This gap necessitated the need for a study on the perception of flipped classrooms in physics instruction to be done in Kauma Sub-County, Kilifi County, Kenya.

Specific Objective of the Study

To assess Kauma Sub-County secondary school students' perceptions of the flipped classroom strategy in physics instruction in Kauma Sub-County, Kilifi County.

Hypothesis of the Study

$H0_1$: Students do not perceive flipped classrooms as an effective strategy for physics instruction.

LITERATURE REVIEW

The flipped classroom strategy has been widely explored in science education research due to its potential to improve student engagement and performance. According to Ngigi et al. (2022), FCS promotes active participation by shifting knowledge acquisition outside the classroom and dedicating in-class time to collaborative problem-solving. This instructional model aligns with constructivist learning theories, which emphasize active engagement and peer interaction in knowledge construction (Vygotsky, 1978, as cited in Omondi & Wanjiru, 2023). In physics education, studies suggest that FCS enhances student confidence and ability to apply theoretical concepts in practical contexts (Mwangi & Oduor, 2023). However, challenges such as student resistance, digital access inequalities, and teacher preparedness remain significant concerns (Ochieng & Mutiso, 2021).

Empirical Review

Ahmed & Asiksoy (2021) in their study on the effects of gamified flipped learning method on

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students' innovation skills, self-efficacy towards virtual laboratory courses and perceptions, gamified flipped learning class showed a positive change in perception of virtual laboratories. This was a result of the learners getting more engaged and changing their attitude towards virtual laboratories which led to high levels of understanding and also improved classroom interactions.

Cho et al (2021) on active learning through flipped classrooms in mechanical engineering of FCS to change in perception of concepts, they used mechanical engineering students to collect evidence. The results showed that most of the learners changed their perception towards the course and they concluded that the FC has positive impacts on learner's perceptions of concepts.

Fornons, Palau & Campión (2021) examined high school students' perceptions of the flipped classroom in mathematics. The findings of the study indicated that students accepted the strategy. Learners accredited it as an effective strategy for learning due to its self-centred characteristic and the collaborative aspect. Also Cevikbas, & Kaiser (2022) in their study about student engagement in flipped secondary mathematics, concluded that the strategy has the potential to play a positive role in behavioural, cognitive, and emotional engagement as it provides learners with opportunities to learn mathematics on their own.

Despite the documented benefits, research on FCS implementation in Kenyan rural schools remains scarce. A study by Githinji and Mbugua (2023) found that students in urban schools benefited more from FCS due to better access to digital resources. In contrast, rural students faced difficulties related to unreliable internet connectivity and a lack of technological infrastructure. However, interventions such as offline digital content and blended learning model**s** have been proposed to mitigate these barriers (Wangui et al., 2024). Given this context, this study sought to examine how secondary students in Kauma Sub-County perceive the effectiveness of FCS in physics instruction and identify factors that influence their engagement with this pedagogical approach.

METHODOLOGY AND RESEARCH DESIGN

This study adopted a mixed-methods research design, combining descriptive survey and quasi-experimental approaches. The target population comprised Form One physics students in selected secondary schools in Kauma Sub-County. Data collection involved questionnaires for students, an observation checklist, and pre-test and post-test assessments to evaluate learning outcomes. Quantitative data was analyzed using descriptive statistics (mean, standard deviation) and inferential statistics (MANOVA), while qualitative data from open-ended questions was analyzed thematically.

Two secondary schools were randomly selected as experimental groups. A total of 84 Form One students participated in the study. These students were taught the topic of Electrostatics (I) using the flipped classroom strategy for a period of two weeks. Perception questionnaires were administered to the two experimental groups after they had undergone the treatment. The questionnaire had two sections, section one comprised closed-ended statements, and section two comprised open-ended questions. The closed-ended statements were framed into a Likert-scaled format with a maximum of five choices illustrating the extent of their agreement with the perception statements provided. It also had one general statement where the students were to indicate whether they perceived the flipped classroom as a good strategy for physics instruction, where they were to choose either 'YES' or 'NO'

The open-ended questions were to allow the students to explain their choices on the Likert scale and to state the challenges they experienced while using the flipped classroom strategy of instruction.

Data Presentation

In this study data tables and pie charts were used to present the summary of the data collected.

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Tables were used to present data on student perception while pie charts presented the pattern of students' perception of the strategy.

FINDINGS OF THE STUDY

A total of 84 students from the experimental groups answered the questionnaire, and the following results were obtained from their responses. The responses to the Likert-scaled questionnaires are summarized in Table 1.

Table 1: Perception Choices

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I find the flipped classroom strategy engaging	2 (2.24%)	9 (10.84%)	16 (19.28%)	36 (43.37%)	20 (24.10%)
The flipped classroom method helps me understand the subject matter better	4 (4.81%)	7 (8.43%)	21 (25.30%)	36 (43.37%)	15 (18.07%)
The resources provided for flipped classroom activities are helpful.	0 (0.00%)	4 (4.88%)	20 (24.39%)	35 (42.68%)	23 (28.05%)
I feel more prepared for class discussions in a flipped classroom setting	0 (0.00%)	1 (1.20%)	16 (19.28%)	35 (42.17%)	31 (37.34%)
The flipped classroom encourages me to learn at my own pace	2 (2.44%)	3 (3.66%)	10 (12.20%)	27 (32.93%)	40 (48.70%)
I am satisfied with my learning outcomes in a flipped classroom environment.	0 (0.00%)	3 (3.61%)	14 (16.87%)	40 (48.19%)	26 (31.13%)
I feel motivated to participate in activities in a flipped classroom	1 (1.20%)	3 (3.61%)	7 (8.43%)	28 (33.74%)	44 (53.01%)
The flipped classroom strategy improves my problem-solving skills.	3 (3.61%)	5 (6.02%)	13 (15.66%)	31 (37.35%)	31 (37.35%)
I am confident in my ability to succeed in a flipped classroom	0 (0.00%)	3 (3.61%)	5 (6.02%)	38 (45.78%)	37 (44.57%)

From these results, 24.10% (20) strongly agreed and 43.37% (36) agreed that the flipped classroom strategy was engaging when used for instruction, 19.28% (16) neither agreed nor disagreed with the statement, 10.84% (9) disagreed and 2.24% (2) strongly disagreed that the flipped classroom strategy was engaging. This concurs with a study by Lo and Chew (2021) in their study on Flipped Classroom and engagement whose findings suggested that this strategy helped learners to increase some level of emotional engagement such as participation, attention and interaction. This information is summarized as shown in Figure 1.

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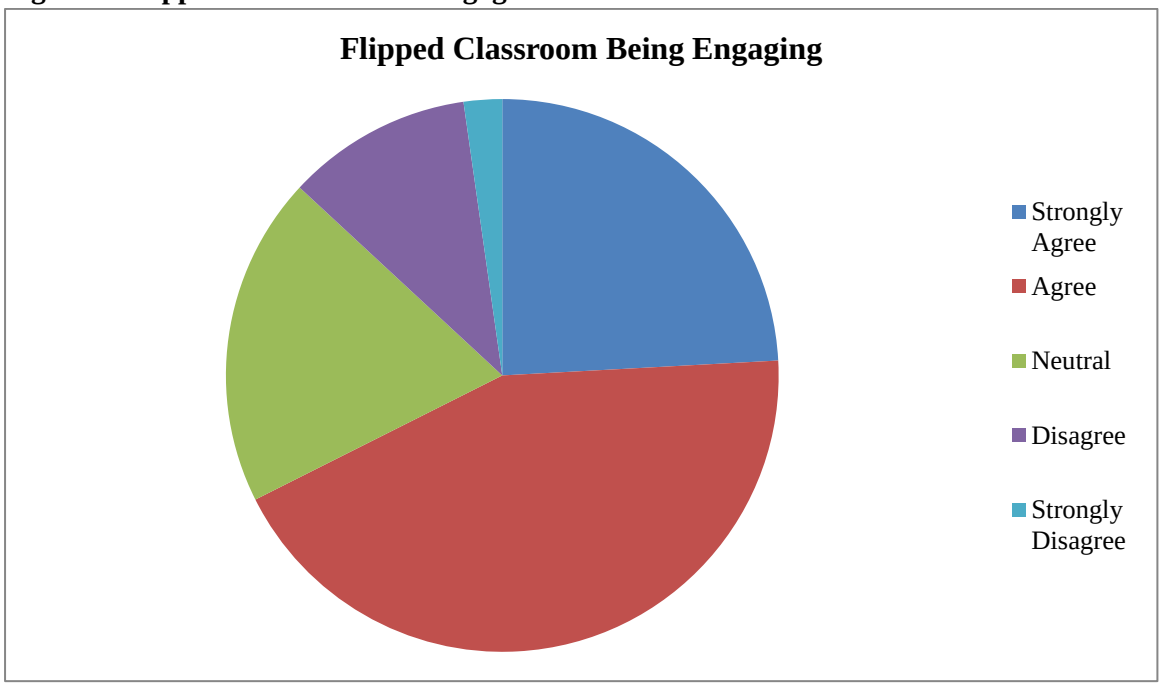
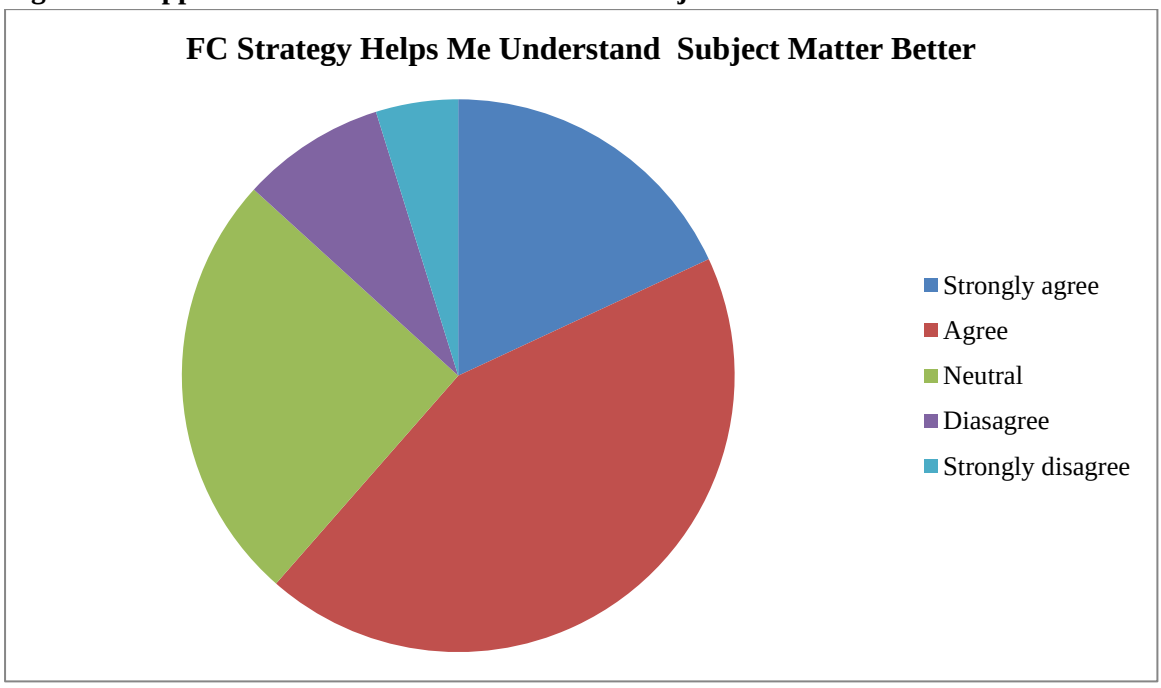
Figure 1: Flipped Classroom and Engagement



On helping students to understand the subject matter, 43.37% (36) and 18.07% (15) respectively agreed and strongly agreed that the flipped classroom strategy helped them to understand the subject matter. 25.30% (21) had neutral opinions about the ability of the flipped classroom strategy to help them understand the subject matter, while 4.81% (4) and 8.43% (7) disagreed and strongly disagreed with the statement, as shown in Figure 2. This concurs with a study by Marina and Rildo (2021) on the effectiveness of the flipped classroom in students' concept understanding, whose results indicated that not all students understood the concepts well. However, a bigger percentage of the students showed a significant improvement in concept understanding.

Figure 2: Flipped Classroom and Understand the Subject Matter.



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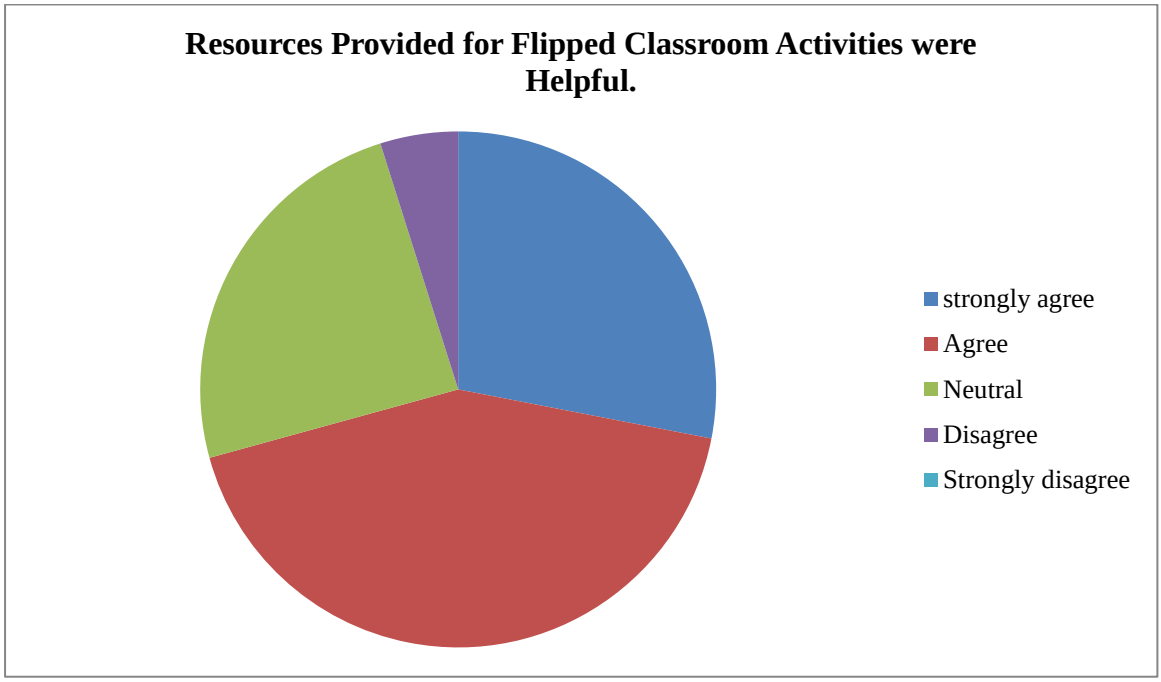
Further, 82 students gave their choices on the helpfulness of the resources provided for the classroom activities pre-determined as follows, 28.05%(23) strongly agreed that the resources were helpful, 42.68% (35) agreed, 24.34% (20) had neutral opinions, 4.88% (4) disagreed that the resources were helpful and none of them strongly disagreed. This indicates that the majority of learners agreed that the resources provided were of great help in their learning process, as shown in Figure 3. This concurs with a study by Xiao and Adnan (2022) on integrating multimodal digital resources with the Flipped Classroom. Their results indicated that the Flipped Classroom allowed the integration of a variety of learning resources such as Virtual reality, augmented reality and online three-dimensional models of human anatomy.

Figure 3: Helpfulness of the Provided Resources for Learning in a Flipped Classroom



Furthermore, the responses indicate that 37.34% (31) strongly agreed that they felt more prepared for discussions in the flipped classroom setting, 42.17% (35) agreed with the statement, 19.28% (16) were neutral about the statement and 1.20% (1) disagreed the feeling of more prepared for the discussions in the classroom setting. From these findings, it was evident that most learners went to class prepared for the in-class discussion. This concurs with an analysis of the effect of Flipped Classroom and learning performance, flow and concentration on discussion by Li, Huo, Li and Kuo (2022) that most learners were well prepared for discussion after their individualized interaction with the learning materials. This finding is summarized in Figure 4.

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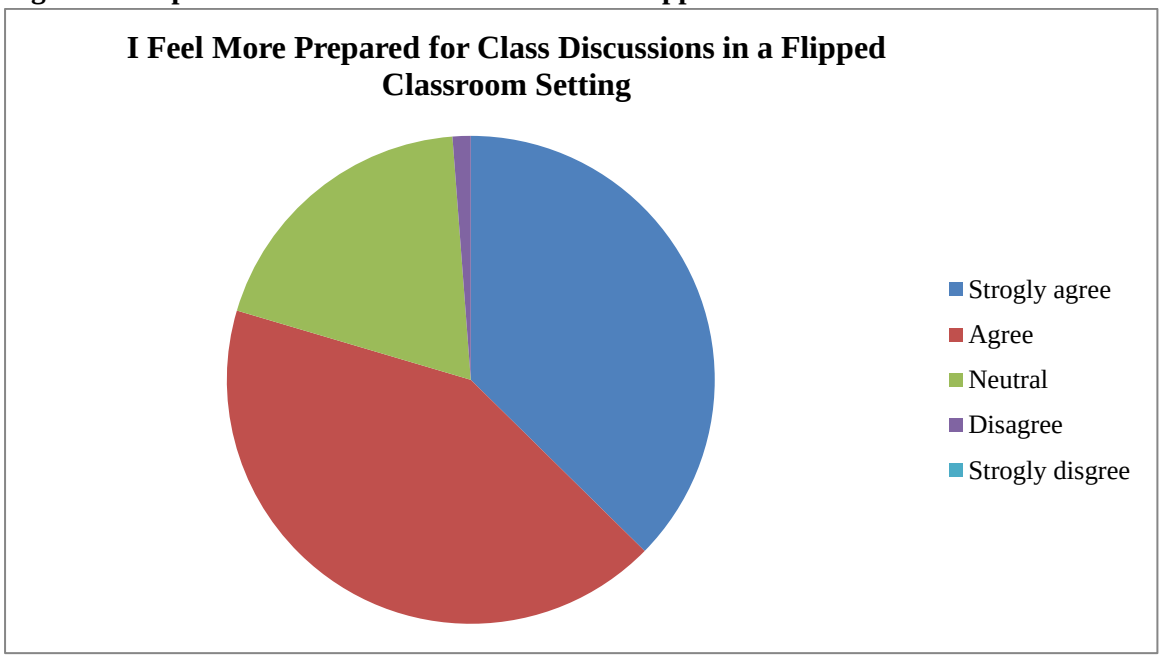
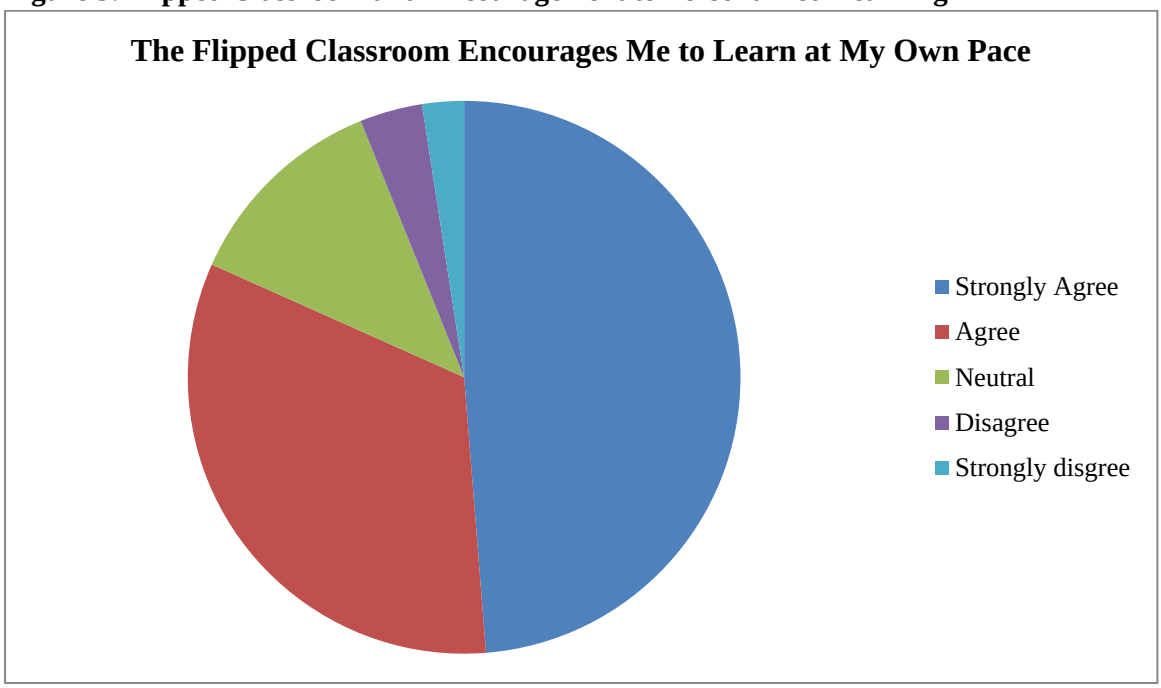
Figure 4: Preparedness for Class Discussions in a Flipped Classroom



Moreover, Table 1 also indicates that 82 students gave their choices on the ability of FC strategy to improve personalized learning. 2.44% (2) of the respondents strongly disagreed that the flipped strategy allows them to learn at their own free pace, 3.66% (3) disagreed, 12.20% (10) were neutral about the statement 32.93% (27) agreed and 48.70% (40) strongly agreed that this strategy allows them to be learning at their own pace. This concurs with a study by Li, Huo, Li and Kuo (2022) that students perceived Flipped Classroom to help improve personalized learning. Figure 5 summarizes this finding.

Figure 5: Flipped Classroom and Encouragement to Personalized Learning



Each lesson had learning objectives that the students were expected to meet by the end of the lesson. Concerning this, a general statement was given where the learners were to state their level

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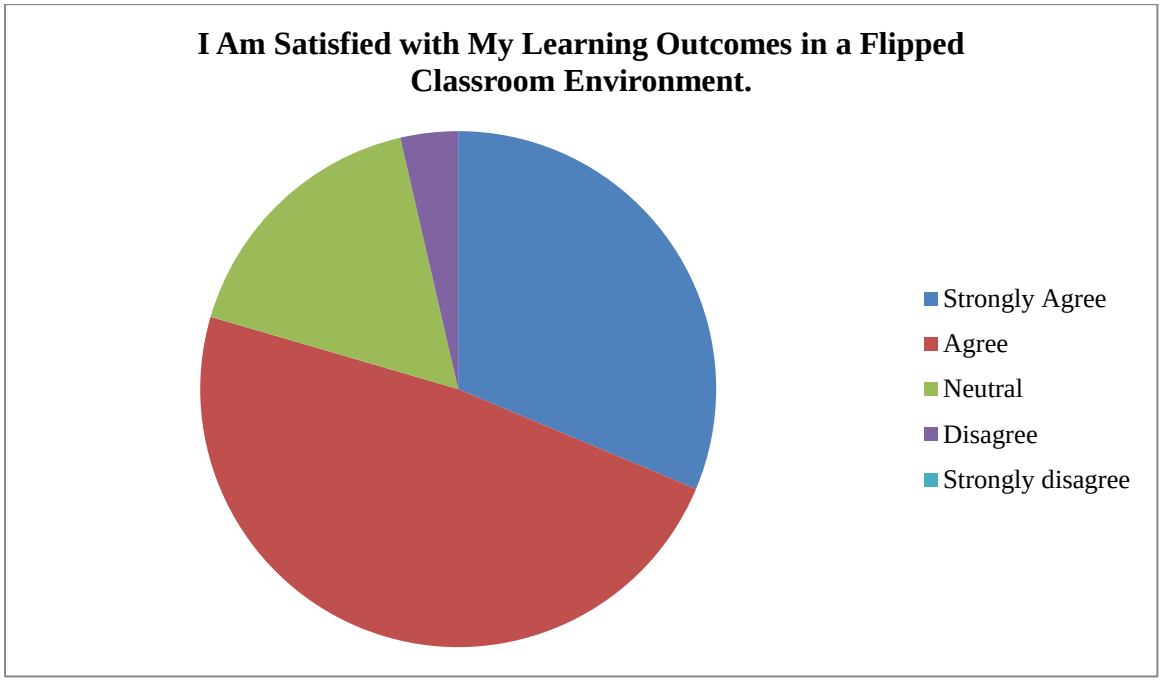
of satisfaction with the flipped classroom strategy towards meeting the stated learning outcomes and their responses were recorded. From Table 1, 31.33% (26) strongly agreed that the flipped classroom strategy helped them to meet the learning objectives, 48.19% (40) agreed with the statement, 16.87% (14) had neural opinions, 3.61% (3) disagreed with the statement and none of them strongly disagreed with the statement as shown in Figure 6. This indicated that 80% of the respondents agreed that the Flipped Classroom strategy helped them meet the stated learning outcomes. This concurs with a study by Chen (2021) on Flipped Classrooms and learning outcomes that students were satisfied with the level of meeting the expected learning outcomes in the Flipped Classroom as compared to those in traditional teaching methods.

Figure 6: Flipped Classroom and Level of Satisfaction to Meeting the Expected Learning Outcomes.



All the lessons had several learning activities therefore a general statement was made that flipped classrooms made the students feel motivated to participate in the activities. From their responses in Table 1, 1.20% (1) and 3.61% (3) respectively strongly disagreed and disagreed that the flipped classroom strategy motivated them to participate in the learning activities. 8.43% (7) neither agreed nor disagreed with the statement, while 33.74% (28) and 53.01% (44) respectively agreed and strongly disagreed with the statement as shown in Figure 7. This concurs with a study by Lo and Chew (2021) that Flipped strategy motivated learners to participate in learning activities.

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Figure 7: Motivation to Participate in Activities in a Flipped Classroom.

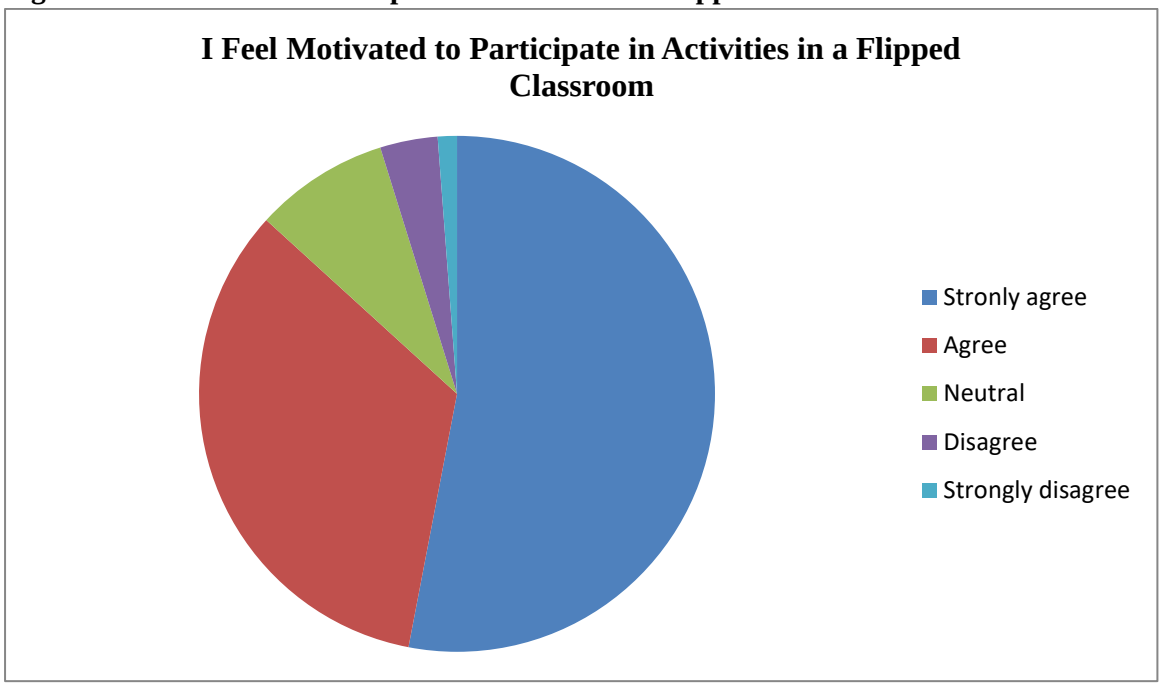
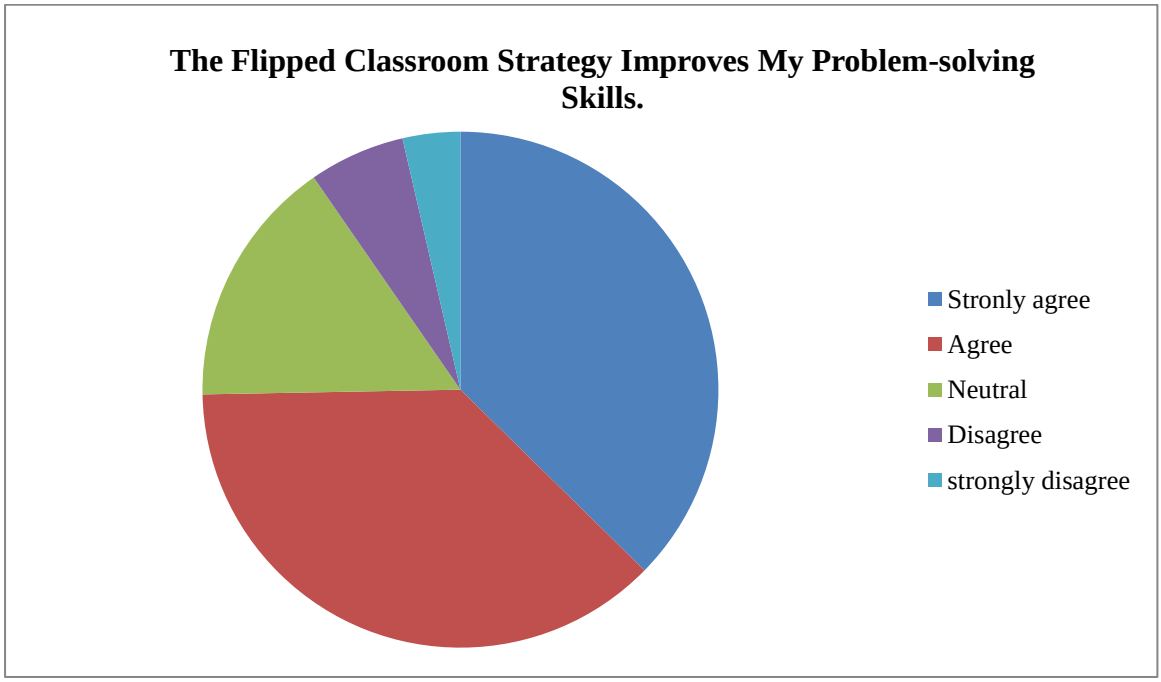


Table 1 also indicates that 37.35% (31) and 37.35% (31) strongly agreed and agreed the flipped classroom strategy improved their problem-solving skills respectively, 15.66% (13) were neutral, and 6.02% disagreed while 3.61% strongly disagreed that this strategy improved their problem-solving skills as shown in Figure 8. This concurs with a study by Mudlofir (2021) that flipped classroom strategy improved problem-solving skills.

Figure 8: The Flipped Classroom Strategy Improves My Problem-solving Skills.



On the confidence of the ability of the flipped strategy to help the learners to improve their performance, table 1 shows that, 44.57% (37) and 45.78% (38) respectively strongly and agreed that this strategy gave them confidence that when it is used for physics instructions it can help them succeed. 6.02 (5) neither agreed nor disagreed, 3.61% (3) disagreed with the statement but none

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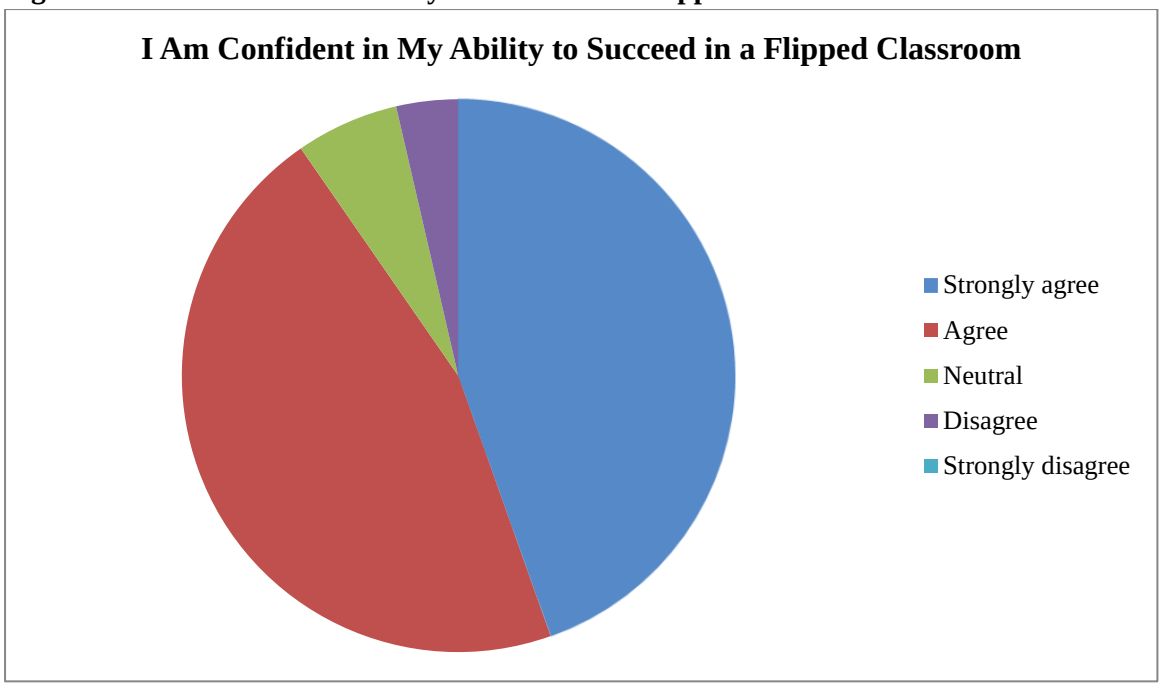
of the respondents strongly disagreed with the statement that they had a strong confidence with the flipped strategy to help them perform better in physics as shown in Figure 9. This concurs with a study by Dogan, Badt and Yasar (2023).

Figure 9: Confidence in the Ability to Succeed in a Flipped Classroom



The questionnaire also had a closed-ended question where the students were to choose whether they perceived the flipped classroom strategy to be a good method for physics instruction. 75% (63) of the students agreed that they perceived it to be a good method, 22.62% (19) disagreed and 2.38% (2) did not choose any answer as shown in Figure 9.

Table 2: A Summary of Perception Fixed Variable Choices Between-Subjects Factors

		Value Label	N
I perceive the flipped classroom strategy as a good method for physics instruction	1	yes	63
	2	no	19

In addition, a MANOVA test was conducted between the perception responses of the students and the students' responses on the Likert-scaled statements with the help of SPSS 16 and a confidence level of 0.05 to test $H0_1$. The following Table 3 and Table 4 show a summary of the results.

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Table 3: Tests of within Subjects Effects

	F	df1	df2	Sig.
I find the flipped classroom strategy engaging.	53.787	1	80	.000
The flipped classroom method helps me understand the subject matter better.	8.338	1	80	.005
The resources provided for flipped classroom activities are helpful.	24.821	1	80	.000
I feel more prepared for class discussions in a flipped classroom setting.	17.864	1	80	.000
The flipped classroom encourages me to learn at my own pace.	56.025	1	80	.000
I am satisfied with my learning outcomes in a flipped classroom environment.	22.356	1	80	.000
I feel motivated to participate in	25.428	1	80	.000
activities in a flipped classroom	31.871	1	80	.000
The flipped classroom strategy improves my problem-solving skills.	12.086	1	80	.001

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Table 4: Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.
Wilks' lambda	.255	23.328[a]	9.000	72.000	.000
Roy's largest root	2.916	23.328[a]	9.000	72.000	.000

Each F tests the multivariate effect of perception. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

From these results, the significance level of the MANOVA test was 0.000 for Wilks' lambda and Roy's largest root. Since 0.00 <0.05, $H0_1$ was rejected and therefore secondary school students in Kauma Sub County, Kilifi County, Kenya perceive flipped classrooms as an effective strategy for physics instruction. Based on the objective of this study, the study established that initially, learners were observed to have a hard time trying to adopt the flipped strategy. However, over time, students recognized the benefits of the interactive approach, improved performance, and self-directed learning. Students perceived the flipped classroom strategy as a good strategy for physics instruction. Xiao & Adnan (2022) studied students' perceptions of flipped learning in teacher education and found that while students initially struggled to adjust to the method, they later reported higher engagement and deeper understanding. This supported the observation. The findings of this study were that students perceive flipped classrooms as an effective strategy for physics instruction. This finding concurred with those of Ahmed and Asiksoy (2021) in their study on the effect of the gamified flipped learning method on students' innovation skills and perceptions of GFC. According to their findings, students positively perceived the gamified flipped classroom strategy as a helpful strategy for educational instruction. These studies backed up the findings of this study that a flipped classroom is a good strategy for physics instruction.

CONCLUSION

Based on the study findings students positively perceive the flipped classroom strategy as a good strategy for physics instruction. The analysis of the factors used to determine their perception of the strategy revealed that student found the flipped classroom strategy engaging and helped them to meet their learning needs. This was attributed to the ability of the strategy to allow students to have autonomy in the learning process

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and active engagement in the learning activities. Moreover, the flipped classroom strategy enhanced the learners' ability to understand the subject matter. Students felt more prepared for class discussions in a flipped classroom setting, this suggested that the flipped strategy enables readiness for interactive learning. Additionally, students reported feeling motivated to participate in learning activities. Lastly, the strategy was perceived to improve learners' problem-solving skills. This indicated that students were able to develop critical and analytical skills with the flipped classroom strategy.

Recommendations

Based on the findings of the study the following recommendations are made:

- Teachers should employ the flipped classroom strategy as an instructional method when teaching learners who achieve dismally in physics in order to improve their physics performance.
- A study is to be done on the impact of flipped classrooms on students' anxiety levels, and self-efficacy in physics learning.

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