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Influence of Instructional Methods on Female Students' Performance in Mathematics in Baringo Central Sub-County, Kenya

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Mathematics is a crucial subject in achieving Vision 2030, which aims to make Kenya highly advanced. Nevertheless, girls' achievement in Mathematics has been low over time in Kenyan high schools. Their poor output and disinterest in mathematics could be attributed to inappropriate instructional methods employed by teachers. Inappropriate methods of instruction tend to stifle knowledge retention and application. This paper explores how mathematics teachers' use of instructional methods shapes girls' scores in the Kenya Certificate of Secondary Education in Baringo Central Sub-County. The research appropriated the systems approach to instruction mooted by Ayot and Patel. It was a descriptive survey by design sampling 190 respondents, comprising 18 subject instructors, 6 heads of sections, and 166 female students. Purposive sampling was utilised to pick the heads of departments and Mathematics teachers and simple random sampling to obtain the Form Four learners. Questionnaires for instructors and learners, interviews for HODs, and an observation framework were used to collect data. The collected data was processed using both Chi-square and Karl Pearson correlation. Descriptive statistical techniques, such as standard deviation, percentages, frequency tables, and means, were also used. The study's findings indicated that the instructional methods influenced girls' mathematics performance. The study established that instruction techniques had a limited yet significant bearing ($[r=0.210]$ $p<0.05$) on girls' output in KCSE Mathematics tests. It was concluded that the instructional methods used influenced girls' performance in KCSE Mathematics. Instructors' approaches to teaching mathematics impact how learners apply, evaluate, and generate knowledge and solve math problems. Therefore, the study recommends that teachers are in-serviced more in Mathematics education.

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INTRODUCTION

One of the key objectives of instruction is to realize desirable outcomes in the learners. Learners are supposed to master and cultivate the requisite knowhow, competences, attitudes, and values for resolving issues and enhancing life. The main goal of instruction at all educational levels is to positively change the learner via a variety of teaching and learning strategies. Therefore, the efficacy of any instruction system mostly relies on the teacher's selection and use of appropriate instructional methods (Atandi et al., 2019).

Since they shape how pupils respond to learning and how instructors arrange and deliver content, instructional strategies are crucial in an education system (Shabani et al., 2023). They are activities in which teaching strategies are implemented. A strategy is a detailed plan for achieving success in a given situation. It is the overall approach to organizing and planning a lesson to achieve the set lesson objectives (Muthwii et al., 2015). It may also be described as a teacher's approach to stimulate and challenge the learner to cultivate knowledge, competences, attitudes, and values in a typical classroom. In any teaching situation, the teacher facilitates students' learning by employing a combination of instructional methods to achieve the desired objectives. Instructional methods enable the teacher to organize and manage the classroom sessions process, present clear explanations, illustrations, and clear descriptions, and assign and check whether learning occurs. They facilitate the interaction between the teacher and learners to realize teaching-learning goals.

Instructional methods consist of teachers' principles and methods to enhance and relate the

training to learners. It is well attested that the instructor's selection of a teaching strategy significantly shapes learning outcomes. In essence, the results of the teacher-learner interaction, including marks, grades, and mean scores, reflect the efficacy of an instructional strategy. As such, teachers employ a combination of methods to achieve the lesson objectives. Teaching is an ongoing process that utilizes a variety of strategies all aimed at gradually transforming the learner to desired ends (Castle, 2016).

Instructional methods are classified according to the level of engagement of the teacher and the learner. Certain changes in the knowledge, comprehension and habits of learners should emerge from an effective teaching strategy. It should also spark learners' interest and move the focus from verbalism and cramming to learning via intentional, concrete, and realistic scenarios, instead of merely imparting facts and figures. Muthiwii *et al.* (2015) categorize teaching methods into teacher-centred and learner-centred methods. The teacher presents the material orally to the learner while they listen or take notes using instructor-centred strategies that involve one-way communication (Anderson, 2015). Kizlik (2019) observes that teacher-centred methods dominate many Kenyan classrooms. Students have very little say in the learning session, which is entirely controlled by the instructor. In this approach, the teacher regards students as having empty spaces in their brains that need to be filled with information. Consequently, the learning process is usually marked by transmitting and cramming facts received from the teacher rather than having a clear mastery of content. This method is seen as autocratic since it views students as empty vessels

to be filled with information and hardly permits any opportunity for active student participation. As such, there is little opportunity for learners to provide feedback on how well the lesson was taught (Anderson, 2015).

Learner-centred teaching methods involve students constructing their own mastery of content and developing personal feelings about the learned ideas. The instructor is a guide to learning. He or she directs the trainees as they examine reality, gaining increased mastery of their knowledge and learning through exchange and interaction (Anderson, 2015). These methods transform learners into active agents in the instructional system (Muthwii *et al.*, 2015). Since learner-orientation puts the pupil at the heart of the instructional process, learning takes place in group settings wherein students are stirred to pose queries, conceptualize issues, and initiate discussions. In such scenarios, learners cultivate diverse thinking skills, including analysing, generating, and assessing. Much focus is put on inquiry and problem-related mastery, making learners the drivers of learning. They learn how to research so as to independently and continually master content throughout life.

Choice of Teaching Methods and Mathematics Achievement

It has been acknowledged that the greatest factor in learners' academic achievement is the method of instruction used in the instructional process (Atandi *et al.*, 2019; Shabani *et al.*, 2023). Academic achievement is widely exam-based, implying that the learner has to replicate the knowledge the teacher conveyed to them. As such, the instructional strategies determine how much learning occurs and how much knowledge the pupil can acquire. Because content differs in complexity and scope, various instructional methods will help the teacher attain their instructional objectives. According to Deci and Ryan (2017), incorporating a variety of teaching techniques improves learner motivation since it keeps them engaged in learning activities.

In Kenya, every student aspiring to advance his or her career in any tertiary learning institution is

expected to perform well in Mathematics at the Kenya Certificate of Secondary Education (KCSE) level. This is because Mathematics is essential to learning in arts, sciences, and technology. However, mathematics is perceived by many students as an abstract and difficult subject that is full of rules and procedures to be memorized. Most of them give little attention to the subject and concentrate on other subjects. Most people agree that when planning, executing and assessing math lessons, taking into account the needs, interests and abilities of the students, they will learn the material more effectively (Atandi *et al.*, 2019). For one to ably master math concepts, one needs to teach the subject well. Teaching Mathematics can be interesting, complicated and difficult for some instructors and learners. Whenever the Kenya National Examinations Council announces the outcomes of national examinations, there is often complaints of pupils' poor scores in maths. Teachers are equally unhappy that the subject is often poorly performed.

Scholars have advanced diverse views that account for poor performance in Mathematics. Some attribute it to poor instructional methods (Cheptirim *et al.*, 2023). This means that the burden of poor performance rests on the teachers' shoulders. A good Mathematics teacher is expected to utilize different instructional methods. This is because no teaching model is designed to realize all forms of learning. This implies that no singular teaching strategy is the best for all scenarios and with all instructors and learners. The strategy the teacher adopts should stem from the knowledge and skills of the instructor.

There has been increasing criticism of instructional methods for teaching Mathematics in secondary schools in Kenya (Changwony *et al.*, 2020). This is because Mathematics instruction has been dominated by lecturing and giving notes, accompanied by using the chalkboard only and prescribed textbooks (Sirajo & Abdulahi, 2023). To achieve learning objectives, the instructional strategies and resources chosen by the instructor must help the student to imbibe, remember, and apply knowledge (Kizlik, 2019). Only then can

the learners effectively apply in life what they learn. Education stakeholders have critically questioned instructional methods used in teaching Mathematics.

Similar to other regions of Kenya, the Baringo Central Sub-County exhibits significant gender disparities in math achievement. Girls have consistently scored extremely poorly on the KCSE exam (Changwony et al., 2020). Most students tend to score below average. Most girls score low mean grades. This inspired the researchers to inquire into how the teaching methods used in mathematics shape girls' maths scores in Baringo Central. As Mathematics is a compulsory requirement for admission to higher institutions of learning in the country, secondary school students must perform well in the subject. However, some factors, including poor instructional methods, adversely affect students' capacity to understand and score well in Mathematics. Poor performance in Mathematics has denied many intelligent and talented Kenyan youth admission into the career courses of their choice at the university, consequently producing poor and unhappy professionals in the nation. Therefore, the study undertook to clarify the influence of instructional methods on girls' math scores in Baringo Central boarding secondary schools in Kenya.

LITERATURE REVIEW

Teaching Methods and Girls' Performance in KCSE Mathematics

According to Shabani *et al.* (2023), there is a high association between learners' low scores in Mathematics and the instructional strategies used. The common teaching methods applied in Mathematics include lecture methods, teacher-oriented strategies, and routine cramming. To establish reasons behind students' subpar performance in math in Pakistan, Tahir and Hadayat (2016) gathered information from parents, instructors and learners. The participants were picked using simple random sampling approach to fill a questionnaire. According to the results, the low scores in math was due to teachers' sternness in class, followed by lack of

sufficient revision by pupils. From the parents, learners' inattention was the main culprit in students' subpar performance in math.

Behzadi et al. (2014) evaluated how instructional strategies shaped learners' math and reading abilities in Iran. In the quasi-experimental investigation, third-grade students from 17 schools were picked as respondents through cluster sampling. According to the outcomes, learners that received study skills instruction scored better and attained higher academic levels relative to those who received training using conventional approaches. The researchers deduced that instructional strategies, like metacognitive and cognitive, supported girls' mastery of math skills in the classroom.

In a study in Tanzania, Mlozi et al. (2013) noted that pupils performed sub-optimally in math owing to inadequate training and instructional aids. They also observed that the simultaneous use of Kiswahili and English languages during instruction confounded learners. In Nigeria, learners' disagreeable attitudes towards math, fear and fright, overfilled math classes, inadequate training aids, absence of math workshops and libraries, poor evaluation of math instructors, coupled with low parental support to learning have also been reported as the leading reasons for low performance in Mathematics in public high schools (Sa'ad et al., 2014).

According to an inquiry by Michael (2015), the most effective strategies for training math skills in the classroom touch on students' five intellectual organs. It is crucial to assign problems to students so they can solve math problems and comprehend sums written on the board with the help of teachers during instruction. Michael goes on to say that for students to better grasp the math material, classroom size should be optimized and realistic teaching aids should be appropriated. This will allow students to do as they are taught to hear.

According to Kithinji's (2014) investigation in Meru County, Kenya, inadequate teaching strategies were a factor in low scores in math. In

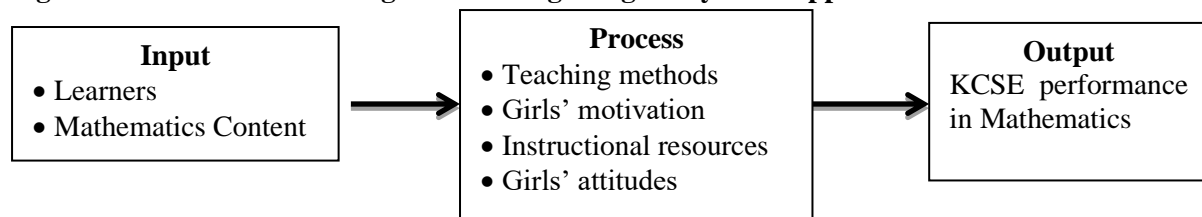
their research, Tshabalala and Ncube (2013) also noted that teaching, resources, teacher behaviour, prior math training and learners’ apprehension significantly shaped girls’ achievement in the subject. A few of these elements might be responsible for the poor math outcomes in Baringo Sub-County. Ndinda (2016) conducted a study to examine variables affecting geometry achievement among learners in Makadara Sub-County of Kenya. One of the factors examined was teaching strategies. For study purposes, 240 pupils from six different schools were delineated at random to participate. Learners taught using diverse instructional strategies were given a test to gauge geometry scores. The findings of the study showed a positive and significant correlation between students' geometry attainment and the methods used in instruction. While the current study only looked at the performance of girls, the reviewed study included both male and female students. Furthermore, this study was descriptive in nature, whereas the other study was quasi-experimental.

Theoretical Framework

The research was based on the Systems Approach to instruction suggested by Ayot and Patel (1987). According to the theory, teaching and learning are vigorous procedures that fit into the system's

process. The structure of a typical system consists of the three fundamental segments input, process, and output. The systems approach can be used to examine the orderliness, efficiency, and effectiveness of teaching and learning. In any teaching situation, learners constitute the inputs in the education system. These inputs are then treated at various levels of instruction, which differ, and they emerge as learned individuals with desired know-how, competencies and dispositions in a specific subject. In the classroom, the concepts given to the learner by the instructor are also the input whereas teaching and learning tasks form the process wherein the learners interact with their environment to attain skills. The outcomes from assessments and tests reveal the output. In the case of this study, the pupil is the input and via the instructional process, the input undergoes the necessary alterations. Performance of girls in mathematics is the output that provides feedback about the teaching and learning process. Thus, through operationalisation of the instructional process, particularly by adopting appropriate instructional methods, it is possible to generate desirable outputs in form of good performance among female students in mathematics. This process is illustrated in *Figure 1*.

Figure 1: A model for teaching and learning using the systems approach



METHODOLOGY

Research Design

This was descriptive survey research by design. Data was gathered from a random selection of participants.

Population and Sample

The study was carried out in Baringo Central Sub-County in Kenya. The target comprised 18 Maths instructors, 6 Maths HODs and 739 Form Four

girls. Maths teachers took part in the investigation because they are the implementers of the subject’s curriculum. The respondents sampled were 190, comprising of 6 HODs of Mathematics, 18 subject instructors, and 166 female learners.

Research Instruments

The main data collection tools deployed in the inquiry were a questionnaire for instructors and learners and interview guide for HODs. The dependability score for the learners’ questionnaire

was 0.7103 whereas it was 0.7854 for instructors' questionnaire, both which were higher than 0.6, the ideal threshold as per Neuman (2007). Minor revisions were effected on the instrument prior to its administration to enhance validity and reliability.

Data Analysis and Presentation

Quantitative data was processed descriptively using frequencies, means, percentages, standard deviations and correlations. Qualitative data was processed using a thematic approach.

RESULTS AND DISCUSSION

The research was undertaken exclusively in girls-only high schools. As such, all the learner participants were female. In this section, the findings of the investigation are presented and discussed.

Instructional Strategies and Girls' KCSE Scores in Mathematics

Mathematics instructors and learners were asked to indicate how often diverse instructional strategies were deployed in math lessons. The items were scored on the range of: 1-Never, 2-

Rarely, 3-Sometimes, 4-Often and 5-Always. Means and standard deviation were calculated to present the findings and see the differences. The outcomes are illustrated in *Table 1*.

As depicted in *Table 1*, learners and instructors reported that the lecture method was hardly applied, although learners' means were higher ($M=2.32$) than those of instructors' ($M=1.52$). These results showed that the lecture approach was not popularly utilised in teaching math in the schools studied. This outcome was reiterative of what Mbugua *et al.* (2012) noted in their study, that a paltry 5.6% of math instructors utilised the lecture approach. The lecture technique is not useful as it majorly turns learners into passive partakers in the classroom. Oundo and Chuka (2013) state that those who use the lecture method do so to complete the math syllabus in time. The lecture approach is considered faster. However, it is not effective in ensuring students' mastery of content. Moreover, inadequate number of subject instructors in schools could account for the popular use of this method in Mathematics lessons.

Table 1: Instructors and learners' ratings of teaching techniques

Teaching method	Mathematics teachers		Girls	
	Mean	SD	Mean	SD
Lecturing method	1.5294	1.00733	2.3253	1.44900
Group or class discussion	3.7059	1.04670	3.5422	1.20405
Demonstration by students to one another (or to others)	3.2353	.97014	3.2892	1.22628
Teacher helping students individually	3.6471	1.41161	3.4277	1.41557
Question and answer	3.2353	1.39326	3.8614	1.35247
In-class exercises	4.5882	.71229	4.0301	1.07548
Peer teaching	3.0588	1.19742	2.9157	1.24759
ICT and e-learning	1.9412	.74755	1.9217	1.41417
Composite statistics	3.1177	1.0608	3.1642	1.2981

Further, the instructors ($M=3.70$) and students ($M=3.54$) indicated that group discussions were often used in math teaching in their institutions. These results showed that such discussions were popularly used in Mathematics instruction. Mbugua *et al.* (2012) similarly noted that most (64.2%) maths instructors utilized the discussion approach in a study. The approach is lauded for

creating a supportive instructional framework that ensures each learner's unique needs are addressed.

Additionally, the study results in Table 1 show that the educators ($M=3.23$) and learners (3.28) agreed that the teaching method of demonstrations among students was sometimes used in Mathematics instruction in their respective schools. Therefore, this method was used at times in Mathematics classes. Furthermore, most of the

teachers indicated that they frequently ($M=3.64$, $SD=1.41$) helped learners individually during math lessons whereas the learners intimated that they were assisted occasionally ($M=3.42$, $SD=1.41$). This finding suggested that teachers have varying opinions from those of learners concerning individualized learning approaches in Mathematics instruction in schools. The students also indicated that question-answer was regularly used ($M=3.86$, $SD=1.35$) relative to teachers who stated they rarely used it ($M=3.23$, $SD=1.39$). This finding indicated that learners favoured to learn via the question-answer approach while the instructors did not prefer it. This result affirmed Michael's (2015) view that students prefer question-and-answer sessions with instructors in the Mathematics lessons.

The study results further show that teachers ($M=4.58$, $SD=0.71$) always used in-class tasks to teach maths. Meanwhile, the pupils said the teachers used it regularly ($M=4.03$, $SD=1.07$). As such, teachers had higher ratings than students on the use of in-class exercises in Mathematics instruction. The findings concurred with the view by Tahir and Hadayat (2016) that in-class tasks enhance the educational outcomes of Mathematics learners.

It further emerged from teachers ($M=3.05$, $SD=1.19$) and learners ($M=2.91$, $SD=1.24$) that peer teaching approaches were at times utilised. Lastly, the tutors ($M=1.94$, $SD=0.74$) and learners ($M=1.92$, $SD=1.41$) both concurred that ICT and e-learning techniques were hardly used. They explained that the ICT facilities were unavailable in their institutions. This fact could also be explained by teachers' lack of the requisite ICT skills for teaching and learning Mathematics. To explain this economically, Garcia and Ortiz (2013) note that the unavailability of key inputs for the instruction process might concurrently impair with educational results. This implies that all inputs, including ICTs and the relevant skills, must be availed to strengthen girls' achievement in Mathematics education.

Composite statistical data further showed that tutors ($M=3.11$, $SD=1.06$) and learners ($M=3.16$,

$SD=1.29$) agreed that, at times, teachers diversified their teaching styles in math classes. The two groups affirmed that in-class exercises were the commonest style deployed in math lessons. Nevertheless, the second-ranked style per teacher was group discussions, although learners ranked it third. Overall, both the teachers and students seemed to have similar responses concerning teaching methods used in Mathematics in the study area. Most instructors seemed to favour learner-centred approaches, as revealed in the interviews with one of the heads of mathematics departments:

“If the method is student-centred, the performance will be promising. Nevertheless, if it is teacher-centred, the worse of the results will be the outcome” (Oral Interview, HOD 01).

The average mean scores obtained suggested that certain instructional styles were unpopular among the learners. Tahir and Hadayat (2016) affirm that some instructional styles that math instructors use do not assist learners in developing a conceptual mastery of the subject. Learners' performance is significantly affected when they fail to cultivate a conceptual mastery of math concepts.

Further, the teachers and learners were urged to mention other styles often deployed in Mathematics instruction. The teachers mentioned team instruction, demonstrations, elucidations, brainstorming, revisions, rapid tests, inter-stream competitions, and seminars. On their side, the students identified the following methods: revision questions, review of topics less understood, math lunches, rapid tests, consultations, laboratory works, practicum, library search, and symposiums. Contrary to the study results, Tahir and Hadayat (2016) argue that subpar scores in Mathematics is attributable to the non-use of practicum and current styles of teaching. The lack of practical sessions contributes to the development of negative attitudes towards the subject among the learners.

Further, the tutors and students were urged to state the ideal styles to be used in training maths. From

their feedback, 45(27.1%) identified class discussion since it allowed them to better master concepts. Meanwhile, 34(20.5%) said individualized teaching would be most appropriate. Other teaching strategies mentioned by learners included rapid tests (14.5%) and question-answers (12.0%). These strategies were favoured since they helped the learners to tackle their weaknesses and to know how to tackle questions related to the subject.

In an interview, one HOD said,

“Teaching methods that involve student activities improve understanding and hence performance. In addition, methods that simplify concepts and understanding by girls lead to better performance in KCSE Mathematics paper” (Oral Interview, HOD 01).

From the study results, most Mathematics teachers favour using learner-oriented methods styles when teaching maths. Many instructors, 10(58.8%), affirmed the students’ view that the ideal teaching styles for Mathematics lessons is group discussion. They argued that this method helped students to participate, thus building their self-esteem and confidence in their abilities in the subject. Teachers ranked Peer teaching second, 2(11.8%). Therefore, the teachers’ most preferred approach to teaching Mathematics was via group and seminar discussions.

The study tested the hypothesis, which stated that instructional methods do not significantly influence girls’ academic performance in Mathematics. A Karl Pearson correlation was conducted to test this hypothesis. Average data on teaching methods was correlated with performance data on an ordinal scale. The results are indicated in *Table 2*.

Table 2: Influence of Teaching Methods on KCSE Performance by Schools

		Teaching Methods	KCSE
Teaching Methods	Pearson Correlation	1	.210**
	Sig. (2-tailed)		.007
	N	166	166
KCSE	Pearson Correlation	.210**	1
	Sig. (2-tailed)	.007	
	N	166	166

***. Correlation is significant at the 0.01 level (2-tailed).*

The study outcomes in *Table 2* show that there was a significant positive relationship ($r=0.210$, $p=0.007$) between instruction styles used by teachers and girls’ performance in Mathematics in KCSE. The null hypothesis was thus disallowed ($p<0.05$), resulting in the conclusion that there is a significant positive link of teaching styles and girls’ scores in maths in the study area. Nevertheless, the effect seems positive but weak, which implies that instructors’ continuous application of diverse teaching styles could enhance learners’ math scores. Behzadi et al. (2014) has similarly noted that inducting tutors on teaching strategies enhanced learners’ mastery of math concepts in Iran.

To support the findings, one of the HODs said: “A teaching method that involves the student

(student-centred) approach yields better performance as opposed to a teacher-centred approach, which will result in dismal performance” (Oral Interview, HOD 02). Another HOD remarked thus: “Teaching approach that increases learners’ understanding of the subject would lead to improved performance in Mathematics” (Oral Interview, HOD 03). As such, teachers must consider deploying teaching styles that strengthen learner engagement and peak their interest in math to raise their performance. Ndinda (2016) posits that teachers’ teaching styles contribute to performance in geometry examinations. In a study conducted in Makadara, Nairobi, Ndinda observed the methods used by teachers did not stir learners to succeed in the lesson. This suggests that teaching styles are a

great factor in the ultimate scores that students get in math tests. Teachers' non-diversification in teaching approaches also contributes to poor performance in the subject.

CONCLUSION

Female students are expected perform as well as their male counterparts in Mathematics in secondary schools. However, this is not being realized. Evidence from the study indicates that girls' performance in secondary schools has remained low in Baringo Central. One reason for this is teachers' choice of teaching methods for Mathematics. Most teachers use teacher-centred approaches as opposed to student-centred approaches. Teacher-centred approaches deprive the student of independent inquiry and lead to the cultivation of negative attitudes towards the subject, both of which are precursors to poor performance. The study has confirmed that teaching methods significantly influence girls' scores in KCSE Mathematics.

Recommendations

The study has revealed that instructional methods significantly influence girls' scores in national math examinations in public high schools in Baringo Central Sub-County. In light of this, the study recommends that to improve the subject's performance among girls; Mathematics teachers should employ various instructional methods, especially learner-centred methods, such as demonstrations, participatory techniques, and educational technology and peer tutoring in teaching. Moreover, Mathematics teachers need in-servicing on advanced and current strategies of teaching Mathematics. Schools and curriculum support offices at the County government level should regularly sponsor Mathematics teachers to attend in-service programmes and forums.

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