

Tracking the influence of strategy formulation practices in public secondary schools on performance of students in Science, Technology, Engineering and Mathematics [STEM] subjects: A case of Murang'a County, Kenya

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<https://doi.org/10.51867/ajernet.7.2.107>

ABSTRACT

This article addresses the fundamental question of how strategy formulation practices in public secondary schools influence Science, Technology, Engineering and Mathematics (STEM) subject performance, specifically examining the Murang'a County context. Understanding this relationship is crucial for educational stakeholders seeking to optimise strategic planning processes to enhance student achievement in critical STEM disciplines that underpin national development objectives. This study was guided by strategy and performance theories. The study adopted a mixed-methods approach and a descriptive survey design with a convergent parallel model. The target population consists of 7,089 individuals across 330 public secondary schools in Murang'a County. The study uses a combination of sampling techniques to ensure representativeness: proportionate sampling and quota sampling to select 713 participants. Questionnaires were administered to principals, STEM teachers, and Form 3 students; in-depth interview schedules were conducted with education officers, and a document analysis was conducted. A field exercise had 710 responses, yielding a 99.6% response rate. Piloting was conducted in Kiambu County. Quantitative data were analysed using descriptive statistics (e.g., means, frequencies) and inferential statistics – chi-square and regression. Qualitative data underwent thematic analysis. The study concludes that strategy formulation practices by principals significantly enhance student performance in STEM subjects, with a 9.2% improvement per unit increase. Teachers and students affirm that these strategies improve outcomes, supported by education officers and document analysis. However, many schools struggle to develop effective STEM strategies, leading to poor performance. Targeted policy interventions and training are needed to strengthen strategy formulation for better STEM education outcomes. The study recommends that principals, teachers and other key education stakeholders should acquire necessary strategy formulation knowledge.

Keywords: Performance, Public, Secondary Schools, STEM Subjects, Strategy Formulation

I. INTRODUCTION

In contemporary educational contexts, strategic planning represents a disciplined effort to produce fundamental decisions and actions that shape institutional direction, focusing on future-orientated decision-making processes that require comprehensive information gathering and exploration of strategic alternatives. The global emphasis on Science, Technology, Engineering, and Mathematics (STEM) education has intensified as nations recognise their critical role in preparing twenty-first-century workforce capabilities. Among all the subjects, STEM subjects are being prioritised because current students need to mitigate emerging national and global issues (Royal Education Council, 2021). STEM education employs an interdisciplinary approach that connects rigorous academic concepts with real-world applications, enabling students to develop competencies essential for competing in the modern economy. This imperative has prompted educational systems worldwide to reimagine their strategic approaches, with countries like Finland developing comprehensive national curricula, Singapore implementing the "Thinking Schools, Learning Nation" vision, and New Zealand granting principals statutory responsibility for strategic planning processes (Organization for Economic Cooperation Development [OECD], 2007). International experiences demonstrate varied approaches to educational strategic planning. The United States embraced strategic planning in 1993, implementing four-step processes that significantly improved educational outcomes through comprehensive needs assessment and systematic evaluation (Cook, 2005). European nations have made substantial strides despite pedagogical challenges, while Malaysia has continuously invested in education policy reforms to align with global demands. These international precedents underscore the transformative potential of strategic planning when properly implemented and resourced.

In Kenya, strategic planning in education was formally introduced in 2005, with the Ministry of Education mandating all public institutions to develop comprehensive strategic plans by 2013. The Kenya Education Sector Support Program (KESSP) between 2006 and 2011 established frameworks for strategic planning practices in secondary

schools, aligning with Vision 2030's social pillar objectives of providing quality education for sustainable development. The government's strategic plan envisioned producing globally competitive graduates with skills necessary for achieving middle-income status by 2030 (Ministry of Education [MOE], 2007).

However, despite these policy initiatives and substantial investments in teacher capacity building, student performance in STEM subjects across Kenyan public secondary schools remains disappointingly low. The Commission for University Education reported an alarming decline in mathematics and sciences performance, with Central region counties, particularly Murang'a County, experiencing particularly dismal results as illustrated by table 1 below. This performance gap persists despite rigorous in-service training programmes for STEM teachers and increased resource allocation to schools. There is dis-connect between strategic planning adoption and STEM performance outcomes presents a critical research gap. While numerous schools in Murang'a County have developed strategic plans, their influence on student achievement in STEM subjects remains unclear. Previous studies indicate that challenges including funding shortages, policy implementation gaps, inadequate staffing, and poor teacher motivation continue to hamper strategic plan effectiveness.

Table 1

Performance of students in STEM subjects in public secondary schools in Murang'a County

STEM Subjects	KCSE Performance mean score out of 12 points				
	2017	2018	2019	2020	Average
Mathematics	2.6	2.7	3.6	3.3	2.9
Chemistry	2.2	2.6	2.6	2.4	2.5
Biology	1.8	2.4	3.4	3.1	2.4
Physics	2.9	3.0	4.0	3.6	3.2
Average	2.4	2.7	3.4	3.1	2.8

This article addresses the fundamental question of how strategy formulation practices in public secondary schools influence STEM subject performance, specifically examining the Murang'a County context. Understanding this relationship is crucial for educational stakeholders seeking to optimise strategic planning processes to enhance student achievement in critical STEM disciplines that underpin national development objectives. Thus, the study research question was "To what extent is the influence of strategy formulation practices on the performance of students in STEM subjects in public secondary schools of Murang'a County, Kenya?"

1.1 Research Objective

The objective of this study is to track and analyze the influence of strategy formulation practices in public secondary schools on students' performance in STEM subjects in Murang'a County, Kenya.

1.2 Specific Objective

Specifically, the study seeks to determine how principals' practices in goal setting, stakeholder involvement, resource alignment, and structured implementation planning affect teaching effectiveness and academic achievement in mathematics and science subjects. By examining these strategic processes, the study aims to establish whether strengthening strategy formulation practices can address the persistent underperformance in STEM and enhance overall student outcomes in public secondary schools.

II. LITERATURE REVIEW

2.1 Theoretical Review

The theoretical framework was anchored on two relevant theories: Geoffrey Chamberlain is one of the latest theories of strategy, which was first published in the year 2010 (Chamberlain & Geoffrey, 2010). The theory explains in detail what strategy is all about and the forces that shape the strategy. It goes further and outlines the process that forms strategy as well as the mechanism by which strategy can take effect. In public schools principals develop and implement both deliberate and emergent strategies aimed at improving academic performance. But in most cases this is not realised, and therefore poor performance of STEM subjects persist. This demands them to apply main issues highlighted in strategy theory when developing strategies. In this regard, they need to develop a strategy bearing in mind what they are targeting, the main thing being to improve students' performance in STEM subjects. Principals must ensure internal, external and stakeholders' forces support the strategy; hence, there are high chances of its success. Besides this, they should be able to positively manipulate economic and psychological forces that drive strategy to

success. Likewise, principals need to be aware that developed strategies are not important and do not serve the function if they are not properly implemented.

Don Elger's theory of performance was first published in the year 2007 (Elger, 2007). It is mainly concerned with how to increase performance, which is valued result in an organisation like a school. According to him, a performer can be an individual or a group of people working together for a common goal. The theory of performance informs learning in classrooms, workshops and other venues associated with learning, such as academic advising, self-development, departments, academic committees and professional research groups. This theory gives insight on how performance can be enhanced in an organisation. The theory discusses in detail issues that influence performance, namely, performers' mindset, enriching environment and reflective practice. The performance of students in secondary school, especially in STEM subjects, is a major issue of concern whose concrete solution has not yet been found. This demands the education managers pay more attention to this issue as they plan and devise strategies that would provide an appropriate remedy.

2.2 Empirical Review

Strategy is an action that managers take to attain one or more of the organisation's goals. The strategic planning process is composed of three main bundles of strategic practices, namely strategic analysis, strategic choice and strategic implementation practices (Johnson et al. 2020). Hagoug and Abdallah (2021) indicated that there is a positive association between academic performance and strategic capabilities. A strategy is all about integrating organisational activities, utilising and allocating the scarce resources within the organisational environment so as to meet the preset objectives. Strategy is about shaping the future and is the human attempt to get to desirable ends with available means (McKeown, 2012). Strategy results from the detailed strategic planning process and entails a set of activities or processes that an organisation intends to use in order to achieve its set goals and aims. Kwaslema and Onyango (2021) argue that, if well adopted in the management of public secondary schools, strategic planning can ensure successful implementation of strategic decisions which are critical for school performance. Strategic planning has a positive, moderate, and significant impact on organisational performance; it is particularly potent in enhancing organisational effectiveness (George et al. 2019). It is also worth mentioning that schools that are operating without strategic plans portray a lack of commitment to quality management, which may jeopardise the provision of quality education. Wesonga et al. (2024) observed that there is disconnect between formulated strategies in various organisations and their execution into effective actions.

Hsu and Fang 2019 pointed out that there's limited understanding of how integrated STEM learning opportunities can boost student creativity, aid in developing advanced thinking abilities, or influence their beliefs and attitudes toward STEM subjects. STEM education is crucial for preparing students for the 21st-century workforce and professional careers (Arguello & Orta 2020). The challenge within STEM education lies in the scarcity of equipment and resources, together with the rigid structure of schools (Le et al. 2021). Le et al. (2021) further noted that the other challenge in STEM education emanates from the absence of a structured curriculum framework, teaching resources, and evaluation criteria. STEM education significantly improves students' academic achievements, as evidenced by studies showing positive correlations between STEM instruction and student performance in various subjects (Abdul-Rahaman & Tindam, 2024). Successful STEM-based instruction is strongly associated with teachers' quality since qualified teachers would be able to create effective learning through suitable instruction. Accordingly, teachers should encourage themselves to improve their knowledge and skills in order to become an inspiring facilitator throughout the STEM-based teaching-learning process (Chang & Park, 2014). Oparaocha (2017) pointed out in his study the idea that an effective STEM education can be realised in the school in which an efficient manager with high STEM awareness cooperates with his colleagues. A study carried out by Kristin et al. (2016) noted that students' performance in STEM is affected by three factors, namely teachers' practices, active participation of students in STEM activities and motivations of students in science, mathematics and engineering fields.

Strategy formulation is a critical process through which an organization, including schools, develops specific actions to achieve its goals. It involves analyzing internal and external factors, prioritizing key issues, and choosing the most effective courses of action to meet objectives (Baroto et al. 2014). A well-formulated strategy provides a roadmap for achieving results, but it is only meaningful when implemented effectively. This includes defining a clear vision and mission, setting long-term objectives, and selecting strategies that are realistic and achievable within available resources (Giuseppe, 2015). When strategy formulation is paired with proper implementation, it is strongly linked to improved organizational performance (Linyard, 2021; Mohamed & Mohamud, 2021). Motivation plays a crucial role in enhancing educational outcomes, influencing both teacher performance and student achievement. Similarly, motivated students demonstrate higher engagement, better understanding of learning content, and improved academic performance (Yong & Yeo, 2012). Motivation can also be cultivated by helping students appreciate the relevance of STEM education in real life, which encourages curiosity, persistence, and self-directed learning (Cavas, 2011; President Obama, 2009). Without motivation, students may disengage from learning, become passive learners, and fail to develop critical thinking or problem-solving skills.

In schools, teamwork supports curriculum management, instructional planning, and effective program implementation (Zaveria & Thinguri, 2017). Collaborative environments reduce teacher isolation, foster collegiality, and encourage the sharing of resources and best practices, ultimately improving teaching quality and student outcomes (Phalane, 2012). Strong leadership that guides and motivates teams fosters ownership, accountability, and motivation among staff, which enhances overall school performance (Oster, 2012). The methods used to teach students also play a direct role in learning outcomes, particularly in STEM subjects. Effective teaching aligns with learners' needs, encouraging critical thinking, problem-solving, creativity, and active engagement (Adunola, 2011). Learner-centered approaches, such as cooperative learning, allow students to explore concepts, engage in hands-on activities, and take ownership of their learning, leading to higher achievement (Chika, 2012). Integrating technology, including ICT-based tools, further enhances students' research skills, problem-solving abilities, and engagement with content (Munishi, 2004).

Linking strategy formulation to STEM performance, it is evident that principals play a central role in proactively shaping educational outcomes (Adeleke et al. 2008). Research indicates that effective strategic practices positively influence organizational performance (Borrero et al. 2020). In the context of STEM education, three areas emerge as critical for principals to focus on: teacher and learner motivation, teamwork, and learner-centered teaching methods. While these elements are widely recognized as essential for improving student outcomes, there remains a need to explore whether principals intentionally formulate strategies specifically aimed at enhancing students' achievement in STEM subjects.

III. METHODOLOGY

3.1 Research Design

This study adopted a mixed-methods approach under the pragmatic research paradigm, combining qualitative and quantitative data to examine how principals' strategy formulation practices influence students' performance in STEM subjects. A descriptive survey design within a convergent parallel model was employed, allowing for simultaneous collection and separate analysis of quantitative and qualitative data, which were later integrated to draw comprehensive conclusions. While quantitative data provided statistical insights, qualitative data captured participants' perspectives, providing a holistic understanding of the research problem. This enabled answering the research question: To what extent is the influence of strategy formulation practices on the performance of students in STEM subjects in public secondary schools of Murang'a County? Likewise, hypotheses answered are the following: HO2: Strategy formulation practices have no statistically significant influence on the performance of students in STEM subjects in public secondary schools of Murang'a County. H2: Strategy formulation practices have a statistically significant influence on the performance of students in STEM subjects in public secondary schools of Murang'a County.

3.2 Study Area

The study was conducted in Murang'a County, Kenya, covering eight sub-counties that are characterized by consistently poor STEM performance relative to neighboring counties.

3.3 Target Population

The target population consisted of 7,089 individuals from 330 public secondary schools, including 36 education officers, 330 principals, 1,503 STEM teachers, and 5,220 Form 3 students who were available and reliable.

3.4 Sampling and Sample Size

The study used a combination of quota and proportionate sampling, a representative sample of 713 participants was selected: 8 education officers from each sub-county, 33 principals, 150 STEM teachers, and 522 students. A 99.6% response rate was achieved, ensuring reliable and representative data for analysis.

3.5 Data Collection Instruments and Procedures

Three main instruments were used to collect data. Questionnaires were administered to principals, STEM teachers, and students to gather demographic information and responses related to strategic planning and STEM performance. In-depth interviews with education officers provided qualitative insights into strategic planning practices, while document analysis checklists reviewed school timetables, exam records, strategic plans, and subject selection records to complement primary data. Validity was ensured through expert review and piloting, while reliability was confirmed with Cronbach's alpha coefficients of 0.785 for principals, 0.886 for teachers, and 0.721 for students. Triangulation of instruments enhanced the credibility and dependability of the findings. Data were collected over a six-month period, following ethical approval from Mount Kenya University, county authorities and permits from National Commission for Science Technology and Innovation (NACOSTI). Questionnaires and document reviews were administered in schools, while interviews were conducted at convenient venues.

3.6 Data Analysis

Quantitative data were analyzed using descriptive statistics (means, frequencies) and inferential statistics (chi-square and regression) at a significance level of $\alpha = 0.05$ using SPSS v24, with regression models assessing the influence of strategic planning practices on STEM performance. Qualitative data were analyzed thematically, with verbatim quotes used to illustrate emerging patterns, and findings were presented using tables, charts, and narrative explanations to ensure clarity and comprehensiveness.

3.7 Ethical Considerations

The nature and the purpose of the research were expounded to the participants by the researcher. This entailed explaining to them the procedure to be followed during data collection so that they can participate willingly and without fear. The researcher assured the respondents that no private information would be divulged to a third party. The participants were not required to reveal their personal identity orally or in writing during data collection. In regard to confidentiality, the participants were assured that the information provided would only be used for research purposes. There wasn't any power dynamics noted when interviewing education officers about principals.

IV. FINDINGS & DISCUSSION

4.1 Descriptive Statistics of Strategy Formulation Practices

Here descriptive analysis is done whereby issues pertaining to the influence of strategy formulation practices on the performance of students in STEM subjects are discussed with tables entailing mean, standard deviation, as well as frequencies and percentages.

4.1.1 Influence of Strategy Formulation Practices on Performance of Students in STEM Subjects -Principals' Perspective

From the principal's questionnaire, the items' mean and standard deviation of their responses are as indicated by table 2 below. On the rating scale of one to four, four was for always and three for sometimes, whereas two was for rarely and one for never.

Table 2

Mean and standard deviation of principals' data on strategy formulation

	N	Minimum	Maximum	Mean	Std. Deviation
Strategy prioritization	33	2.00	4.00	3.3333	.64550
Teacher-learner motivation	33	2.00	4.00	3.5152	.56575
Team building	33	1.00	4.00	3.2424	.79177
Heuristic/problem solving teaching methods and strategies	33	1.00	4.00	3.0303	.72822
Valid N (listwise)	33				

Table 2 shows thirty-three respondents rated the level of application of various strategy formulation practices in secondary school. Whereby teacher-learner motivation and need strategy prioritisation recorded a mean of 3.5152 and 3.3333, respectively, and a standard deviation of 0.56575 and 0.64550, respectively, showing that they are always applied in school. The findings concur with Cavas (2011), who observed that the major factor that affects students' attitude and achievement in science is their motivational level. Team building and heuristic or problem-solving teaching methods and strategies followed closely with means of 3.2424 and 3.0303, respectively, and standard deviations of 0.79177 and 0.72822, respectively, indicating they are sometimes applied in school. The findings resonate with Phalane (2012), who revealed that in the school environment improvement and effectiveness can be realised through teamwork.

Table 3 below gives the outcome of cross-tabulation analysis for principals' responses correlating dependent and independent variables. This entails the average score in the influence of strategy formulation practices on the performance of students in STEM subjects versus the average score in the performance of students in STEM subjects being influenced by principals' strategic planning practices.

Table 3*Cross-tabulation analysis for principals' data on strategy formulation*

		Average score in performance of students in STEM subjects is influenced by principals' strategic planning practices			
		Agree	Disagree	Strongly Disagree	Total
Average score in influence of strategy formulation practices on the performance of students in STEM subjects	Sometimes	0(0%)	1(3%)	0(0%)	1(3%)
	Rarely	1(3%)	13(39.4%)	4(12.2%)	18(54.6%)
	Never	0(0%)	7(21.2%)	7(21.2%)	14(42.4%)
	Total	1(3%)	21(63.6%)	11(33.3%)	33(100%)

The information in table 3 shows that the majority of respondents (54.6%) reported that the average score in influence of strategic formulation practices on performance of students in STEM subjects was rare. However many of them (39.4%) disagreed, (12.2%) strongly disagreed and only (3%) agreed. A big fraction of the other participants (42.4%) stated that the average score in influence of strategic formulation practices on performance of students in STEM subjects was never. Whereby (21.2%) disagreed likewise (21.2%) strongly disagreed and none agreed. Those who reported that the average score in influence of strategic formulation practices on performance of students in STEM subjects was done sometimes (3%) with all of them disagreeing.

4.1.2 Influence of Strategic Formulation Practices on Performance of Students in STEM Subjects - Teachers' Perspective

From the teachers' questionnaire, the items' mean and standard deviation of their responses are as indicated by table 4 below. On the rating scale of one to four, four was for 'strongly agree' and three for 'agree', whereas two was for 'disagree' and one for 'strongly disagree'.

Table 4*Mean and standard deviation of teachers' data on strategy formulation*

Statement	N	Minimum	Maximum	Mean	Std. Deviation
Adequate provision of learning resources and materials	150	3.00	4.00	3.8067	.39624
Better pay including remedial stipends	150	1.00	4.00	3.5067	.63189
Manageable workload and learner friendly timetable	150	2.00	4.00	3.6867	.51990
Low student versus teacher ratio	150	1.00	4.00	3.3533	.74308
Motivation through performance rewards for good results	150	2.00	4.00	3.5600	.58482
Improved pedagogical skills due to principal mentorship	150	2.00	4.00	3.4467	.58547
Valid N (listwise)	150				

Table 4 indicates one hundred and fifty respondents rated the level of agreement on how various strategy formulation practices enable STEM teachers to teach better in order to improve the performance of students in STEM subjects. Whereby adequate provision of learning resources and materials and manageable workload and learner-friendly timetable recorded the highest means of 3.8067 and 3.6867, respectively, and standard deviations of 0.39624 and 0.51990, respectively. Likewise, motivation through performance rewards for good results and better pay, including remedial stipends, had means of 3.5600 and 3.5067, respectively, and standard deviations of 0.58482 and 0.63189, respectively. On the other hand, improved pedagogical skills due to principal mentorship and low student-versus-teacher ratio had means of 3.4467 and 3.3533, respectively, and standard deviations of 0.58547 and 0.74308, respectively. This implies that all these strategy formulation practices enable STEM teachers to teach better in order to improve the performance of students in STEM subjects. Similarly, Adunola (2011) noted that poor academic performance by the majority of students is fundamentally linked to the application of ineffective teaching methods by teachers to impart knowledge to learners.

Table 5 below gives the outcome of cross-tabulation analysis for teachers' responses correlating dependent and independent variables. This entails the average score in the influence of strategy formulation practices on the performance of students in STEM subjects versus the average score in the performance of students in STEM subjects being influenced by principals' strategic planning practices.

Table 5*Cross-tabulation analysis for teachers' data on strategy formulation*

		Average score in performance of students in STEM subjects is influenced by principals' strategic planning practices			
		High	Moderate	Low	Total
Average score in influence of strategy formulation practices on the performance of students in STEM subjects	Agree	2(1.3%)	0(0%)	0(0%)	2(1.3%)
	Disagree	12(8.0%)	27(18.0%)	7(4.7%)	46(30.7%)
	Strongly disagree	12(8.0%)	62(41.3%)	28(18.7%)	102(68.0%)
	Total	26(17.3%)	89(59.3%)	35(23.3%)	150(100%)

The information in table 5 shows that the majority of respondents (68.0%) reported that the average score in the influence of strategy formulation practices on the performance of students in STEM subjects was strongly disagree. However, many of them (41.3%) indicated it was moderate, and 18.3% showed it was low, while 8.0% indicated it was high. About 30.7% stated that the average score in the influence of strategy formulation practices on the performance of students in STEM subjects was 'disagree', whereas 18.0% indicated it was moderate, 8.0% showed it was high and only 4.7% indicated it was low. Those who reported that the average score in the influence of strategy formulation practices on the performance of students in STEM subjects was agreeable were 1.3%, with all of them indicating it was high.

4.1.3 Influence of Strategic Formulation Practices on Performance of Students in STEM Subjects - Students' Perspective

From the students' questionnaire, the items' mean and standard deviation of their responses are as indicated by table 6 below. On the rating scale of one to four, four was for 'strongly agree' and three for 'agree', whereas two was for 'disagree' and one for 'strongly disagree'.

Table 6*Mean and standard deviation of students' data on strategy formulation*

Statement	N	Minimum	Maximum	Mean	Std. Deviation
Cooperating well with subject teacher	520	1.00	4.00	3.6077	.54820
Working alone as an individual	520	1.00	4.00	2.5846	.94377
Being inquisitive and working together as a team	520	1.00	4.00	3.5135	.68553
ICT use during teaching and learning	520	1.00	4.00	3.1269	.94515
Valid N (listwise)	520				

Table 6 shows five hundred and twenty respondents rated the level of agreement on various strategy formulation practices on the performance of students in STEM subjects. Cooperating well with the subject teacher recorded the highest mean of 3.6077 and a standard deviation of 0.54820. Likewise, being inquisitive and working together as a team had a high mean of 3.5135 and a standard deviation of 0.68553. The other practices involved the use of ICT during teaching and learning, which had a mean of 3.1269 and a standard deviation of 0.94515. Working alone as an individual is the only practice that had a slightly low mean of 2.5846 and a standard deviation of 0.94377. Going by the mean scores recorded, all these practices enable the student to perform better in STEM subjects, though to a varying degree. The findings agree with Munishi (2004), who affirms that ICT has been proven to play an important role in the teaching-learning process, as it provides learners with the understanding, skills and knowledge necessary for scientific research.

Table 7 below gives the outcome of cross-tabulation analysis for students' responses correlating dependent and independent variables. This entails the average score in the influence of strategy formulation practices on the performance of students in STEM subjects versus the average score in the performance of students in STEM subjects being influenced by principals' strategic planning practices.

Table 7*Cross-tabulation analysis for students' data on strategy formulation*

		Average score in performance of students in STEM subjects is influenced by principals' strategic planning practices				
		Very high	High	Moderate	Low	Total
Average score in influence of strategy formulation practices on the performance of students in STEM subjects	Agree	0 (0%)	3 (.6%)	7 (1.4%)	2 (.4%)	12 (2.3%)
	Disagree	3 (.6%)	55 (10.6%)	181 (34.8%)	85 (16.4%)	324 (62.3%)
	Strongly Disagree	1 (.2%)	18 (3.5%)	95 (18.3%)	70 (13.7%)	184 (35.4%)
	Total	4 (.8%)	76 (14.6%)	283 (54.4%)	157 (30.2%)	520 (100%)

The information in Table 7 shows that the majority of respondents (62.3%) reported that they disagreed with the average score of the influence of strategy formulation practices on the performance of students in STEM subjects. However, many of them (34.8%) indicated it was moderate, 16.4% showed it was low, and 10.6% indicated it was high, with only 0.6% suggesting it is very high. Those who reported that the average score in the influence of strategy formulation practices on the performance of students in STEM subjects strongly disagree were 35.4%, with 18.3% and 13.7% indicating it was moderate and low, respectively. On the same note, 3.5% and 0.2% suggested it was high and very high, respectively. About 2.3% of participants reported that the average score in the influence of strategic formulation practices on the performance of students in STEM subjects was 'agree' (1.4%), showing it is moderate, whereas only 0.6% and 0.4% suggested it was 'high' and 'low', respectively.

4.2 Inferential Statistics of Strategy Formulation Practices

The study used Chi-square to establish the influence of strategy formulation practices on the performance of students in STEM subjects. The findings are presented by tables below:

Table 8

Principals' Chi-square on strategy formulation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.825a	4	.430
Likelihood Ratio	4.463	4	.347
Linear-by-Linear Association	3.383	1	.066
N of Valid Cases	33		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .03.

Table 8 above has a Pearson chi-square value of 3.825, implying that strategy formulation practices influence the performance of students in STEM subjects. However, the influence had no statistical significance, with an asymptotic significance value of 0.430, which is greater than 0.05; $X^2(1,33) = 3.825$, $p = 0.430$, $\alpha = 0.05$.

Table 9

Teachers' Chi-square on strategy formulation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.476 ^a	4	.004
Likelihood Ratio	13.050	4	.011
Linear-by-Linear Association	9.506	1	.002
N of Valid Cases	150		

a. 3 cells (33.3%) have expected count less than 5. The minimum expected count is 35.

Table 9 above has a Pearson chi-square value of 15.476, implying that strategy formulation practices influence the performance of students in STEM subjects. However, the influence had statistical significance with an asymptotic significance value of 0.004, which is less than 0.05; $X^2(1,150) = 15.476$, $p = 0.004$, and $\alpha = 0.05$.

Table 10

Students' Chi-square on strategy formulation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.964 ^a	6	.063
Likelihood Ratio	12.171	6	.058
Linear-by-Linear Association	11.269	1	.001
N of Valid Cases	520		

a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .09.

Table 10 above has a Pearson chi-square value of 11.964, implying that strategy formulation practices influence the performance of students in STEM subjects. However, the influence had no statistical significance, with an asymptotic significance value of 0.063, which is greater than 0.05; $X^2(1,520) = 11.964$, $p = 0.063$, and $\alpha = 0.05$.

4.2.1 Qualitative Themes of Strategy Formulation Practices

The researcher prepared and organised data collected from the field using open-ended questionnaires, interview schedules and document analysis. There were 7 education officers and 33 principals as well as 150 teachers and 520 students, who were involved in qualitative data collection. The data was collected and organised so that the main themes

can be noted down. The themes pertaining to the influence of strategy formulation practices on the performance of students in STEM subjects are presented in a comprehensible manner, as seen below in the narrative.

Principals said the following in regard to how STEM strategies are formulated in schools:

“Through departmental and staff meeting which come up with STEM need identification action plans” (Principal response on 18th Jan 2024).

Principals also said that the following people are responsible of formulating STEM strategies in school:

Science teachers, academic committee, deputy principal and principal” (Principal response on 14th Mar 2024).

Teachers gave the following opinion in regard to how STEM oriented strategies are developed in schools:

“Through meetings held at departmental level” (Teacher response on 6th Jun 2024).

Teachers mentioned the following as challenges encountered when implementing STEM formulated strategies in school:

Lack of enough teaching and learning resources as well as human resource. High workload and inadequate time. High student versus teacher ratio which hinders individualized learning. Negative attitude of learners and lack of interest. Lack of proper coordination within department. Absenteeism of learners due to lack of school fees and indiscipline (Teacher response on 15th Feb 2024).

Students said they use the following personal strategies in order to secure good grades in STEM subjects:

“Summarizing notes of topics covered. Revising by doing questions in past papers, topical questions and revision books. Being more inquisitive and allocating more time to STEM subjects. Cultivating cordial relationship with STEM teachers” (Student response on 15th Feb 2024).

According to education officers, principals motivate teachers and learners in order to better performance of STEM subjects by:

“Providing monetary rewards for improved and better performance. They also spearhead the development of school strategic plan, which provides teachers with working direction” (Education officer response on 25th Jan 2024).

In regard to how principals cultivate teamwork spirit among teaching staff in their schools, they said:

“In fact they do, only that social problems involving individual differences among teachers may water down their effort” (Education officer response on 22 Feb 2024).

Education officers gave the following comment in regard to whether heuristic teaching method and strategies promote students' positive attitude towards STEM subjects:

“Yes only that they require more preparation to implement” (Education officer response on 23rd May 2024).

The following information was noted in analysed documents in regard to strategy formulation. There is no strategy formulated in regard to STEM subjects in many schools. Some schools formulate strategy, but they are poorly implemented due to lack of funds and lack of involvement of stakeholders.

4.3 Integrated Mixed Result Findings

The convergence model was applied, whereby quantitative and qualitative data pertaining to the influence of strategy formulation practices on the performance of students in STEM subjects were collected and analysed. This involved the use of questionnaires, interview schedules and document analysis checklists. The different results were analysed and compared for proper interpretation. The qualitative data enabled the researcher to validate and confirm quantitative findings, hence obtaining valid and well-substantiated conclusions.

Teachers' chi-square shows strategy formulation practices have a statistically significant influence on the performance of students in STEM subjects in public secondary schools. In contrast, principals' and students' chi-square shows strategy formulation practices have no statistically significant influence on the performance of students in STEM subjects in public secondary schools. Since two inferential statistical analyses indicate that strategy formulation practices have no statistically significant influence on the performance of students in STEM subjects in public secondary schools. A conclusion is therefore drawn whereby the null hypothesis (Ho2) is accepted in favour of the alternative hypothesis (Ha2).

Principals' descriptive statistics show that various strategy formulation practices are always applied in secondary schools. Similarly, teachers' descriptive statistics indicate that strategy formulation practices improve the performance of students in STEM subjects. On the other hand, students' descriptive statistics show that formulated strategies make the performance of students better. The main themes recorded using open-ended questions, interview schedules and document analysis agree with the descriptive and inferential findings. The triangulated findings show that strategy formulation practices influence the performance of students in STEM subjects. Linyard (2021) observed that strategy formulation is generally associated with higher performance. However, many schools are unable to formulate proper strategies on STEM subjects, which makes the students perform poorly in these learning areas.



4.4 Regression Analysis of the Entire Data

Table 11

Regression model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.530 ^a	.280	.255	.54967

Table 12

Regression Analysis

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.953	5	3.391	11.222	.000 ^b
	Residual	43.507	144	.302		
	Total	60.460	149			

a. Dependent Variable: PS

b. Predictors: (Constant), SA, SF, SS, IS, SE

The F value indicated by table 68 above on regression analysis is 11.22. This implies an existing influence of principals’ strategic planning practices on the performance of students in STEM subjects. Based on the significance level of 0.00, the influence is statistically significant since it is less than 0.05.

Table 13

Regression model equation

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.182	.483		.378	.706
	SA	.057	.104	.040	.546	.586
	SF	.117	.097	.092	1.206	.230
	SS	.149	.083	.140	1.808	.073
	IS	.254	.059	.322	4.330	.000
	SE	.305	.089	.252	3.450	.001

a. Dependent Variable: PS

$$Y = 0.182 + 0.04X_1 + 0.092X_2 + 0.14X_3 + 0.322X_4 + 0.252X_5 + 0.483$$

Where:

Y = Strategic planning practices

0.182 = Value of Y when X₁ = X₂ = X₃ = X₄ = X₅ = 0

X₁ = Strategic analysis practices

X₂ = Strategy formulation practices

X₃ = Stakeholders’ strategic input practices

X₄ = Implemented strategic action practices

X₅ = Strategy evaluation practices

0.483 = Error term

The statistics in table 13 above show a model equation relating the performance of students in STEM subjects to principals’ strategic planning practices. According to the data, the dependent variable (Y), which is the performance of students in STEM subjects, would be 0.182 + 0.483 without principals’ strategic planning practices. The model implies that if all other variables are held constant. A unit increase in strategic formulation practices would increase performance of students in STEM subjects by 0.092 or 9.2%.

4.5 Discussion

The study explored aspects such as teacher-learner motivation, teamwork building and heuristic teaching strategies as the indicators for the strategy formulation. Strategy theory was relevant as it explains the process followed during strategy formulation. Likewise, during strategic planning the organisation members are required to formulate strategies that can be applied in order to realise set goals. While performance theory covers issues pertaining to STEM subjects’ performance, which is the ultimate goal of strategy formulation practices in school, with improved

performance being the target. Performance theory gives insight on how performance can be enhanced in an organisation. The theory discusses in detail issues that influence performance, namely, performers' mindset, enriching environment and reflective practice. Similarly Oparaocha (2017) pointed out in his study the idea that an effective STEM education can be realised in the school in which an efficient manager with high STEM awareness cooperates with his colleagues. The performance of students in secondary school, especially in STEM subjects, is a major issue of concern whose concrete solution has not yet been found. This demands the education managers pay more attention to this issue as they plan and devise strategies that would provide an appropriate remedy.

Strategy theory explains in detail what strategy is all about and the forces that shape the strategy. It goes further and outlines the process that forms strategy as well as the mechanism by which strategy can take effect. In public schools principals develop and implement both deliberate and emergent strategies aimed at improving academic performance. But in most cases this is not realized basically due to strategies developed lacking effectiveness and therefore poor performance of STEM subjects is not properly addressed.

Adeleke et al. (2008) stated that it is through strategy formulation that the school principal can be proactive in achieving the set goals. On the other hand Borrero et al. (2020) found that effective strategic practices positively influence organizational performance. As per the research findings, it is confirmed that strategy formulation practices influence the performance of students in STEM subjects. From the regression model equation, when all other variables are held constant, a unit increase in strategy formulation practices would increase performance of students in STEM subjects by 0.092 or 9.2%. Principals do apply various strategy formulation practices in secondary schools. Likewise, teachers indicate that strategy formulation practices improve the performance of students in STEM subjects. On the other hand, students' shows that formulated strategies make the performance of students better. The data collected from education officers and document analysis in regard to strategy formulation practices affirms the findings. However, many schools are unable to formulate proper strategies on STEM subjects, which makes the students perform poorly in these learning areas. This is an eye opener to principals in regard to strategy they need to apply in STEM subjects.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The descriptive, inferential and thematic analysis provided sufficient evidence that principals' strategy formulation practices influence the performance of students in STEM subjects. Education officers, principals and teachers recognise that strategy formulation practices can promote better performance of students in STEM subjects. Education officers indicated that students perform better when principals motivate teachers and learners. Principals showed that various strategy formulation practices are always applied in secondary schools. Similarly, teachers indicated that strategy formulation practices improve the performance of students in STEM subjects. On the other hand, students showed that formulated strategies make the performance of students in STEM subjects better. The regression model equation showed that strategy formulation practices would increase performance of students in STEM subjects by 9.2% when other factors are held constant. Nevertheless, many schools are unable to formulate proper strategies on STEM subjects, which makes the students perform poorly in these learning areas. The key education stakeholders should be trained on formulating appropriate strategies that can make students in STEM subjects perform better. Since strategy formulation is a critical stage during strategic planning.

5.2 Recommendation

The key education stakeholders should be trained on formulating appropriate strategies that can make students in STEM subjects perform better. Since strategy formulation is a critical stage during strategic planning. The teacher training colleges should incorporate into the curriculum mandatory strategic planning coursework for all teachers being trained.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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