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Research Article

High School Teachers' Perceptions and Practices of Mathematics Curriculum in Ghana

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How do mathematics teachers view about the curriculum can affect their role in classroom activities. In this context, this study examined teachers' perceptions of the math curriculum for senior high schools in Ghana and their interrelation with classroom practices. Quantitative data were collected from a random sample of 69 mathematics teachers across the senior high schools in the Ashanti Region of Ghana. The results of the data showed that the teachers have confidence toward the subject. However, they view math curriculum as a rigid and abstract with more theoretical practices rather than practical connection, which they think is nonrealistic and irrelevant in the current form. Most of the math teachers were not confident about linking the classroom activities to students' real life. They do not have sufficient knowledge and experience in curriculum design. In this sense, the core mathematics curriculum for Ghanaian senior high schools is not realistic and relevant. Some curriculum recommendations have been suggested at the end of this paper.

1. Introduction

The need for quality mathematics education has become a global concern. All over the world, every nation strives to offer their young ones the best education, including mathematics education [1]. As the world advances in technology, studying mathematics is no longer an option but a necessity [2]. Studies have demonstrated that mathematics is the building block for all other science subjects, including humanities, business, and technology [3, 4]. Countries such as Finland, the United Kingdom (UK), and the United States (US) have advanced in science due to their formidable mathematics education [5]. Indeed, Trends in International Mathematics and Science Study (TIMSS) is now the benchmark to measure the success of every country's educational system. A close observation of the assessments of the TIMSS over the years reveals that the best performing countries, including China, the US, Singapore, the UK, and Finland, among others, are among the best economies in the world, and this gives credence to the fact that mathematics education is synchronized with national development [1, 6]. This view supports developing countries such as Ghana to reconsider their curriculum to provide quality mathematics education, which could impact national development.

There is an agreement on the fact that a curriculum can be a written or unwritten document that encompasses all taught in schools [7, 8]. The curriculum should be an organized, structured process that might include social behaviors and content and thinking skills. This is a course of study that will enable the learner to acquire specific knowledge and skills. The curriculum consists of the "roadmap" or "guideline" of any given discipline that outlines the philosophy of teaching [7]. It is a combination of instructional practices, learning experiences, and students' performance assessments designed to help students learn and evaluate if the learning outcomes have been achieved [9, 10]. Therefore, the mathematics curriculum comprises all the learning experiences that should enlighten the learners to be innovative, critical thinkers, and problem solvers [11]. It must be noted that curriculum is an ongoing process that involves design, implementation, assessment, and reform [7, 12].

Mathematics education in every country stands on a curriculum [13]. The curriculum, according to experts, has some images that reflect the aspirations and culture of the country [7]. Many curriculum models have been suggested that should guide any country in curriculum design, implementation, and assessment in terms of the focus of the curriculum, either content or process or the learner [14]. In line with this, the process must involve all stakeholders in education, especially the government, civil society groups, opinion leaders, and most importantly, teachers and students as the focal group [7, 15].

One will not be far from right to say that Ghana is lagging because of the kind of mathematics curriculum used in the country, especially in senior high schools [16]. This is because a country that prides itself as the beacon of democracy in Africa was the last but one when they first enrolled in the TIMSS in 2003, and the story was not different in the second race in 2007. Mereku [17, 18] posited that the students were not skillful because the Ghana curriculum emphasizes low-order thinking skills such as recall of facts, but the TIMSS questions required higher-order thinking skills in solving contextual problems. Almost all the reforms in the mathematics curriculum that took place in the country after independence could not bring any positive changes. There is no surprise that the country has never tried to reenlist in the TIMSS [19].

Unfortunately, in Ghana, education reforms and, for that matter, curriculum design have been the preserve of politicians [20]. This is partly because the constitution of the republic arrogates that power to the minister in charge of education and, for that matter, the government [15]. According to Belbase et al. [7], several scholars have tried to provide a befitting definition for the term curriculum. However, there has not been a single accepted definition due to its nature, design, development, and implication.

1.1. Teachers' Perceptions and Practices. Aboagye and Yawson [9] and Acharya [21] examined teachers' perceptions of curriculum in the context of Ghana. They observed that a teacher is a core person whose responsibility regarding curriculum development cannot be underestimated. This view indicates that the teacher, as the implementer of the curriculum, must play a crucial role in its design. The findings of Aboagye and Yawson [9] not only showed teachers' appreciation of the new curriculum but also issues associated with the new educational reforms in terms of workload, lack of resources, lack of teachers' involvement in curriculum planning, and preparing teaching and learning resources. As Abudu and Mensah [22] rightly put it, allowing teachers to participate in the curriculum designed is just the right decision to ensure successful implementation. There is no indication that the teacher's role in curriculum design is nonnegotiable. However, studies conducted so far indicate that teachers view that their participation in the curriculum design is negligible. Abudu and Mensah [22], for instance, in their study, made a recommendation that the "availability of school curriculum leaders is critical to improving teachers' participation in the curriculum" ([22], p. 28). This view was based on observing several barriers to teachers' participation in the curriculum design. The suggestion was that leaders in every school should be responsible for issues involving curriculum design. These issues clearly indicate the importance of teacher participation in the curriculum design and implementation for successful reform in education. Curriculum design and implementation should be decentralized [22].

A study was conducted by Bay et al. [23] in Turkey to examine the teachers' views on school-based curriculum development (SBCD) approach. They observed that teachers were unhappy with their low level of participation in curriculum development. The findings suggested that the curriculum development should be implemented at the school, not by the external authorities [23]. The study made many recommendations, including appointing providing curriculum expert in each school to ensure that teachers' views are taken into account when it comes to issues on curriculum development.

The new math that woefully failed in the US was primarily criticized for being developed by only experts without much involvement from the subject teachers [24]. It is worthy to note that since the council of mathematics teachers was instituted to take charge of curriculum issues, the transitions have been smooth and efficient [25, 26]. Mereku [18] alerted that the modern mathematics introduced in Ghana in the 1987 reform came with high expectations but failed because the concept design was by psychologists without incorporating teachers' views of the subject.

Teachers' activities in the classroom must be relevant and exciting to the students, so they will have the urge to learn with conceptual understanding. As observed by Saxe and Sussman [27], mathematics is a language of nature and must be taught using practical approaches and inquiry-based learning. Studies have indicated that teachers mainly present mathematics as an abstract concept, as if it has nothing to do with daily activities. It has been observed that mathematics, especially in senior high schools, is mainly computational. Teachers usually fail to teach mathematics in context but focus on solving textbook questions [28, 29]. For instance, problem solving is not a stand-alone topic in the mathematics curriculum. However, it is expected to be integrated into all the topics. The paper noted that even the few teachers who can teach using the problem-solving approach fail to assess the students in that direction. Additionally, researchers [17, 30, 31] have revealed that teachers sometimes find it difficult to teach mathematics in context. This kind of feeling is because nonroutine questions are not readily available in the books and teachers need to create their word problems or context-based questions, which most fail to do [15, 32, 33].

The review of prior studies showed a gap in the literature of teacher perceptions and practices of mathematics curriculum in Ghana. Therefore, the current study aimed to feel that gap in the literature of mathematics education.

1.2. Objective. The study examines high school teachers' perceptions of the mathematics curriculum and their classroom practices in Ghana. The objectives of the study are as follows:

Table 1: Distribution of mathematics teachers by demographic information, gender, age, teacher qualification, teacher experience, and school type.

Demographic variables	Category	Number	Percentage (%)
Gender	Male	64	92.8
	Female	5	7.20
Age (years)	Below 30 years	14	20.29
	31–36 years	29	42.03
	37 years or above	26	37.68
Education level	Bachelor's degree	45	65.2
	Master's degree	24	34.8
Teaching experience (years)	1–5 years	17	24.6
	6–10 years	20	29.0
	11–15 years	32	46.4
School type	Public	66	95.7
	Private	3	4.3

(1) To determine mathematics teachers' perceptions about the mathematics curriculum for senior high schools in Ghana
(2) To find out the classroom practices of mathematics teachers in implementing the mathematics curriculum

1.3. Research Questions. The following research questions were formulated to achieve the objectives mentioned above: What are teachers' perceptions about the mathematics curriculum for senior high schools in Ghana? What are the classroom practices of mathematics teachers in implementing the curriculum?

2. Methodology

2.1. Population and Sample. A quantitative survey approach was used for this study to collect quantitative data that were analyzed using descriptive and inferential statistics. Senior high schools in Ghana have been grouped into four categories by the Ghana Education Service (GES) based on specific characteristics such as infrastructure level and the availability of qualified teachers. The study population was mathematics teachers in senior high schools in the Kumasi Metropolitan Assembly of the Ashanti Region of Ghana.

The Kumasi Metropolis has 15 senior high schools representing all four categories, with a mathematics teacher population of 230 as of the 2022 academic year. The study population gave more variability as the data captured teachers' views across the four categories. These numbers were estimated by the Ashanti Regional Health Directorate of the GES. A total sample of 69 mathematics teachers volunteered to participate in the study. A sample size of 69 is a fair representation of a population size of 230 with a margin of error of 10%. Table 1 presents the demographic information of the sampled teachers. The potential of sampling bias was addressed by employing simple random sampling through the use of open social networks of mathematics teachers in the selected geographical region.

The demographic information indicates that male respondents represented 92.8%, while female respondents represented 7.2%. Their ages show that 42% were between 31 and 36 years, 29% were between 37 and 42 years, 7.2% were between 43 and 49 years, 1.4% were above 49 years, and another 1.4% were below 25 years. Teacher qualifications show that respondents with Bachelor's degrees represented 65.2% of the total and those with Master's degrees accounted for 34.8%. Furthermore, teacher experience shows that respondents between 1 and 5 years were 24.6%, those with 6–10 years were 29%, those with 11–15 years accounted for 29%, and more than 15 years of teaching experience were 17.4%. The school type shows that public school respondents accounted for a more significant portion, with a percentage of 95.7%, while private school respondents represented 4.3%.

2.2. Construction of Questionnaire. A structured online survey questionnaire was developed by the researchers as the data collection instrument. The study focused on high school mathematics teachers' perceptions of the mathematics curriculum and classroom practices. There were, therefore, two variables under investigation. An extensive review of existing literature on these variables was done to develop a reliable measurement for these variables. Twenty-five measurement items for perceptions about the mathematics curriculum were adapted from Aboagye and Yawson [9]. The measurement items for classroom practices of teaching mathematics were 20. As part of validity checks for the survey instrument, a mathematics education professor specializing in curriculum theory at the United Arab Emirates University was asked to review the instrument's relevance to the study. Further modifications, such as rewording and reframing, were made.

The questionnaire comprised three sections. Section A was about respondents' demographic information, including gender, age, years of teaching experience, level of education (Bachelor's degree, Master's degree, or Ph.D. degree), and school type (public or private). A Likert scale, which serves as a tool for measuring attitudes, was used for the size of items in Sections B and C. Section B comprised the measurements of perceptions about the curriculum. They were measured using a 5-point Likert scale of strongly disagree (coded as 1), disagree (coded as 2), neutral (coded 3), agree (coded 4), and strongly agree (coded 5). Section C, which measured classroom practices of mathematics teachers, also used a 5-point Likert scale of never (coded 1), rarely (coded 2), sometimes (coded 3), quite often (coded 4), and always (coded 5).

2.3. Data Collection Procedure. The researchers sought approval for the study from the Department of Mathematics Education of the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development in the Ashanti Region of Ghana. Having received the needed approval, the questionnaire was converted into an online survey using Google Forms. The private emails and social media group pages of mathematics teachers from the targeted population were used to circulate the questionnaire. The potential respondents were to open the link to the Google Forms and answer the questions online. There was a section to read the objective of the study and guarantee of safeguarding the personal identity of the participants in the consent form. The online questionnaire was adopted in order to adhere to the social distance restrictions due to the COVID-19 pandemic. The questionnaire included a brief introduction to the study, what it seeks to achieve, and a notice to participants of their voluntary participation in the study. Reminders were sent to potential respondents after a week to request that they complete the questionnaire. After 2 weeks after circulating the questionnaire, 69 senior high school mathematics teachers in the Ashanti Region responded.

2.4. Validity and Reliability. The researchers employed the IBM Statistical Package for the Social Sciences (SPSS) 26 software, a statistical tool to check for the validity and reliability of the data collected from the sample study. After factor analysis, the 25 constructs for perceptions about the curriculum were put into four thematic components. They are realistic and relevant curriculum (RRC), transformative curriculum (TC), participation in curriculum practices (PCP), and abstract and theoretical curriculum (ATC). After factor analysis, the 20 constructs for classroom practices were grouped into three thematic components. They are classroom practices (CP), teaching and learning materials (TLM), and instructional skills (IS). The Cronbach's α test was used to measure internal consistency within the 45 constructs in the questionnaire, as well as the reliability of the seven latent variables. The results are shown in Table 2.

Before conducting the analytical tests, the reliability of the 45 measurement items of the study questionnaire was tested using Cronbach's α test. The results revealed high reliability and internal consistency ($\alpha = 0.959$) among the measurement items. The Cronbach's α test was again used to measure the internal reliability among the seven latent variables that reflected the main study variables.

Table 2 shows the scores of the internal reliability coefficient, Cronbach's α, of 0.960 for RRC, 0.916 for TC, 0.695 for PCP, 0.668 for ATC, 0.927 for CP, 0.855 for TLM, and 0.615 for IS, respectively. The α value of 0.7 or greater is considered acceptable, but if it is 0.6 or above then, the reliability is questionable [34]. However, this norm is misleading as it should be based on specific research context and purpose rather than as a gold standard. When number of items is small, it may be lower than 0.7 and still acceptable [35]. The instrument was examined by three researchers in education and provided with minor feedback to simplify the language for clarity. They accepted the tool as suitable for the study.

Table 2: Reliability coefficients for the composite variables and the overall scale.

Constructs	N	No. of items	Cronbach's α
RRC	69	14	0.960
TC	69	6	0.916
PCP	69	3	0.695
ATC	69	2	0.668
CP	69	11	0.927
TLM	69	6	0.855
IS	69	3	0.615
Overall	69	45	0.959

Table 3: Normality test of the variables.

Variables	Kolmogorov–Smirnov[a]			Shapiro–Wilk		
	Statistics	*df*	Sig.	Statistics	*df*	Sig.
RRC	0.090	69	0.200*	0.972	69	0.122
TC	0.117	69	0.020	0.937	69	0.002
PCP	0.116	69	0.022	0.958	69	0.020
ATC	0.173	69	0.000	0.943	69	0.003
CP	0.116	69	0.023	0.916	69	<0.001
TLM	0.160	69	0.000	0.939	69	0.002
IS	0.080	69	0.200*	0.973	69	0.141

*The lower bound of the true significance. [a]Lilliefors significance correction.

2.5. Analysis and Interpretation. The online survey was processed using IBM SPSS to uncover the research question (IBM SPSS 26). Cronbach's α was used to determine the dependability of the acquired data. The descriptive statistics for the profile of the participants were also analyzed. A nonparametric test based on the normality test by Shapiro–Wilk and Kolmogorov–Smirnov (Table 3) tests for the seven factored components, namely, RRC, TC, PCP, ATC, CP, TLM, and IS, was done to analyze the asymptotic significance (two-tailed test) of their items (see Tables 4–11) with Wilcoxon signed rank tests. The independent-samples Mann–Whitney U test and independent-samples Kruskal–Wallis test were also used to look for probable inter-relationships between the demographic variables under the study (age, years of experience, and highest education). Furthermore, a Spearman's rank correlation analysis was performed to see if the pairs of factored variables had any significant link [36].

3. Results

In this study, 69 received data sets were validated and qualified for data analysis. The data were passed through the Kolmogorov–Smirnov and Shapiro–Wilk tests of normality (Table 3), and it was observed that the RRC and IS variables

Table 4: One-sample Wilcoxon signed ranked test for RRC (test value = 3 from the 5-point Likert-scale items).

Variables	Total (N)	Test statistics	Standard error	Standard test statistics (Z)	Asymptotic Sig. (two-tailed)
The objective of the curriculum matches the national educational goals (Q5)	69	916.000	110.380	1.572	0.116
The high school math curriculum is more relevant to students' lives (Q6)	69	908.500	121.532	0.675	0.500
It challenges students (Q7)	69	877.000	121.151	0.417	0.677
It offers students better learning opportunities (Q8)	69	767.500	99.137	1.311	0.190
It employs student-centered teaching techniques (Q9)	69	715.500	111.823	–0.241	0.809
It provides teaching approaches that focus on improving students' critical thinking and problem solving (Q10)	69	782.000	106.042	0.877	0.380
Its content layout prepares students for the job market (Q12)	69	578.000	105.874	−1.048	0.294
It promotes project-based learning (Q13)	69	762.000	115.447	–0.312	0.755
It is easy to follow while teaching (Q16)	69	976.000	112.930	1.824	0.068
It is per the needs of students (Q17)	69	498.000	90.139	–0.732	0.464
It connects significant math concepts with other disciplines (Q20)	69	990.000	111.596	2.218	0.027
It helps in the creativity of students (Q23)	69	707.500	104.887	0.176	0.860
It helps in the critical thinking of students (Q24)	69	1,023.000	120.028	1.637	0.102
It helps in students' collaboration in problem solving (Q25)	69	859.500	110.731	1.057	0.291
Overall RRC	69	1,314.000	160.008	1.094	0.274

Table 5: One-sample Wilcoxon signed ranked test for TC (test value = 3 from the 5-point Likert-scale items).

Variables	Total (N)	Test statistics	Standard error	Standard test statistics (Z)	Asymptotic Sig. (two-tailed)
I am well prepared and equipped to teach the high school math curriculum (Q3)	69	1561.500	141.124	3.922	<0.001
It gives me more opportunities to be more creative (Q4)	69	1138.500	129.571	1.725	0.085
It prepares students for standardized tests (Q14)	69	952.500	115.220	1.584	0.113
It connects with what students have learned in prior grades (Q18)	69	1062.000	109.582	2.916	0.004
It connects students' learning needs for the college or university (Q19)	69	1096.500	114.831	2.843	0.004
It connects math concepts across algebra, geometry, arithmetic, and statistics (Q21)	69	1347.500	127.955	3.615	<0.001
Overall TC	69	1610.000	152.861	3.516	<0.001

were not significant (p-value > 0.05). It was observed that TC, PCP, ATC, CP, and TLM are significantly different from the normal distribution (p-value < 0.05), with only two of the variables (RRC and IS) not being significant (p-value > 0.05). As a result, the remaining tests were further performed using nonparametric tests.

3.1. Realistic and Relevant Curriculum (RRC). The test results from a one-sample Wilcoxon signed rank test performed to examine the reality and relevance of the mathematics curriculum (RRC) revealed that the curriculum is able to connect significant mathematics concepts with other disciplines such as science and technology ($T = 990.0$, $Z = 2.218$, $p = 0.027 < 0.05$), and all

Table 6: One-sample Wilcoxon signed ranked test for PCP (test value = 3 from the 5-point Likert-scale items).

Variables	Total (*N*)	Test statistics	Standard error	Standard test statistics (*Z*)	Asymptotic Sig. (two-tailed)
I took part in the process of math curriculum design (Q1)	69	240.000	112.425	−4.470	<0.001
My views as a stakeholder were factored into the curriculum design (Q2)	69	305.500	128.387	−4.514	<0.001
It presents complex content for teaching (Q11)	69	291.500	84.687	−2.669	0.008
Overall PCP	69	307.000	142.050	−4.713	<0.001

Table 7: One-sample Wilcoxon signed ranked test for ATC (test value = 3 from the 5-point Likert-scale items).

Variables	Total (*N*)	Test statistics	Standard error	Standard test statistics (*Z*)	Asymptotic Sig. (two-tailed)
The curriculum is rigid and abstract (Q15)	69	759.500	113.325	–0.093	0.926
It is based on a clear theoretical framework (Q22)	69	970.500	106.685	2.390	0.017
Overall ATC	69	761.500	108.317	0.669	0.503

Table 8: One-sample Wilcoxon signed ranked test for CP (test value = 3 from the 5-point Likert-scale items).

Variables	Total (*N*)	Test statistics	Standard error	Standard test statistics (*Z*)	Asymptotic Sig. (two-tailed)
I use the curriculum for planning lessons and activities to teach (P1)	69	1,221.500	109.171	4.635	<0.001
I encourage students to ask questions (P9)	69	1,865.500	135.025	6.584	<0.001
I allow my students to talk to each other when they are solving math (P11)	69	777.500	88.317	2.684	0.007
I form groups of students (P12)	69	1,259.500	104.887	5.439	<0.001
I correct them when I find their mistake while solving math problems (P13)	69	1,457.500	115.041	5.976	<0.001
I give students math assignments (P14)	69	1,538.000	118.794	6.229	<0.001
I apply continuous assessment (P15)	69	1,557.000	125.111	5.607	<0.001
I listen to my students' voices (P16)	69	1,425.000	112.019	6.093	<0.001
I challenge my students with creative questions (P17)	69	1,375.500	112.185	5.642	<0.001
I connect classroom math with students' everyday life (P18)	69	1,313.000	109.444	5.459	<0.001
I ask students to solve on board (P19)	69	1,122.000	102.530	4.477	<0.001
Overall CP	69	1,998.500	152.953	6.054	<0.001

items appearing under this variable were not significantly different from the neutral view ($p > 0.05$). The overall composite value for RRC showed that teachers were not optimistic about how realistic and relevant the senior secondary mathematics curriculum is for effective teaching and learning ($T = 1314.0$, $Z = 1.094$, $p = 0.274 > 0.05$) (see Table 4).

3.2. Transformative Curriculum (TC). Table 5 shows the result of the one-sample Wilcoxon signed rank test for TC. The test results showed that teachers rated their connection of maths concepts across algebra, geometry, arithmetic, and statistics with the mathematics curriculum to be significantly higher than neutral ($T = 141.124$, $Z = 3.922$, $p < 0.05$). It was highly rated ($p < 0.05$) for how prepared and equipped these mathematics teachers were to teach with the curriculum, connecting it with what students had learned in previous grades and their learning needs for college or university. The teachers were not enthused with how the curriculum prepares students for standardized tests and the opportunities it provides for students to be more creative as their

Table 9: One-sample Wilcoxon signed ranked test for TLM (test value = 3 from the 5-point Likert-scale items).

Variables	Total (*N*)	Test statistics	Standard error	Standard test statistics (*Z*)	Asymptotic Sig. (two-tailed)
I consult textbooks while teaching any topic (P2)	69	1,717.500	130.207	6.163	<0.001
I use TLMs such as models and audio–visuals to connect abstract concepts (P3)	69	503.000	76.698	0.671	0.502
I use TLMs to develop the level of students thinking (P4)	69	613.500	73.252	2.498	0.012
I use the math curriculum to design questions for assessment (P5)	69	1,217.500	106.180	4.977	<0.001
I follow student-centered teaching (P6)	69	1,431.000	118.750	5.331	<0.001
I demonstrate models of math patterns (P8)	69	753.000	77.108	3.910	<0.001
Overall TLM	69	1,952.500	156.263	5.420	<0.001

Table 10: One-sample Wilcoxon signed ranked test for IS (test value = 3 from the 5-point Likert-scale items).

Variables	Total (*N*)	Test statistics	Standard error	Standard test statistics (*Z*)	Asymptotic Sig. (two-tailed)
I lecture while introducing a new math concept (P7)	69	353.000	96.774	−2.682	0.007
I keep my students silent while teaching (P10)	69	598.000	106.410	−0.855	0.392
I ask students to follow memorization of all math problem solving (P20)	69	313.000	94.488	−2.910	0.004
Overall IS	69	517.500	131.772	−2.789	0.005

Table 11: One-sample Wilcoxon signed rank test on the perception of math curriculum (test value = 3 from the 5-point Likert-scale items).

Variables	RRC	TC	PCP	ATC
Total (*N*)	69	69	69	69
Test statistics	1,314.000	1,610.000	307.000	761.500
Standard error	160.008	152.861	142.050	108.317
Standardized test statistics	1.094	3.516	−4.713	0.669
Asymptotic Sig. (two-sided test)	0.274	<0.001	<0.001	0.503

hypotheses ($p = 0.113$ and 0.085, $p > 0.05$) were significantly retained. Overall, the teachers rated TC as high ($T = 1{,}610.0$, $Z = 3.516$, $p < 0.05$).

3.3. Participation in Curriculum Practices (PCP). Teachers taking part in the process of math curriculum design, their views as stakeholders factored into the curriculum design, and their perception of the curriculum to present complex content for teaching and learning of mathematics were mostly rated to be either agree or strongly agree as their *p*-value was less than 0.05 (see Table 6). Overall, teachers' participation in curriculum practices was well acknowledged as it was highly significant, with a *p*-value < 0.05 (Table 11).

3.4. Abstract and Theoretical Curriculum (ATC). The teachers are very optimistic that high school mathematics curriculum is based on a clear theoretical framework ($Z = 2.390$, $p = 0.017 < 0.05$) (see Table 7). They were highly critical of the rigidity and how abstract the curriculum was, affecting their responses to be strongly disagree and disagree ($Z = -0.093$, $p = 0.926 > 0.05$) and, subsequently, the overall ATC is not being significant ($Z = 0.669$, $p = 0.503 > 0.05$).

3.5. Overall Perception of Mathematics Curriculum. The one-sample Wilcoxon signed rank test was performed to examine the teacher's perceptions of the mathematics curriculum. The test results, as shown in Table 11, showed that the teacher's response to the factored variables, TC and PCP, was significantly higher than neutral (either agree or strongly agree) ($p < 0.05$). Notwithstanding this, RRC and ATC were not significantly higher than neutral ($p > 0.05$).

3.6. Classroom Practices of Teaching Mathematics. The factored component CP was highly significant ($Z = 6.054$,

Table 12: One-sample Wilcoxon signed rank test classroom practices (test value = 3 from the 5-point Likert-scale items).

Variables	CP	TLM	IS
Total (*N*)	69	69	69
Test statistics	1,998.500	1,952.500	517.500
Standard error	152.953	156.263	131.772
Standardized test statistics	6.054	5.420	−2.789
Asymptotic Sig. (two-sided test)	<0.001	<0.001	0.005

Table 13: Independent-samples Mann–Whitney *U* test (highest education).

Statistics	RRC	TC	PCP	ATC	CP	TLM	IS
Total (*N*)	69	69	69	69	69	69	69
Mann–Whitney *U*	557.50	547.50	429.50	609.00	513.00	529.00	452.50
Wilcoxon *W*	857.50	847.50	729.50	909.00	813.00	829.00	752.50
Mean rank (Bachelor's degree *N* = 45)	34.61	34.83	37.46	33.47	35.60	35.24	36.94
Mean rank (Master's degree *N* = 24)	35.73	35.31	30.40	37.88	33.88	34.54	31.35
Test statistics	557.50	547.50	429.50	609.00	513.00	529.00	452.50
Standard error	79.328	79.218	78.863	78.017	79.259	79.011	78.914
Standardized test statistics	0.221	0.095	−1.401	0.884	–0.341	–0.139	−1.109
Asymptotic Sig. (two-sided test)	0.825	0.925	0.161	0.376	0.733	0.889	0.268

$p<0.05$) (see Table 12). Under the computed variable, TLM (Table 8), the teachers' responses did not agree with the use of teaching and learning materials such as models and audio–visuals to connect abstract concepts when teaching mathematics ($Z=0.671$, $p=0.502>0.05$). However, their response was very significant about their consultation with textbooks while teaching any topic, the use of TLMs to develop the level of students' thinking, the use of curriculum to design questions for assessment, following student-centered teaching, and demonstration of models of math patterns ($p<0.05$) (see Table 9).

Controlling students while teaching seems to be very challenging for the classroom teacher ($Z=–0.855$, $p=0.392>0.05$) but was unable to affect the overall IS performance as it was rated significant ($Z=–2.789$, $p=0.005<0.05$) (see Table 10). This result was a consequence of a higher than neutral ($p<0.05$) response from the teachers in their perception of the use of the lecture method while introducing a new mathematics topic and asking the students to follow the memorization of all mathematical problems solved (Table 10).

3.7. Highest Educational Difference. A Mann–Whitney *U* test was performed to examine if there was a significant difference between the Bachelor's and Master's degrees of the mathematics teachers on all the factored variables, as shown in Table 13.

The results indicated that the ranked mean of the teacher respondents that responded to the factored variables such as PCP, CP, TLM, and IS had a Bachelor's degree as their highest educational level, while RRC, TC, and ATC had a majority of Master's degree. However, the mean rank for the two educational levels for TC (mean rank: Bachelor = 34.83, Masters = 35.31) and that of TLM (mean rank: Bachelor = 35.24, Masters = 34.54) was very close, indicating how they almost evenly responded to these variable items. There was no statistically significant difference between Bachelor's degrees and Master's degrees in terms of their RRC, TC, PCP, ATC, CP, TLM, and IS ($p>0.05$).

3.8. Year of Experience Difference. An independent-samples Kruskal–Wallis test for the factored variables of years of experience was performed to see if the teachers' number of years in the teaching field made any significant difference in their RRC, TC, PCP, ATC, CP, TLM, and IS (see Table 14). The test results revealed that there was a significant difference between 1–5, 6–10, and 11–15 years regarding their RRC, TC, PCP, ATC, CP, TLM, and IS ($p>0.05$). Nonetheless, there was a statistically significant difference between some years of experience regarding participation in curriculum practices ($T=8.341$, $df=2$, $p=0.015<0.05$). Table 15 shows that the difference between the teachers' years of experience between 6–10 and 1–5 years and 11–15 and 1–5 years is statistically significant ($p<0.05$).

3.9. Correlation between RRC, TC, PCP, ATC, CP, TLM, and IS. Because most of the variables in the "perceptions about mathematics curriculum" and "classroom practices of teaching and learning" had nonnormal distributions, Spearman's bivariate rank correlations were used to look at the relationship between the factored variables (see Table 16).

All the factored variables showed a positive correlation with each other. PCP was weakly correlated with the rest of the perception about the mathematics curriculum variables, recording PCP against TC as weak-positively correlated ($r=0.187$). However, the strongest positive correlation was found between TC and RRC variables. On the side of classroom practices of teaching and learning, TLM and CP were strongly correlated ($r=0.901$), while IS and CP were weak-positively correlated

Table 14: Independent-samples Kruskal–Wallis test (years of experience).

Statistics	RRC	TC	PCP	ATC	CP	TLM	IS
Total (N)	69	69	69	69	69	69	69
Test statistics	0.655[a]	1.865[a]	8.341	0.625[a]	1.475[a]	1.205[a]	7.028
Degree of freedom	2	2	2	2	2	2	2
Asymptotic Sig. (two-sided test)	0.721	0.394	0.015	0.732	0.478	0.547	0.030

[a]Test statistics is not significant at 0.05 level.

Table 15: Pairwise comparisons of years of experience.

Sample 1-–Sample 2	Test statistics	Sig.	Adj. Sig.[a]
6–10 years to 1–5 years	7.690	0.006	0.017
11–15 years to 1–5 years	4.864	0.027	0.082
6–10 years to 11–15 years	0.000	1.000	1.000

Each row tests the null hypothesis that the samples 1 and 2 distributions are the same. Asymptotic significances (two-sided tests) are displayed. The significance level is 0.05. [a]Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 16: Spearman's bivariate rank correlation.

	RRC	TC	PCP	ATC	CP	TLM	IS
RRC	1	0.815**	0.381**	0.662**	0.493**	0.523**	0.259*
TC	0.815**	1	0.187	0.615**	0.650**	0.571**	0.155
PCP	0.381**	0.187	1	0.264*	0.166	0.320**	0.194
ATC	0.662**	0.615**	0.264*	1	0.414**	0.492**	0.316**
CP	0.493**	0.650**	0.166	0.414**	1	0.901**	0.167
TLM	0.523**	0.571**	0.320**	0.492**	0.901**	1	0.211
IS	0.259*	0.155	0.194	0.316**	0.167	0.211	1

*Correlation is significant at 0.05 level (two-tailed). **Correlation is significant at 0.01 level (two-tailed).

($r = 0.167$). In all, IS correlating with all the factored variables recorded the lowest correlation coefficients, with the lowest being IS and TC ($r = 0.155$) (see Table 16).

4. Discussion

The composite variables passed the average α test with a few internal reliabilities closer to the 0.06 standard. Considering this result, the total factored variables are highly depended on the understudied data. The mathematics curriculum, which promotes project-based learning, connects central math ideas to other disciplines, and provides teaching methodologies that focus on increasing students' critical thinking and problem solving, was determined to be lacking and had a detrimental effect on students [19]. On the other hand, teachers' ability to integrate essential arithmetic topics into other disciplines was praised. Major education orientations need to be carried out on the need for teachers to become aware of how practical and relevant the senior high school mathematics curriculum is. This result is in line with what Nabie et al. [29] and Wijaya et al. [31] have observed that teachers focus much on the traditional computation algorithms more than on trying to situate mathematics lessons in context.

The findings also revealed how teachers are unaware of the connection between curriculum objectives and national educational goals. This finding is consistent with Boakye [37]. How can it challenge students to pay attention and be very creative while teaching takes place in order to offer better learning opportunities and prepare them for future job markets at a point where teachers employ good student-centered teaching techniques if the teachers implementing the curriculum do not see the relevance it has on students' life? Practically, students are to be encouraged to become critical thinkers and cooperate with them to solve real-world problems using the mathematics curriculum [15]. It is no wonder teachers do that since many studies have revealed that teachers who implemented the curriculum are not involved in its very design hence the disconnection [15, 23, 28, 38, 39].

Most teachers are well prepared and equipped to teach senior high school mathematics, linking the curriculum to students' prior knowledge, present grades, and future learning needs for college or university [40]. According to the data, teachers were pleased with the curriculum's ability to connect mathematics topics across algebra, geometry, arithmetic, and statistics. The reality is that the Government of Ghana (GOG), through the GES, has ensured that the various senior high schools have adequate qualified staff to handle their specialized area [21, 40]. So, in this paper, there are no issues regarding teachers' content knowledge and pedagogical skills. However, the reality is different in practice [2].

Remarkably, teachers' perspectives as stakeholders in the curriculum design are only considered during the implementation stage. As per the data, teachers believe that the curriculum is overly rigid and abstract, which can only be described as theoretical. As Mereku [18] observed, the 1987 reformed failed because it was done by psychologists without input from the classroom teachers. It is worthy to note that one of the concerns of the critics of the US new math curriculum was that it was done by experts without classroom teachers' participation, hence the failure [5, 24, 41].

5. Conclusion and Recommendations

The study through the findings has made it clear that the core mathematics curriculum for Ghanaian senior high schools is questionable in terms of being realistic and relevant [20]. It is basically theoretical, abstract, and overly rigid [37]. The challenges, as revealed, can be blamed on the established fact that the curriculum implanters are not involved in the curriculum design. Good mathematical classroom practices are widely praised; however, when teaching and learning are on track, they should improve their use of models and other technological devices to connect abstract concepts to practical, real-life situations.

Based on the findings, some recommendations can be prescribed as, in the meantime, the teachers must be taken through a series of refresher courses to bring them up to speed with the philosophy of the curriculum. The use of teaching and learning materials, such as models and audio–visuals, to connect abstract concepts to real-life situations must be prioritized. The government must take steps to design a new mathematics curriculum embedded with technology use and process skills such as inquiry-based learning and problem solving. Most importantly, teacher education programs and activities should focus on changing perceptions toward mathematics curriculum as a guide to develop inquiry-based classroom activities with more creative and constructive role of each mathematics teacher in the classroom.

Data Availability

The data for the study can be made available upon genuine request.

Ethical Approval

The study followed proper ethical practice of seeking informed consent from the participants and approval from the Department of Mathematics Education, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Kumasi, Ghana, to conduct this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

[1] M. O. Martin, M. von Davier, and I. V. S. Mullis, *Methods and Procedures: TIMSS, 2019 Technical Report*, International Association for the Evaluation of Educational Achievement, 2020.

[2] O. Fitzmaurice, N. O'Meara, and P. Johnson, "Highlighting the relevance of mathematics to secondary school students – why and how," *European Journal of STEM Education*, vol. 6, no. 1, Article ID 07, 2021.

[3] J. R. Batlolona, T. Laurens, M. Leasa, M. Batlolona, R. Kempa, and J. J. Enriquez, "Comparison of problem based learning and realistic mathematics education to improve students academic performance," *Jurnal Pendidikan Progresif [Journal of Progressive Education]*, vol. 9, no. 2, pp. 185–197, 2019.

[4] J.-M. Diego-Mantecón, Z. Ortiz-Laso, and T. F. Blanco, "Implementing STEM projects through the EDP to learn mathematics: the importance of teachers' specialization," in *Mathematics Education in the Age of Artificial Intelligence*, P. R. Richard, M. P. Vélez, and S. Van Vaerenbergh, Eds., vol. 17 Mathematics Education in the Digital Era, pp. 399–415, Springer, Cham, 2022.

[5] H. Kepner, "Why Johnny can't add: the failure of the new math Morris Kline. New York: St. Martin's Press, 1973. 170 p. $8.95," *Journal of Teacher Education*, vol. 25, no. 1, pp. 84–86, 1974.

[6] I. V. S. Mullis, M. O. Martin, C. A. Minnich et al., *TIMSS, 2011 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Volume 1 and 2*, TIMSS & PIRLS International Study Center, Boston College, Chestnut Hill, MA, 2012.

[7] S. Belbase, B. Sharma, B. P. Pant et al., "Philosophical foundations for curriculum decision: a reflective analysis," *SN Social Sciences*, vol. 2, Article ID 39, 2022.

[8] J. Choppin, A. R. McDuffie, C. Drake, and J. Davis, *Curriculum Metaphors in US Middle School Mathematics*, North American Chapter of the International Group for the Psychology of Mathematics Education, 2015.

[9] E. Aboagye and J. A. Yawson, "Teachers' perception of the new educational curriculum in Ghana," *African Educational Research Journal*, vol. 8, no. 1, pp. 6–12, 2020.

[10] C. Cobbold, S. Kofie, A. Bordoh, and I. Eshun, "Functions and practices of curriculum supervision in senior high schools in the Assin North municipality of Ghana," *American Journal of Social Sciences*, vol. 3, no. 4, pp. 120–128, 2015.

[11] National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics*, NCTM, 2000.

[12] L. A. Buckley, "Unfulfilled hopes in education for equity: redesigning the mathematics curriculum in a US high school," *Journal of Curriculum Studies*, vol. 42, no. 1, pp. 51–78, 2010.

[13] M. Akkus, "The common core state standards for mathematics," *International Journal of Research in Education and Science (IJRES)*, vol. 2, no. 1, pp. 49–54, 2016.

[14] M. A. Hjalmarson, "Mathematics curriculum systems: models for analysis of curricular innovation and development," *Peabody Journal of Education*, vol. 83, no. 4, pp. 592–610, 2008.

[15] E. Ampadu, "Implementing a new mathematics curriculum: mathematics teachers' beliefs and practices," *International Journal of Research Studies in Education*, vol. 3, no. 1, pp. 79–90, 2014.

[16] S. Sellar and B. Lingard, "The OECD and the expansion of PISA: new global modes of governance in education," *British Educational Research Journal*, vol. 40, no. 6, pp. 917–936, 2014.

[17] D. K. Mereku, *Mathematics Curriculum Implementation in Ghana*, Danjoe Production, Accra, Ghana, 2004.

[18] D. K. Mereku, "Five decades of school mathematics in Ghana," *Mathematics Connection*, vol. 9, pp. 73–86, 2010.
[19] S. Adu-Gyamfi, W. J. Donkoh, and A. A. Addo, "Educational reform in Ghana: past and present," *Journal of Education and Human Development*, vol. 5, no. 3, pp. 158–172, 2016.
[20] A. A. Owusu, J. A. Opare, and E. Larbie, "Politics and Ghana's pre-tertiary curriculum reform programmes: have these helped the nation?" *International Journal of Academic Research in Education and Review*, vol. 4, no. 5, pp. 163–173, 2016.
[21] M. Acharya, "Professional development activities for activity-based learning: case of high school health and population teachers in Kathmandu, Nepal," *Research in Pedagogy*, vol. 9, no. 2, pp. 143–150, 2019.
[22] A. M. Abudu and M. A. Mensah, "Basic school teachers' perceptions about curriculum design in Ghana," *Journal of Education and Practice*, vol. 7, no. 19, pp. 21–29, 2016.
[23] E. Bay, Ö. F. Vural, R. Kahramanoğlu, and Z. A. Aşk, "Teacher views on school-based curriculum development approach (an analysis of applicability in Turkey)," *Mustafa Kemal University Journal of Graduate School of Social Sciences*, vol. 13, no. 34, pp. 180–201, 2016.
[24] A. Isbrucker (2021, April 21), What Happened to New Math? *Age of Awareness*, https://medium.com/age-of-awareness/what-happened-to-new-math-eeb8522fc695.
[25] D. Brahier, S. Leinwand, and D. Huinker, "Principles to actions: mathematics programs as the core for student learning," *The Mathematics Teacher*, vol. 107, no. 9, pp. 656–658, 2014.
[26] M. T. Morgan and N. Robinson, "The "Back to the Basics" movement in education," *Canadian Journal of Education/ Revue Canadienne de l'education*, vol. 1, no. 2, pp. 1–11, 1976.
[27] G. B. Saxe and J. Sussman, "Mathematics learning in language inclusive classrooms: supporting the achievement of english learners and their english proficient peers," *Educational Researcher*, vol. 48, no. 7, pp. 452–465, 2019.
[28] S. Amoako Atta and S. Asiedu-Addo, "The use of problem solving approach linking classroom mathematics to real-life activities at Bekwai SDA SHS," *Global Scientific Journals*, vol. 9, no. 3, pp. 1174–1195, 2021.
[29] M. J. Nabie, P. Akayuure, and S. Sofo, "Integrating problem solving and investigations in mathematics: Ghanaian teachers' assessment practices," *International Journal of Humanities and Social Science*, vol. 3, no. 15, pp. 46–56, 2013.
[30] K. Akyeampong, "Teacher educators' practice and vision of good teaching in the teacher education reform context in Ghana," *Educational Researcher*, vol. 46, no. 4, pp. 194–203, 2017.
[31] A. Wijaya, M. van den Heuvel-Panhuizen, and M. Doorman, "Opportunity-to-learn context-based tasks provided by mathematics textbooks," *Educational Studies in Mathematics*, vol. 89, pp. 41–65, 2015.
[32] A. Amponsah-Tawiah, "*An investigation into pupils' experiences of solving non-routine mathematics problems: a case study of Ghana International School*," M.Phil. Thesis, The University of Ghana, 2020.
[33] J. Cai and T. Wang, "Conceptions of effective mathematics teaching within a cultural context: perspectives of teachers from China and the United States," *Journal of Mathematics Teacher Education*, vol. 13, pp. 265–287, 2010.
[34] J. A. Gliem and R. R. Gliem, "Calculating, interpreting, and reporting Cronbach's α reliability coefficient for likert-type scales," in *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*, pp. 82–88, The Ohio State University, Columbus, OH, 2003.
[35] E. Cho and S. Kim, "Cronbach's coefficient alpha: well known but poorly understood," *Organizational Research Methods*, vol. 18, no. 2, pp. 207–230, 2015.
[36] M. AlMahdawi, S. Senghore, H. Ambrin, and S. Belbase, "High school students' performance indicators in distance learning in chemistry during the COVID-19 pandemicy," *Education Sciences*, vol. 11, no. 11, Article ID 672, 2021.
[37] P. A. Boakye, "*Explaining education reforms in Ghana: an institutional and ideational perspective*," Doctoral dissertation, University of Saskatchewan, 2019.
[38] S. K. Apau, "Teachers' concerns about the implementation of the standard-based curriculum in Ghana: a case study of effutu municipality," *Educational Research and Reviews*, vol. 16, no. 5, pp. 202–211, 2021.
[39] C. Byrne and M. Prendergast, "Investigating the concerns of secondary school teachers towards curriculum reform," *Journal of Curriculum Studies*, vol. 52, no. 2, pp. 286–306, 2020.
[40] E. Abakah, J. Widin, and E. K. Ameyaw, "Continuing professional development (CPD) practices among basic school teachers in the central region of Ghana," *SAGE Open*, vol. 12, no. 2, 2022.
[41] S. J. Ball, "Back to basics: repoliticising education," *FORUM*, vol. 57, no. 1, pp. 7–10, 2015.