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# Assessment of Mathematics Instructional Resources (Mirs) In Public Senior High Schools in The Central Region, Ghana

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## Abstract

This paper investigated the status quo regarding the availability and usage of Mathematics Instructional Resources-(MIRs) for teaching and learning mathematics in the public Senior High Schools (SHSs) in the Central Region of the Republic of Ghana. A descriptive survey research design was used using quantitative and qualitative methodologies. The respondents include 72 mathematics teachers, selected using quota sampling, and 20 storekeepers, selected purposively, from eight (8) public Senior High Schools (SHSs). Two sets of close-ended survey questionnaires and observation schedules were employed. Reliability coefficients of 0.756 and 0.821 were obtained after subjecting the research instruments to vetting and pilot testing. Both descriptive and inferential statistics were employed in analyzing data and testing hypotheses. The results showed that mathematics textbooks, syllabus, teachers' reference books for mathematics, mathematical sets, graphical calculator, and chalk/marker boards were available and adequate in the SHSs, whereas electronic MIRs such as computers, overhead projectors, and interactive whiteboards were not available for teaching and learning of mathematics. It also emerged that teachers utilize MIRs in diverse ways, among others. It is recommended that the Ministry of Education (MoE) in collaboration with other stakeholders in education, must take steps to ensure that the other MIRs are available and adequate in the various SHSs. The implications of this study for research and practice are discussed.

**Keywords:** Mathematics instructional resources, MIRs, Availability, Utilization, SHSs, Mathematics education

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## Introduction

Instructional Resources (IRs) are materials or objects used by teachers and learners to make classroom activities more interactive, comprehensive, and all-embracing during lessons (Tamakloe, Amedale & Atta, 2005). They transmit information, ideas, and notes to learners (Abdullahhi, 2010). IRs, no matter their nature and composition, constitute an essential and relevant component of successful teaching and learning. Usman and Adewumi (2006) state that IRs can be referred to as the wide variety of equipment and materials used for teaching/learning by teachers to stimulate self-activity on the part of the learners. Instructional Resources (IRs) are available from many sources, including visual and audio-visual materials and resource places and people (Tamakloe, Amedale & Atta, 2011). According to Onyilagha and Nnajiofor (2016), visual equipment are those materials that you see and include; flashcards, posters, charts, textbooks, real objects, models, chalkboard, and other related reference materials. Audio-visual materials are those materials that stimulate both the visual and audio senses. Examples are computers, televisions and radio sets, electronic videos, audiotapes, filmstrips, moving pictures, and slides

Megbo and Saka (2015), assert that actual teaching cannot be wholly attained without using IRs. This is because they encourage faster and more active communication between the instructor and students. The issue of effective communication in the classroom is crucial. Since it is evident that IRs can help achieve effective communication, which results in effective learning, it becomes necessary to ascertain the extent of their availability and utilization. Contributing to the importance of IRs, Mwangi (2006) pointed out that IRs enhance retention, stimulate students' interest and make learning more permanent by providing first-hand experience with the realities of the physical and social environment. Many educators and educationists agree that using IRs goes a long way in helping students understand and remember what they have been taught. Any effort to enhance effective teaching and learning of any subject, especially mathematics, should encompass the availability and use of instructional resources.

Despite the emphasis put on the value of IRs within instructing and education development, it is perceived that they are used sparingly by teachers in teaching mathematics; teachers teach in their various schools without instructional materials, the reasons being that they are not available. Research on the availability and usage of instructional resources for teaching at various stages of education have been reported in contradicting manners. While some researchers found instructional resources to be available in schools, others found instructional resources to be unavailable and inadequate. For instance, a study by Ifeakor (2006) found that some instructional resources were available and adequate but were partly used in teaching and learning. On the other hand, Achimugu (2016) reported that most instructional teaching resources were unavailable or utilised during the teaching process, which calls for more investigation into the subject matter. The implication of these conflicting reports calls for more research efforts in that direction. It is for this unsettled research conclusions this study sought to investigate whether or not instructional resources are available and adequate for teaching, the extent to which instructional resources are used, and factors depriving teachers of using instructional resources for teaching mathematics among the Senior High Schools (SHS) in Agona West Municipality and Agona East Districts in the Central Region of Ghana.

## Purpose of the Study

The purpose of the study was to investigate the status quo regarding the availability and usage of Mathematics Instructional Resources (MIRs) for mathematics lessons among public SHSs in the Agona West Municipality and the Agona East District in the Central Region of Ghana. Because of the above assertion, this study specifically seeks to examine the following:

1. The availability of MIRs for teaching and learning mathematics in public SHSs in Agona of Central Region
2. How teachers utilize MIRs for teaching and learning mathematics in public SHSs in Agona of Central Region
3. The factors inhibiting the utilization of MIRs in teaching and learning mathematics at the public SHSs in Agona of Central Region
4. The demographic variables and how they influence utilization of MIRs at the SHSs in Agona of Central Region

## Research Questions

Based on the purpose of this study, the following research questions guided the study:

1. What Mathematics Instructional Resources (MIRs) are available for the teaching and learning of mathematics in the public SHSs?
2. How are Mathematics Instructional Resources (MIRs) used by teachers for effective teaching and learning of mathematics in the public SHSs?
3. What factors inhibit the utilization of Mathematics Instructional Resources (MIRs) in Mathematics lessons in the public SHSs?

## Research Hypotheses

Regarding objective four of the study, the following null hypotheses were stated in line with the fourth objective:

1. $H_0$: There is no statistically significant difference between male and female mathematics teachers regarding the degree of utilization of MIRs.
2. $H_0$: There is no statistically significant difference between age group of mathematics teachers and their degree of utilization of MIRs.
3. $H_0$: There is no statistically significant difference between teaching experience and degree of utilization of MIRs.

## Significance of the Study

First, it has been identified by the Secondary Education Commission (SEC), cited in Aggarwal (2001), that even the best curriculum and the perfect syllabus remain dead unless quickened into life by a suitable teaching method. As such, the study's findings would expose the available instructional resources and their usage for teaching

Mathematics within the Agona West and East districts. Secondly, the study would also be relevant for theoretical and practical reasons. Theoretically, the study will contribute new conceptual insight to the existing literature on Mathematics teachers' utilization of Instructional Resources (IRs) and provoke academic discussions on the issue. In addition, policy and implementers would be awakened to the issue and put in place measures if needed to help advance teaching of Mathematics. Finally, the study would also be relevant to SHS Mathematics instructors and learners since they stand to benefit from quality Mathematics instruction.

## Theoretical Framework

This study was guided by the theory of learning as described by cognitive psychologists. Cognitive psychologists posit that in an attempt to learn anything, a child must pay attention to it (source). It also involves exploring the visual field, fixing the eyes successively on different parts of rating, and these parts anticipate a phenomenon that is not yet clearly perceived (Akanbi, 1989). This indicates that students learn better through manipulations of instructional materials combined with illustrations and symbols. The researchers believe that mathematics teachers should ensure availability and usage of different instructional materials and resources to ensure full participation of learners in learning and maximize the acquisition of mathematics competencies. This, we believe, enables students to perceive learning situations positively easily. This position is supported by Farrant (1980) when he said that the inability of the teacher to utilize appropriate instructional materials and resources to teach specific concepts would affect the student negatively in the subject.

## Conceptual Framework

A conceptual framework is a model of presentation where a researcher explores and represents the relationships among the studied variables (Orodho, 2004). Figure 1 shows the relationship of the study variables in this study:

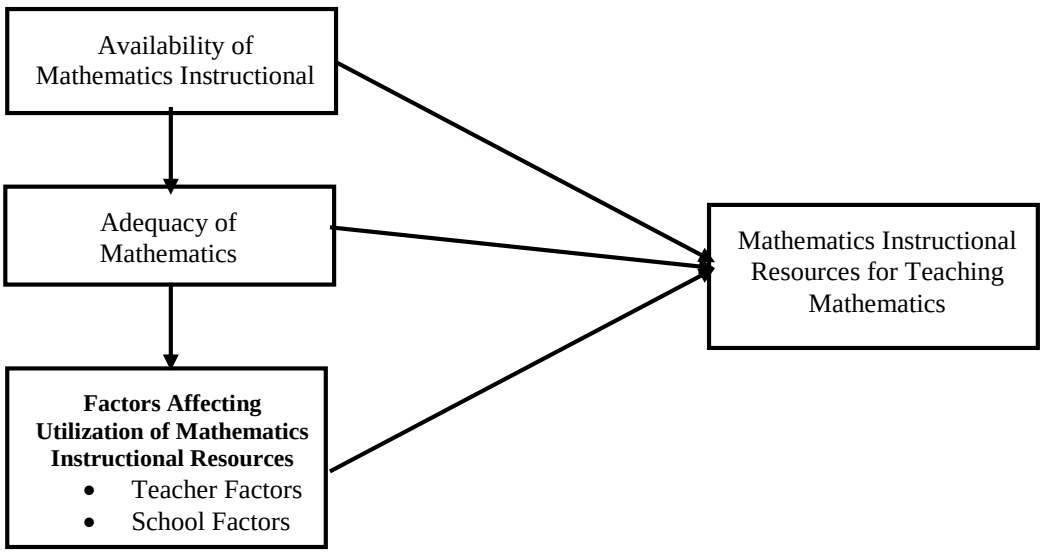


Figure 1. Conceptual Framework

From the conceptual framework illustrated in Figure 1 above, the availability of the MIRs may affect the extent to which the teachers use them for teaching mathematics. Also, it is expected that available MIRs for teaching must be adequate and relevant to the concept being taught, and this should also relate to students' understanding to the concept. However, some challenges inhibit the utilization of the available resources to achieve their aims. These challenges are school related as well as teacher related. From the hypotheses of this study, teaching experience, teachers' gender, and teachers' age group tend to affect the utilization of the instructional materials but they have not been represented categorically in the framework. Thus, the researcher perceived that the challenges, as grouped in the framework should be able to cater for these weaknesses in the framework

## Method

### Research Design

This study employed an Explanatory Sequential Mixed-Methods design. "Mixed methods procedures employ aspects of both quantitative methods and qualitative procedures" (Creswell, 2009, p.17). This design combines quantitative and qualitative data to analyze the research problem(s) comprehensively. In an explanatory sequential design, quantitative data is first collected in the first phase and then follows qualitative data in the second phase to help explain or elaborate on the quantitative results in the first phase. These two sets of data are separate but connected to address unexpected results that might arise from the quantitative data to be examined in more detail. Mixed-methods research, according to Hanson, Creswell, Plano-Clark, Petska, and Creswell (2005), as cited in Ampadu (2012), is an approach to inquiry about a phenomenon, in this manner, making use of both quantitative and qualitative approaches to the premises of collection, examination, and integration of the information or data.

The rationale for this design is that the quantitative data result provides a general picture of the research problem; specifically, through qualitative data collection, the general picture is improved, extended, or explained. With this, better knowledge and understanding of the survey on the availability and utilization of instructional materials in the schools were obtained. Although this design has some loopholes, such as difficulty in getting respondents to answer questions thoughtfully and honestly and getting a sufficient number of the questionnaires completed and returned so that meaningful analysis can be made (Frankel & Wallen, 2000), Notwithstanding these demerits, the descriptive survey helps to observe, describe and document situations as they naturally occur. For these reasons, the descriptive survey design is appropriate for this study.

### The Population

The population for the study consisted of all the senior high schools within two district assemblies, Agona West Municipality and Agona East District in the Central Region of Ghana. However, the target population for this study comprised all public Senior High School mathematics teachers and storekeepers selected from eleven (11) schools within the two districts. The population was selected based on proximity, cost, and time effectiveness. The storekeepers were included in the study because, by their experience, they are knowledgeable and informative about phenomenon under study. Therefore, they provided helpful information for this study. Statistics gathered from the Central Regional Directorate of the Ghana Education Service (GES) of the Ministry of Education (2021)

stipulated that there were eleven (11) accredited Public SHSs (excluding Technical Institutes) in the study areas during the period of this study. Out of the eleven (11) SHSs, six (6) are situated in the Agona West Municipality whilst the remaining five (5) are situated in the Agona East District. These two areas were chosen to enable more respondents to answer the research question and generalize results from the sample's observation to the target population. The estimated number of the target population of respondents in the two study areas was two hundred and seventy-six (276). Out of this number, two hundred and forty-one (241) are mathematics teachers, and thirty-five (35) are storekeepers. These formed the base for the sample of the study

## Sample and Sampling Procedure

The multi-stage sampling technique was used to select the schools and respondents based on the target population. Purposive sampling was used to select the site for the study. The site was Agona of Central Region, made up of two District Assemblies namely; Agona West Municipal Assembly (AWMA) and Agona East District Assembly (AEDA). The researchers used these two areas as strata where simple random sampling technique was used to select four (4) schools from each stratum. Simple random sampling was used to accord each school in the population equal chances of inclusion. Specifically, the lottery method was used for the selection of the schools. Likewise, purposive and quota sampling techniques were used to select 72 mathematics teachers and 20 storekeepers for the study. Purposive sampling was preferred to other sampling techniques due to the fact that, the study focused on SHS Social Studies teachers as well as storekeepers. According to Black (2010), purposive sampling is based on the judgment of the researcher to select a population who are representative to the phenomenon and well-versed with the issue at hand. The number of respondents selected by district and gender is shown in Table 1A and 1B.

Table 1A. Distribution of Sample Groups by District

| Study Areas | No. of Schools | Sample Schools | Sample Teachers | Sample Storekeepers | Total Sample |
|---|---|---|---|---|---|
| Agona West Municipality | 6 | 4 | 38 | 12 | 50 |
| Agona East District | 5 | 4 | 34 | 8 | 42 |
| **Total** | **11** | **8** | **72** | **20** | **92** |

Table 1B. Distribution of Sample Respondents by Gender

| | Math Teachers | | Store Keepers | | Total Sample Size | |
|---|---|---|---|---|---|---|
| Gender | Freq. (f.) | Percent (%) | Freq. (f.) | Percent (%) | Freq. (f.) | Percent (%) |
| Female Respondents | 28 | 38.9 | 11 | 55.0 | 39 | 42.4 |
| Male Respondents | 44 | 61.1 | 9 | 45.0 | 53 | 57.6 |
| **Total** | **72** | **100** | **20** | **100** | **92** | **100** |

From Tables 1A and 1B, a sample size of ninety-two (92) respondents, made up of mathematics teachers and storekeepers, comprising 53(57.6%) males and 39(42.4%) females from the eight senior high schools in the Agona

East Districts and Agona West Municipality was used for the study. Other demographic information of study respondents is shown in Table 2 below.

Table 2. Demographic Characteristics of Study Respondents

| | | Teachers (N=72) | | Storekeepers (N=12) | | Sample (N=84) Total | |
|---|---|---|---|---|---|---|---|
| Variable | Sub-Scale | Freq. (f.) | Percent (%) | Freq. (f.) | Percent (%) | Freq. (f.) | Percent (%) |
| Age Groups (in years): | 25 – 30 | 6 | 8.3 | 1 | 5.0 | 7 | 7.6 |
| | 31 – 35 | 23 | 31.9 | 2 | 10.0 | 25 | 27.2 |
| | 36 – 40 | 26 | 36.1 | 7 | 35.0 | 33 | 35.9 |
| | Above 40 | 17 | 23.6 | 10 | 50.0 | 27 | 29.3 |
| | Total | 72 | 100 | 20 | 100 | 92 | 100 |
| Highest Educational Qualification: | Bachelor's Degree/HND | 55 | 76.4 | 14 | 70.0 | 69 | 75.0 |
| | Master's Degree | 17 | 23.6 | 6 | 30.0 | 23 | 25.0 |
| | Total | 72 | 100 | 20 | 100 | 92 | 100 |
| Length of Service: | Below 5 | 20 | 27.8 | 3 | 15.0 | 23 | 25.0 |
| | 5 – 10 | 26 | 36.1 | 7 | 45.0 | 33 | 35.9 |
| | 11 – 15 | 13 | 18.1 | 6 | 30.0 | 19 | 20.7 |
| | 16 – 20 | 8 | 11.1 | 4 | 20.0 | 12 | 13.0 |
| | Above 20 | 5 | 6.9 | - | - | 5 | 5.4 |
| | Total | 72 | 100 | 20 | 100 | 92 | 100 |
| Attendance to in-Service Training or workshop: | Yes | 17 | 23.6 | 4 | 20.0 | 21 | 22.8 |
| | No | 55 | 76.4 | 16 | 80.0 | 71 | 77.2 |
| | Total | 72 | 100 | 20 | 100 | 84 | 100 |

## Instrument(s) for Data Collection

Survey questionnaire and an observation schedule were used to collect data from respondents. The researchers developed two sets of questionnaires, namely, the Mathematics Teachers' Instructional Resource Questionnaire (MTIRQ) and Store Keepers' Confirmatory of Mathematics Instructional Resource Questionnaire (SKCMIRQ). The MTIRQ had 56 measurement items divided into four (4) sections. The first section had 5 close-ended items which elicited information about the teachers' demographic background. Section two and three respectively elicited responses on the level of availability, extent and ways of utilisation of MIRs in the schools using forty-one (17+17+7) closed-ended items. The final section presents items that collected data on the factors that affect the effective utilisation of MIRs by school teachers on a 5-point Likert Scale (strongly agree to strongly disagree) using ten (10) items.

Similarly, the SKCIRQ had two sections. Section one collected data on the demographic characteristics of the storekeepers, and the second section had a list of MIRs for the storekeepers to identify whether or not the resources are available, including the degree of usage of the resources measured on (Small Extent (SE), Large Extent, (LE), and Very Large Extent (VLE)). Thus, 39 measurement items were included in this questionnaire. Even though the

extent of utilisation of the MIRs can be limited to the teachers, including it in the storekeepers' questionnaire paved the way for the researcher to compare the responses of the two groups of respondents. There were no opened-ended questions in this questionnaire. This was done to limit the respondents to the scope of the study.

The observation was done using Researcher's Observation Guide (ROG). The ROG was developed to determine the availability, adequacy, and extent of utilisation of the MIRs from the researcher's perspective. Generally, the observational guide was used to confirm, cross-validate or corroborate the responses that were supplied in the questionnaires. The checklist only included a YES or NO option to determine whether or not a particular MIR was used for its intended purpose, whether or not the MIRs were available and adequate, and whether or not teachers used the MIRs during teaching and learning.

### Validity and Reliability of the Instruments

The content and construct validity of the instruments was established by having the instruments validated by two experts from the department of mathematics; the University of Education, Winneba (UEW). A reliability coefficient of 0.756 and 0.821 were obtained after subjecting the research instruments to pilot testing using 10 mathematics teachers from a sister SHS in the study region.

### Data Collection Procedures

The researchers made preliminary visits to the selected public SHSs to meet with the Headmasters/Headmistresses of the schools to secure permission and made an appointment for data collection. After the various heads had granted permissions, the researchers briefed the respondents on the purpose and nature of the study and scheduled a day to administer the questionnaires. The data collection lasted for two weeks. First, the questionnaires, intended to collect data from mathematics teachers and storekeepers, were dropped by the researchers and collected the subsequent day. This gave the respondents ample time to complete all items on the questionnaire. Next, data were gathered through the use of the observation guide by the researchers to complement responses obtained from the questionnaires. Finally, the researchers visited various schools and classrooms to observe mathematics lessons and obtain information about utilizing MIRs.

### Data Processing and Analysis

The data obtained were analysed according to the research questions and hypotheses. Data collected were cleaned, coded, and entered into the computer and processed using the IBM Statistical Product and Service Solutions (SPSS) version 22.0 and Microsoft Excel (2010). Data were analyzed using descriptive statistical tools like frequencies, percentages, and mean. Tables and graphs presented the respondents' responses to address the various research questions. Independent samples t-test and the One-Way Analysis of variance (ANOVA) were used to analyse the three research hypotheses at .05 alpha level of significance. The summary of the data analysis is shown in Table 3.

Table 3. Summary of Data Analysis based on Research Questions

| Research Questions/ Hypotheses | Type of Data | Instrument(s) | Analytical tool |
|---|---|---|---|
| RQ1 | Quantitative & Qualitative | Questionnaire & Observation guide | Frequencies, Percentages & Mean |
| RQ2. | Quantitative & Qualitative | Questionnaires, Observation guide | Frequencies, Percentages & Mean |
| RQ3. | Quantitative | Questionnaire | Percentages & Mean |
| RH1-Ho: | Quantitative | Questionnaire | Independent samples t-test |
| RH2-Ho: | Quantitative | Questionnaire | One-Way ANOVA test |
| RH3-Ho: | Quantitative | Questionnaire | One-Way ANOVA test |

## Results

### Research Question 1:

*What Mathematics Instructional Resources (MIRs) are available for the teaching and learning of Mathematics in the public Senior High Schools (SHSs)?*

The intent of research question one was to assess the level of availability and adequacy of MIRs in teaching and learning Mathematics in the public SHSs in Agona of Central Region. To achieve this purpose, two sets of questionnaire (MTIRQ and SKCMIRQ) on a Likert scale rating, coupled with researcher's observation checklist was used to seek opinions of the Mathematics teachers and storekeepers. The responses were evaluated using frequency counts and percentages for Teachers' responses (see Table 3) and Storekeepers' responses (see table 4).

Table 4. Summary of Teachers' Responses on the Availability of MIRs.

| S/N | Item | NA | AM | ANA | AA |
|---|---|---|---|---|---|
| | | No. (%) | No. (%) | No. (%) | No. (%) |
| 1 | Mathematics textbooks | - | - | 17(23.6) | 55(76.4) |
| 2 | Geometrical graph boards | 25(34.7) | - | 47(65.3) | - |
| 3 | Teachers' reference guides/books | - | 8(11.1) | 5(6.9) | 59(81.9) |
| 4 | Mathematics syllabus | - | 3(4.2) | 26(36.1) | 43(59.7) |
| 5 | Mathematics software | 65(90.3) | 7(9.7) | - | - |
| 6 | Flip charts/photographical slides | 47(65.3) | 4(5.6) | 21(29.2) | - |
| 7 | Graphical calculator | - | 11(15.3) | 21(29.2) | 40(55.6) |
| 8 | Mathematics four figure table | 49(68.1) | 11(15.3) | 12(16.7) | - |
| 9 | Mathematical sets | - | 14(19.4) | 13(18.1) | 45(62.5) |
| 10 | Model of 3D shapes | 47(65.3) | 15(20.8) | 10(13.9) | - |
| 11 | Mathematical board instruments | 34(47.2) | - | 38(52.8) | - |
| 12 | Computer with internet system | 34(47.2) | 16(22.2) | 22(30.6) | - |
| 13 | Overhead/Table projector | 31(43.1) | 21(29.2) | 20(27.8) | - |
| 14 | Interactive white boards | 65(90.3) | 7(9.7) | - | - |
| 15 | Mathematical games | 57(79.2) | 15(20.8) | - | - |
| 16 | Chalk/Marker boards | - | - | 29(40.3) | 43(59.7) |
| 17 | Other resources and improvisation | 40(55.5) | 14(19.4) | 18(25.0) | - |

*N=72; Scale: 1 =Not Available (NA); 2 = Ambivalent (AM); 3 = Available but Not Adequate (ANA); 4 = Available and Adequate (A&A)*

Results in Table 4 showed that, 11 out of the 17 itemised mathematics Instructional Resources (MIRs) received unfavourable responses with the majority of the mathematics teachers stating that interactive white boards (n=65; 90.3%), mathematics software (n=65; 90.3%), mathematics games (n=57; 79.2%), mathematics four figure table (n=49; 68.1%), Model of 3D shapes (n=47; 65.3%), flipchart/photographic slides (n=47; 65.5%) and Overhead/table projectors (n=31; 43.1%) were not available in their schools. However, results from Table 4 revealed that mathematics textbooks (n=55; 76.4%), mathematics syllabus (n=43; 59.7%), teacher's reference guide for mathematics (n=59; 81.9%), mathematical sets (n=45; 62.5%) graphical calculator (n=40; 55.6%) and Chalk/marker boards 43(59.7%) received positive responses, indicating they were available and adequate.

Again, the opinions of the storekeepers on the level of availability and adequacy of MIRs for teaching mathematics were also sought and are presented in Table 5 below;

Table 5. Summary of Storekeepers' Responses on Availability of MIRs

| S/N | Item | NA | AM | ANA | AA |
|---|---|---|---|---|---|
| | | No. (%) | No. (%) | No. (%) | No. (%) |
| 1 | Mathematics textbooks | - | - | 7(35.0) | 13(65.0) |
| 2 | Geometrical graph boards | - | - | 20(100) | - |
| 3 | Teachers' reference guides | 3(15.0) | - | 7(35.0) | 10(50.0) |
| 4 | Mathematics syllabus | 4(20.0) | - | 5(25.0) | 11(55.0) |
| 5 | Mathematics software | 15(75.0) | 5(25.0) | - | - |
| 6 | Flip charts/photographical slides | 9(45.0) | - | 11(55.0) | - |
| 7 | Graphical calculator | - | 10(50.0) | 10(50.0) | - |
| 8 | Mathematics four figure table | 14(70.0) | 6(30.0) | | - |
| 9 | Mathematical sets | 4(20.0) | - | 5(25.0) | 11(55.0) |
| 10 | Model of 3D shapes | 12(60.0) | 8(40.0) | - | - |
| 11 | Mathematical board instruments | 3(15.0) | - | 6(30.0) | 11(55.0) |
| 12 | Computer with internet system | 11(55.0) | - | 9(45.0) | - |
| 13 | Overhead/Table projector | 13(65.0) | 7(35.0) | - | - |
| 14 | Interactive white boards | 20(100) | - | - | - |
| 15 | Mathematical games | 15(75.0) | - | 5(25.0) | - |
| 16 | Chalk/Marker boards | - | - | 5(25.0) | 15(75.0) |
| 17 | Other resources and improvisation | 3(15.0) | - | 6(30.0) | 11(55.0) |

*N=12; Scale: 1 =Not Available (NA); 2 = Ambivalent (AM); 3 = Available but Not Adequate (ANA); 4 = Available and Adequate (A&A)*

The results from Table 5 showed that 10 out of the 17 itemised MIRs received negative responses. The interactive whiteboard received the highest negative response 20 (100%), for not being available for teaching mathematics in the schools. This was followed by mathematics software and mathematical games, of which 15 (75.0%) of each of the storekeepers stated that they were not available to teach mathematics in the schools. Also, from the results, mathematics textbooks (n=13; 65.0%), teachers' reference books for mathematics (n=10; 50.0%), chalk/marker boards (n=15; 75.0%), mathematics syllabus, mathematical sets, mathematical board instruments and, other

resources and improvisation of which 11(55.0%) each of the storekeepers indicated that they are available for teaching mathematics in the various schools.

Furthermore, results from Table 6 regarding the observations by the researcher revealed that although other MIRs were available in the schools, they were just a few and were not being used for teaching mathematics. At best, they could be described as decorative elements (see Table 6)

Table 6. Observation results on state of Availability and Adequacy of MIRs

| S/N | Mathematics Instructional Resources (MIRs) | Available | Not Available | Adequate | Not Adequate |
|---|---|---|---|---|---|
| 1 | Mathematics textbooks | √ | | √ | |
| 2 | Geometrical graph boards | √ | | | √ |
| 3 | Teachers' reference guides | √ | | | √ |
| 4 | Mathematics syllabus | √ | | | √ |
| 5 | Mathematics software | | √ | | |
| 6 | Flip charts/photographical slides | | √ | | |
| 7 | Graphical calculator | √ | | | √ |
| 8 | Mathematics four figure table | | √ | | |
| 9 | Mathematical sets | √ | | | √ |
| 10 | Model of 3D shapes | | √ | | |
| 11 | Mathematical board instruments | √ | | | √ |
| 12 | Computer with internet system | √ | | | √ |
| 13 | Overhead/Table projector | √ | | | √ |
| 14 | Interactive white boards | | √ | | |
| 15 | Mathematics games | | √ | | |
| 16 | Chalk/Marker boards | √ | | √ | |
| 17 | Other resources and improvisation | √ | | | √ |

Judging from the responses of responses provided in Tables 4 & 5 coupled with the researcher's observation result in Table 6, it can be concluded that the level of availability and adequacy of MIRs was low in SHSs in the Agona West Municipality and Agona East District in the Central Region of Ghana.

### Research Question 2:

*How are Mathematics Instructional Resources (MIRs) used by teachers for effective teaching and learning of mathematics in the public Senior High Schools (SHSs)?*

It is worthy of notice that utilisation of Mathematics Instructional Resources (MIRs) enhances effective teaching and learning, promoting the understanding of the given mathematics concept. Using MIRs becomes crucial in improving the overall quality of teaching. Because of this, the researcher posed two investigating questions for mathematics teachers. Below are each of the posed questions and their analysis based on the data collected

*To what extent are the available MIRs utilised for teaching mathematics in the public Senior High Schools (SHSs)?*

In response to this question, the mathematics teachers were required to rate the extent of utilization of MIRs in teaching and learning process in the schools. Figure 2 presents the summary of the various percentages of responses by the mathematics teachers.

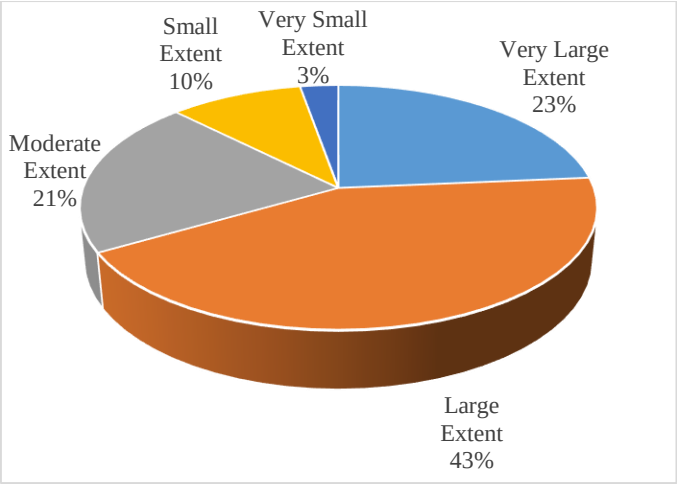


Figure 2. Extent of Utilization of Mathematics Instructional Resources (MIRs)

Results in Figure 2 showed that the majority, (43%+23%) of the teacher respondents representing approximately 66.0%, were of the view that MIRs, to a large extent and considerable extent, were used in their schools. In comparison, 21.0% of the teachers indicated MIRs were used to a moderate extent in their schools. Nevertheless, 10.0% and 3.0% of the teachers indicated MIRs were used to a small extent and minimal extent, respectively. The mathematics teachers were further requested to rate their extent of utilization of some specified MIRs in teaching mathematics. The responses on a 5-point Likert scale were evaluated using means and standard deviations (see Table 7).

Table 7. Teachers' Responses on Extent of Utilization of MIRs

| S/N | Extent of Utilization of Resource | Mean Score | Std.Dev. |
|---|---|---|---|
| 1 | Mathematics textbooks | 4.39 | .581 |
| 2 | Geometrical graph boards | 3.39 | .491 |
| 3 | Teachers' reference guides | 3.43 | 1.387 |
| 4 | Mathematics syllabus | 3.82 | .989 |
| 5 | Mathematics software | 1.18 | .757 |
| 6 | Flip charts/photographical slides | 2.24 | .569 |
| 7 | Graphical calculator | 3.22 | .791 |
| 8 | Mathematics four figure table | 1.84 | .451 |
| 9 | Mathematical sets | 3.15 | 1.002 |
| 10 | Model of 3D shapes | 2.17 | 1.011 |
| 11 | Mathematics board instruments | 3.09 | .682 |
| 12 | Computer with internet system | 1.97 | 1.034 |
| 13 | Overhead/Table projector | 1.94 | .710 |
| 14 | Interactive white boards | 1.93 | .657 |
| 15 | Mathematics games | 1.22 | .727 |
| 16 | Chalk/Marker boards | 4.53 | .723 |
| 17 | Other resources and improvisation | 2.40 | .522 |
| Mean of Means/Average standard deviation | | **2.70** | **0.769** |

Results from Table 6 depicted that 8 out of the 17 itemised MIRs for teaching and learning mathematics are being

used, to a large extent, with chalk/marker boards (M = 4.53, S.D = 0.723) the most used MIR followed by mathematics textbooks (M = 4.39, S.D = 0.581). However, among the MIRs that have been used to a small extent, mathematical games (M = 1.22, S.D = 0.727) were the least used for teaching mathematics. The grand mean of 2.70 implies that MIRs are generally used to a small extent in the SHSs for teaching and learning mathematics. The observation results also found that MIRs for mathematics instruction was not effectively utilized. It was discovered that textbooks and chalk/marker boards are the most commonly used in mathematics lessons (see Table 7).

Table 7. Teachers' Observational Results on the Utilization of MIRs

| S/N | Mathematics Instructional Resources | Extent of Use | |
|---|---|---|---|
| | | SE | LE |
| 1 | Mathematics textbooks | | √ |
| 2 | Geometrical graph boards | √ | |
| 3 | Teachers' reference guides | | √ |
| 4 | Mathematics syllabus | | √ |
| 5 | Mathematics software | √ | |
| 6 | Flip charts/photographical slides | √ | |
| 7 | Graphical calculator | | √ |
| 8 | Mathematics four figure table | √ | |
| 9 | Mathematical sets | √ | |
| 10 | Model of 3D shapes | √ | |
| 11 | Mathematics board instruments | √ | |
| 12 | Computer with internet system | √ | |
| 13 | Overhead/Table projector | √ | |
| 14 | Interactive white boards | √ | |
| 15 | Mathematics games | √ | |
| 16 | Chalk/Marker boards | | √ |
| 17 | Other resources and improvisation | √ | |

*In what ways do teachers use Mathematics Instructional Resources (MIRs) for effective teaching and learning of mathematics in the public Senior High Schools (SHSs) of Agona of Central Region?*

Mathematics teachers' opinions on utilizing MIRs for teaching Mathematics were requested. Various statements were presented to the teacher respondents and required them to agree or disagree with each statement. The responses were analysed and discussed using mean and standard deviation. The mean of means value for acceptance is $X \geq 3.00$; otherwise, reject (see Table 8).

Table 8. Usage of Mathematics Instructional Resources (MIRs) in Mathematics

| S/N | Ways of Usage of MIRs | Mean | Std. Dev |
|---|---|---|---|
| 1 | To demonstrate and motivate learners' interest and readiness for instructional process | 4.37 | .488 |
| 2 | Learners' ability to understand is increased by the use of instructional materials by the teacher | 3.78 | .967 |
| 3 | To enhance learners' aptitude towards instructional process | 2.62 | .956 |
| 4 | Teachers used instructional resources as teaching learning materials (TLMs) | 3.61 | .797 |
| 5 | To prepare and deliver mathematics lessons | 3.39 | .928 |
| 6 | To provide students with meaningful source of information | 3.31 | 1.360 |
| 7 | To communicate with students and other teachers | 2.40 | 1.134 |
| Mean of Means/Average Standard Deviation | | **3.35** | **0.947** |

As evident in Table 8, it was found that, the majority (M = 4.37; SD = 0.488) of the teachers agreed that they use MIRs to demonstrate and motivate learners' interest and readiness for the instructional process. Most teachers also strongly agreed (M = 3.31; SD = 1.360) that they use MIRs to provide students with meaningful information. It was found (M = 3.78; SD = 0.967) that teachers are using MIRs to increase learners' ability to understand. Most teachers were found to agree (M = 3.39; SD = 0.928) with the statement that they use MIRs to prepare and deliver mathematics lessons. The statement "MIRs are used to enhance learner's aptitude towards instructional process" found that most of the teachers agreed (M = 3.62; SD = 0.956). Most teachers agreed (M=3.61; SD=0.797) to the statement, "I use instructional resources as teaching-learning materials". However, the teachers generally disagreed with the claim that they use instructional resources to communicate with students and other teachers (M = 2.40; SD = 1.134). It can be inferred from the results in Table 9 that a greater number of items (5 out of 7) received favorable responses. The mean values of each of the 6 items was above 3.0. The mean of means and mean of standard deviations for all the 7 items were 3.35 and 0.947, respectively. The results indicated that mathematics teachers in the Agona West and East districts utilize instructional resources in diverse ways. The outcomes from the observation on the ways in which teachers use the MIRs are presented in Table 9.

Table 9. Observation Results of usage of MIRs in Mathematics

| S/N | Way of usage | Yes | No |
|---|---|---|---|
| 1 | To demonstrate and motivate learners' interest and readiness for instructional process | √ | |
| 2 | To provide students with meaningful source of information | √ | |
| 3 | Learners' ability to understand is increased by the use of MIRs by the teacher | √ | |
| 4 | Teachers do not use MIRs for teaching and learning for fear of damaging them | | √ |
| 5 | To prepare and deliver mathematics lessons | √ | |
| 6 | To enhance learners' aptitude towards instructional process | √ | |
| 7 | To communicate with students and other teachers | | √ |
| 8 | Teachers used MIRs as teaching learning materials (TLMs) | √ | |

From the observational results, it is evident that mathematics teachers in the schools mostly use the MIRs to demonstrate concepts to students as a form of motivation to arouse learners' interest in mathematics.

**Research Question 3:**

*What factors inhibit the utilization of Mathematics Instructional Resources (MIRs) in Mathematics lessons in the Senior High Schools (SHSs)?*

What was perceived to be important factors that may affect the use of MIRs in mathematics lessons was investigated in the study. Responses of the teachers were analysed using means and standard deviations. A score above 3.0 specify factors affecting teachers in using MIRs and a mean score below 3.0 stipulates that teachers do not face challenges in using MIRs. The results are presented in Table 10.

Table 10. Factors inhibiting usage of MIRs in Teaching Mathematics

| S/N | Statement | Mean | Std. Dev. |
|---|---|---|---|
| 1 | Non-availability and inadequacy of several instructional resources made specifically for mathematics | 4.61 | .571 |
| 2 | Adequate experience and skills in using MIRs | 3.93 | .738 |
| 3 | Lack of suitable places to keep or store the iMIRs | 3.83 | 1.256 |
| 4 | Absence of training offered to teachers on the issues of ICT in education by the school | 3.47 | 1.321 |
| 5 | Incompatibility between the available instructional resources and the lesson/learning objectives | 3.10 | 1.245 |
| 6 | Broken and out of order instructional resources | 3.10 | 1.313 |
| 7 | Lack of support from schools' administrations in terms of provision of funds needed to purchase MIRs when need arises. | 3.42 | 1.264 |
| 8 | Intent of the teachers themselves to use MIRs | 3.58 | 1.275 |
| 9 | Inability to keep up with the technology used for MIRs | 3.01 | .868 |
| 10 | Lack of time in using the MIRs | 1.21 | .871 |
| Mean of Means Score/ Mean S.D Score | | **3.33** | **1.07** |

On the factors that prevent teachers from utilising the MIRs for teaching mathematics in the schools, the results from Table 10 revealed that 9 out of the 10 factors had received positive responses with the non-availability and inadequacy of several MIRs made specifically for mathematics (M = 4.61, S.D = 0.571) being the most factor affecting the teachers. However, lack of time in using instructional resources for teaching (M = 1.21, S.D = 0.871) was never a factor contributing to teachers' inability to use the MIRs. The mean of means and mean of standard deviations for all the items were 3.33 and 1.07, respectively means that, in general, there are several factors affecting the mathematics teachers' effective use of MIRs for teaching mathematics in public senior high schools in the Agona West Municipality and Agona East District of the central region.

## Statistical Test of Hypotheses

### *Hypothesis 1*

**$H_0$:** There is no statistically significant difference between male and female mathematics teachers' use of Mathematics Instructional Resources (MIRs) (see Table 11)

Table 11. T-test Results showing gender implications of MIRs usage

| Gender (Sex) | N | M | SD | T | df | P | Mean Difference |
|---|---|---|---|---|---|---|---|
| Male | 44 | 3.80 | 0.412 | 4.424 | 70 | 0.000* | 0.50 |
| Female | 28 | 3.30 | 0.531 | | | | |

Levene's test showed that the difference between the male and female mathematics teachers was statistically insignificant *($p < 0.05$)*, and hence, this study was girded by equal variances assumed. The independent samples t-test result in Table 11 indicated that the mean score of male teachers (M = 3.80; SD = 0.412) was significantly higher than their female counterparts (M = 3.30; SD = 0.531). The mean difference between male and female teachers was 0.50 in favor of male teachers. This is supported by t(70) = 4.424, p=0.000<0.05; the null hypothesis that stated no statistically significant difference was rejected, leading to the conclusion that male and female teachers differ in the utilization of instructional resources for teaching mathematics.

### *Hypothesis 2*

**$H_0$:** There is no statistically significant difference in mathematics teachers' age and their utilization of Mathematics Instructional Resources (MIRs) for the teaching of mathematics in SHSs (see Table 12).

Table 12. ANOVA Test on the Usage of MIRs According to Age

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 2.044 | 3 | 0.681 | 2.509 | 0.066 |
| Within Groups | 18.467 | 68 | 0.272 | | |
| Total | 20.511 | 71 | | | |

Table 12 revealed that the p-values were greater than 0.05 (p-value > 0.05). The null hypothesis was therefore retained leading to the conclusion that there was no statistically significant difference in teachers' age distributions and their utilization of Mathematics Instructional Resources (MIRs) in the mathematics classroom.

### *Hypothesis 3*

**$H_0$:** There is no statistically significant difference in mathematics teachers' teaching experience and their utilization of Mathematics Instructional Resources (MIRs) in teaching mathematics in SHSs (see table 13)

Table 13. ANOVA Test on Usage of MIRs - length of service

| | Sum of Squares | df | Mean Squares | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 0.408 | 4 | .102 | .340 | .850 |
| Within Groups | 20.103 | 67 | .300 | | |
| Total | 20.511 | 71 | | | |

The results in Table 13 shows that the p-value was greater than 0.05 (p-value < 0.05). The null hypothesis was therefore retained leading to the conclusion that there was no significant difference in teachers' teaching experience and their utilization of instructional resources in teaching of mathematics in public SHSs.

## Discussion

The data analysis revealed that, except for teachers' reference guides for mathematics, mathematics textbooks, mathematics syllabus, mathematical sets, graphical calculators, and chalk/marker boards, which are highly available, all other MIRs were either inadequate or not available in the SHSs. First, this situation can be attributed to the inadequate finance that makes the supply of MIRs problematic. Again, the inadequacy of MIRs can allude to the high intake of students in recent times, making a sufficient supply of curriculum materials and other resources critical. Whatever the reasons, the unavailability of MIRs in the teaching and learning of mathematics does not afford the students an opportunity for maximum understanding since the teaching and learning were done in an abstract form. The outcome is in agreement with the findings of some scholars (Harris, 2002; Oakes & Saunders, 2002; SPRA, 2002; Rand, 2002), who inferred from their studies that many teachers do not have access to the number and quality of instructional resources needed to provide students with the educational opportunities required to meet academic standards.

The unavailability of MIRs revealed through this study also concurs with the results of Oakes and Saunders (2002) that in many schools, shortages of instructional resources for mathematics exist in concert with other problematic school conditions that diminish students' opportunities to learn. With the unavailability of most of the MIRs in schools, teachers will not be able to function at their best regarding lesson delivery.

The study also found that MIRs were utilized to a low extent. This result is in agreement with that of Fatoba and Abidakum (2019) and Arokoyu and Charles-Ogan (2017), which indicated that utilization of instructional resources in secondary schools is moderate and inadequate. Further analysis indicated that mathematics teachers in the Agona West and East districts utilize MIRs in diverse teaching methods. However, it is evident that teachers in secondary schools mostly use the MIRs to demonstrate concepts to students as a form of motivation to arouse learners' interest in mathematics. These findings supported the study of Haddad and Drexler (2002), which recognized that instructional resources could be utilized in at least five diverse ways in education: introduction, exhibition, drill and practice, interaction, and collaboration. In the same vein, Allen (2007) believes that some teachers use concrete materials to give students enjoyment and fun.

The study again revealed that non-availability and inadequacy of several instructional resources explicitly made

for mathematics, adequate experience and skills in using mathematics Instructional Resources (MIRs), lack of suitable places to keep or store the instructional resources, lack of support from schools' administrations in terms of provision of funds needed to purchase instructional resource when need arises were among the observed factors serving as barricade to the utilization of MIRs for teaching the subject. The above finding concurred with the submission of Kareem (2009), that non-availability and inadequacy of several instructional resources and lack of space to keep teaching-learning materials always discourage teachers from creating instructional resources and, therefore, depend on much on talk and chalk, leading to distracting verbalism. The findings confirmed the study of the Organization for Economic Cooperation Development (OECD) in 2009 that some many barriers or challenges inhibit the use of instructional resources in education. These barriers include limited equipment, inadequate skills, minimal support, time constraints, and teachers' lack of interest or knowledge.

Again, the study found no significant difference between the responses of male and female mathematics teachers on the use of MIRs available for the teaching of Mathematics in SHSs. This means that gender does not impact how MIRs are used in teaching Mathematics in the SHSs. This finding agrees with Norris et al. (2003), whose research in California, Florida, Nebraska, and New York revealed that gender does not influence the extent of instructional resource utilization. Finally, there is a significant difference in the Mathematics teachers' age groups as well as Mathematics teachers' experience and the extent of utilization of MIRs for teaching Mathematics in SHSs in the study area. This depicts that teachers' age (experience) influences their usage of MIRs to model students' understanding of the concept being taught. This finding is opposed to Gumo (2003), who opined that a teacher with many years of teaching has learned more about the utilization of instructional materials and can make comparisons, inter-relationships, and connections, which enhance the refinement of what they already know. This makes more experienced educators better users of instructional resources more appropriately than a new graduate

## Conclusion

The study revealed that electronic MIRs, such as computers, overhead projectors, mathematics softwares, etc., were not available for use by mathematics teachers in their instructional deliveries. This development affects teaching and learning mathematics as MIRs play a crucial role in teaching and learning mathematics. Learning is more inclusive and meaningful when MIRs are used during teaching. Therefore, it can be inferred from the findings that Mathematics Instructional Resources (MIRs) of any kind, when made available to Mathematics teachers, can be utilized to improve the teaching process in public SHSs.

## Recommendations

In light of the findings of the study, the following recommendations are made:

1. In collaboration with other education stakeholders, the Ministry of Education (MoE) should prioritize providing adequate MIRs for teaching and learning Mathematics.
2. Adequate funds should be allocated to the schools from the budget of the ministry of education to cater for the shortfall
3. With the numerous benefits of instructional resources to both teachers and students, it is recommended

that workshops, symposiums, and conferences should be organized periodically for mathematics teachers on the importance of the use of MIRs in the attainment of educational objectives. In such programs, they should be exposed to various kinds of MIRs with regard to how and where they can be produced, collected, and utilized.

4. Mathematics teachers should also take the initiative and be creative to improvise their MIRs within the environment to promote effective teaching of Mathematics and enhance student's understanding and application of lesson content.

### Areas for Further Research

1. The researchers suggest that a similar study should be carried out in another geographical area (districts) in Ghana to establish whether the study findings apply to other areas to generalize the results.
2. Additionally, studies should be conducted to seek information from students and determine other variables, such as school factors, and student factors, among others, that affect the utilization of MIRs for teaching Mathematics.

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