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Alignment between the Intended and Enacted practical work component of the Senior High School Integrated Science Curriculum in the Kwadaso Municipality

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Abstract

A cursory observation of how Integrated Science Teachers (ISTs) operationalize the Senior High School Integrated Science Curriculum (SHSISC) reveals a neglect of the practical work component of the subject. Thus, this study sought to determine the extent of alignment between the intended and the enacted practical work components of the Senior High School Integrated Science Curriculum (SHSISC) in the Kwadaso Municipality. Sixty-four (64) lessons of eight (8) Integrated Science Teachers (ISTs) were observed using a Classroom Observation Schedule (COS). The data collected were analysed using frequency counts and percentages. The study found that enacted practical work component of the SHSISC was poorly aligned with the intended practical work. This misalignment has significant implications for Government's attempt to introduce a Standard-Based Curriculum in Senior High Schools (SHSs) in the Municipality. Furthermore, an extensive investigation into the causes of the misalignment is recommended.

Keywords: Intended curriculum; Enacted curriculum; curriculum alignment; Science Practical work

Background to the study

The performance of Senior High School candidates in the practical work component of Integrated Science Curriculum, including that in the Kwadaso Municipality, has been abysmal since the inception of the West African Secondary School Certificate Examination (WASSCE). Mismatch between the Intended and the Enacted practical work has been cited as a possible factor influencing the problem (Azure, 2016; WAEC, 2017).

The Intended Curriculum (IC) is described by Van den Akker (2003) as the standards set by curriculum developers in terms of what and how to teach, which is guided by curriculum materials such as textbooks and official syllabi. The Enacted Curriculum (EC), on the other hand, is the unique way and manner in which teachers present the curriculum to learners as they facilitate learning (Adentwi & Sarfo, 2009). To Webb (1997), Curriculum Alignment (CA) is the degree of match between the elements of two or more forms of curricula which facilitates the acquisition of knowledge and skills by learners. Explaining the meaning of science practical work (SPW), Blosser (1990) referred to it as an instructional practice where learners' knowledge and understanding are developed or improved through active exposure to hands-on activities by the learners instead of using other traditional approaches.

Ebru (2003) used teaching methods, instructional materials and facilities as the criteria for studying the alignment between the intended and the enacted Biology curriculum. Using a survey questionnaire and 685 Biology teachers, the study showed significant differences between the intended and the enacted Biology curriculum. In their study, Kurz et al. (2010) examined the alignment between the intended and enacted 8th-grade science curriculum for 18 teachers in Arizona State using the Survey of the Enacted Curriculum data collection instrument. Kurz et al.'s study revealed that alignment of the EC with the IC was low. Employing the mixed-methods approach, Seitz (2017) also examined alignment between the IC and the EC in Grade 9 Science curriculum in Canada using content and cognitive processes as a criterion of alignment. Similarly, Seitz found that CA between the IC and EC for the cognitive processes was low (7.3% alignment). In a more recent study, ZiebelL and Clarke (2018) also investigated the process of alignment between the IC and EC of Primary School Science in Victoria, Australia focusing on performance types of the learner (knowledge, understanding, application, etc.). The study also revealed a wide gap between the curriculum standards and the EC.

It is noteworthy that the reviewed studies on Curriculum Alignment focused mainly on teaching methods, instructional materials, facilities, cognitive processes or performance types of learners with little attention on Science Practical Work (SPW). The current study examined the extent of alignment between the intended and enacted practical work component of the SHSISC using samples from the Kwadaso Municipality.

The performance of teachers on instructional practices has been noted to be a reliable indicator of the extent of match between IC and the EC (Hattingh & Rogan, 2007 & Schleicher, 2018). The performance of teachers on instructional practices describes how well Integrated Science teachers behave towards the Enacted Curriculum (Hattingh & Rogan, 2007). In this study, one variable will be investigated; that is, teachers' performance regarding practical work instructional practices in SHSs in the Municipality. The analysis of this variable will be used to determine the extent of alignment between the Intended and Enacted curriculum. Thus, the assumption is that the higher the performance of IST's practical work instructional practices the higher the extent of alignment between the enacted and the intended practical work. The study will, therefore, be driven by the research question; what is the extent of alignment between the Intended and Enacted practical work components of the SHSISC in Senior High Schools in the Kwadaso Municipality.

Literature Review

The Concept of Curriculum Alignment

The term "Curriculum Alignment" gained prominence after the publication of English's (as cited in March & Willis, 2007) book titled "Deciding what to teach and Test: Developing, aligning and auditing the curriculum". English defined Curriculum Alignment as "the degree of match or overlap among instruction, content and format of assessment" p. 89. Similarly, Webb (1997) defines Curriculum Alignment (CA) as the degree of match between the elements of two or more forms of curricula which facilitates the acquisition of knowledge and skills by learners. English (as cited in March & Willis, 2007) further emphasized that curriculum alignment seeks to achieve congruence between the Intended and the Enacted Curriculum through the Assessed Curriculum. Supporting English's position, Leitzel and Vogler (1994) observed that curriculum is aligned if the delivery and assessment of the content are in accordance with the intended content. As Baker (2004) puts it; the best way to achieve a high degree of alignment is to start by analysing the intended curriculum and then develop teaching and assessments to match it. In the same token, a high degree of alignment among the various forms of curriculum improves students' learning (La Marca, Redfield, Winter & Despriet, 2001; Anderson, 2002 & Biggs, 2015). To add to this, curriculum alignment is a fundamental pillar in standards-based education (Näsström, 2008). Porter (2006) stated that to determine whether a system is indeed aligned, the instruction must be included in a study of alignment. It is based on Porter's (2006) position that this study made the Enacted Curriculum an important component of this Curriculum Alignment study.

Though Curriculum Alignment has been generally acknowledged as a means of ensuring effective implementation of curriculum, some researchers including Marsh (1993) have suggested that Curriculum Alignment has the tendency to reduce the autonomy of the teacher and his or her creativity. Besides, the adherence to the concept has been criticized as giving too much power to paper and pencil examination and leads the implementer of the curriculum to teach for examinations only (Marsh, 1993).

Methods for Determining Curriculum Alignment

A review of literature has unveiled four major models of analyzing Curriculum Alignment. According to Bennett (2005), the four models are; the Achieve model, the Webb's model, Survey of Enacted Curriculum (SEC) and the model recommended by the Council of Chief State School Officers in South Africa. It is the position of the researcher that understanding these models of Curriculum Alignment will enable him to establish a relevant criterion for investigating the level of alignment between the practical work component of the SHS Integrated Science curriculum and the Enacted Curriculum in the selected schools. According to Bennett (2005), the Achieve model is an approach that provides both qualitative and quantitative investigations using a panel of experts. These experts, who serve as panel judges, determine the degree of alignment using five criteria such as: content centrality, performance centrality, challenge, balance, and range. Bhola (2000) as cited in Ziebell & Clarke 2018), however, has also categorized the models into three major groups; low, moderate, and high complexity models. The Low-level complexity models, according to Bhola, define the most basic alignment methods where alignment between the content of standards and other levels of curriculum are investigated to determine the level of agreement between them. This, in Bhola's view, is simply a correspondence of content and instruction.

An example of the High-level complexity model is the Webb's alignment method. Webb's model, which was originally developed by Norman Webb in 1997, provides a reliable set of procedures and criteria for conducting alignment studies. The model is based on expert judgment and quantified coding and analysis of curriculum standards and assessments. Per the structure of the Webb's model, it constitutes twelve criteria classified into five categories that examine both the breadth and depth of alignment between standards and assessments. The five categories are: content focus, articulation across grades and ages, equity and fairness, pedagogical implications and system applicability. The degree of alignment for each criterion is measured by one of three levels: full, acceptable, or insufficient. Webb's (1997) model is based on the underlying assumption that the enacted curriculum is aligned with standards and assessment (Bhola as cited in Ziebell & Clarke, 2018). Another example of the High-Level Complexity model is the Surveys of Enacted Curriculum (SEC) method. The SEC model involves the use of about four reviewers using a two-dimensional matrix to code standards, instruction, and assessment. The degree of alignment is analyzed from two dimensions; content topic and category of cognitive demand. The information contained within the content matrix may be converted into tables, graphical displays, and content maps to portray differences and similarities.

One of the limitations of Webb's (1997) model of alignment is that the focus is only on matching standards and assessments to the neglect of the Enacted Curriculum. Webb's assumption is that if the standards and assessments are aligned, the instruction or the enacted curriculum will also be aligned. However, in contrast to Webb's assumptions, Porter (2006) stated that to determine whether a system is indeed aligned, the instruction must be included in a study of alignment. It is based on Porter's (2006) recommendation that this study made the

Enacted Curriculum an important component of this Curriculum Alignment study.

In this study, the researcher adopted the low-level complexity model of assessing curriculum alignment. As described by Bhola (as cited in Ziebell & Clarke, 2018) a simple correspondence of content (practical work) of the standard and what is taught in class was determined. Using a rating scale, practical work instructional practices of Integrated Science teachers were observed. This model was adopted because it is less difficult to find a match between standards and other levels of curriculum in low-complexity models (Bhola as cited in Ziebell & Clarke, 2018). According to Bhola, the more complex models with specific criteria may be more likely to result in judgments of a lesser degree of alignment between the different forms of curricula.

The Concept of Science Practical Work

Science practical work has been given different definitions in different contexts, and even in the same environment different names have been assigned to them. Examples of such names are science practical work, lab work, experimental work, laboratory exercises and experiential learning (Kasiyo, 2017). Woolnough (1998), for instance, considers science practical work as the process of carrying out experiments with apparatus in the laboratory. Similarly, Tsai (2003) defines practical work as experiences of learners that are based in the laboratory. It is important to note that the definitions of Tsai (2003) and Woolnough (1998) suggest that science practical work can be carried out only in the science laboratory. These definitions, according to the researcher, is too restrictive suggesting that any hands-on activity that is carried out in the classroom or on the field should not be considered as a practical work activity. However, using the term “Experiential learning” Osborne (2003) defines practical work as a method of teaching where by knowledge is gained or developed by leading students to carry out hands-on activities instead of other traditional approaches. In the same token, Miller (2004) refers to science practical work as any activity which involves the manipulation of objects or materials being studied by students. Similarly, the Department of Basic Education, DBE (2011) of South Africa defines practical work as any activity which links concepts learned in class to actual practices in the surrounding environment. DBE (2011) gave more insight into the definition by emphasizing that practical work involves “hands-on” and "minds-on" activities where learners develop their science process skills. It could be deduced from the definitions of Osborne, Miller and the DBE that the location of the practical work does not determine whether an activity is a practical work or not.

The effectiveness of a practical work has also been on the minds of educational researchers, including Miller (2004). On his part, Miller observes that in order to make practical work more effective, the teacher needs to take the students through three main stages. First, the teacher needs to make the objectives of the practical work clearly known to the students. Second, the actual practical work that needs to be done must be known to the students. Third, how the practical work will be carried out including its precautions should be planned and made known to the students. Supporting Miller, Kasiyo (2017) observed that practical work that is expected to promote the understanding of concepts and process skills needs to involve the students and understood by the students, in terms of its objectives and focus. According to Tyler (1949) "Learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does" (p.63*)*. When describing the use of microscope, for instance, Obeng (2001) recommended the direct involvement of students in the three main processes such as staining, mounting a slide and focusing a specimen to improve their understanding. More recently, Gupta (2020) has defined an effective practical work as that which leads to a change in the behaviours of learners. The revelations made by Miller (2004) and Kasiyo (2017), in the view of the researcher, should be taken serious by teachers. Their position points to the fact that it is not the practical work itself that is the only important thing but how they are presented to the students is also very significant if we want practical work activities to produce the needed results in students. This also emphasizes the need for teachers to involve students in the planning and integration of all practical work activities into Integrated Science lessons. However, according to Danso (2010), teachers in Ghana favour teacher-centered and knowledge-based teaching methods that leave little room for learners' participation. Kim and Tan (2011) also observed that science practical work is one of the most challenging tasks for science teachers. Teachers' reluctance in adopting practical work is due to lack of external support, limited time, large number of students, unavailability of resources, and the absence of trained laboratory assistants (Kim & Tan, 2011). Focusing on the significance of science practical work

Taraban, Box, CMyers, Pollard and Bowen (2007) stated that the continuous use of hands-on laboratory activities gave benefit to students to become more active, improve their knowledge, and enhanced their science process skills. However, the purpose of learning Science at an early stage is not to behave like a scientist, rather the purpose is to develop process skills, concepts and attitudes towards the subject which will enable students to cope effectively with education and achievements at the tertiary level (Sadhana, 2017).

In their Theoretical Model for Science Practical work Ausubel, Novak and Elton (2001) as cited in Bradley (2005) identified eight (8) types of practical work as Directed Activity, Demonstrations, Skill development, Laboratory experiments, Undirected Activity, Open enquiry/problem-solving, Directed Inquiry/Problem Solving and Creative Feedback. Bradley (2005) explained each of the types of practical work as follows:

Directed Activity

This type of practical work is teacher-directed activity in which the students, after following the directions of the teacher, observe an activity, record key variables and use them to describe what is learned mostly by using a workbook.

Demonstrations

Demonstrations take place when students gain knowledge or skills by observing a practical work activity being carried out by a teacher or an expert in the classroom, laboratory or field. The discussions that follows this activity helps the learner to assimilate and make real meaning from the activity. Though a demonstration does not readily promote students' independent discovery, it helps to improve it when demonstrations are done very often. Gupta (2020) also observed that among the various types of practical work, demonstrations are used by teachers in most cases due to the large class sizes that is normally found in schools.

Skill development

Practical work activities that are described as "skill development" are activities carried out by learners to help them to acquire manipulative and process skills. However, the learning of procedural skills in science practical work has recently been a declaration of intention with few examples of successful implementation (Niedderer, 2002). This appears to confirm the point that textbook is the curriculum for science and hence what passed as the teaching of science was nothing more than information-giving by teachers and memorization of the information by students (Collison & Aidoo-Taylor, 1990).While the manipulative skills involves the correct and safe use of laboratory equipment, the process skills are the skills such as observation, measuring, classifying etc. that helps scientists or the students to carry out experiments and other practical-related activities. According to Bradley (2005), both the manipulative skills and the science process skills are not independent of content. That is, a students can only learn how to practically measure dimensions of objects on the shoulders of concepts like "Measurement". The Senior High School Integrated Science Syllabus (2010) of the Ghana Education Service has identified nine intended basic science process skills to be taught in Senior High Schools. These are Observation, Manipulation, Classification, Drawing, Designing, Measuring, Recording, Reporting and Conduct in laboratory or field. In this study, the perceptions of Integrated Science teachers and students on the extent to which Integrated Science teachers assist students to carry out practical work will be based on 18 items related to these nine (9) sciences processes skills.

Laboratory experiment

These are practical work activities carried out by students, based on specific guidelines provided by the teacher, to verify scientific principles, facts or concepts and facts that students have had the privilege to study. With this kind of practical work, students have no input with regards to how they are carried out. Normally, the key steps to be followed by students are the aim of experiment, materials needed, procedure, results and conclusions. Usually, the teacher directs students to present a report about the experiment after the practical work. This type of practical work is a teacher-centered type of practical work which leaves little room for students to construct their own knowledge (Bradley, 2005).

Undirected Activity

These are practical activities, such as, play, trial and error and simple problem-solving activities that are initiated by the students themselves, based on the idea that play is an important way of learning. When students direct activities of the practical work, it promotes the stimulation of questions which may lead to the planning and execution of further practical activities. Bradley (2005) has observed that if students, in the process of carrying out the activity, try to learn something or concepts that are not acceptable in the society, students will be discouraged from learning it.

Open inquiry or problem solving

Sometimes students pose questions to which they expect answers to help them understand concepts well and to satisfy their curiosity. Open inquiry is a practical work activity planned and implemented by students to answer this type of question. As far as its importance is concerned, Bradley (2005) observed that the activity promote students' understanding of concepts through their experiences.

Like other African countries, the Ghana Education Service attaches importance to practical work in science education. This is because practical work is emphasized by the NaCCA in all the science syllabuses, including Integrated Science, to help students attain knowledge and develop practical skills (Ghartey-Ampiah, Tufuor & Gadzekpo 2004). Besides, practical work is examined externally by WAEC in the paper 3 of the Integrated Science WASSCE.

In this study, the term 'Science Practical Work' will be adopted and will be used to refer to any instructional practice where learners' knowledge, understanding and skills are developed or improved through active exposure to hands-on activities by the learners instead of using other traditional approaches. Besides, the observation of teachers' practical work instructional practices in the schools will focus on practical activities related to four types of practical work as described by Bradley (2005). They are directed activity, demonstrations, skill development and laboratory experiment. This is because these are the type of practical activities that could be inferred from the Senior High School Integrated Science curriculum (2010).

Methodology

Research Design

This study employed the cross-sectional survey design. Survey design was chosen because the study intends to generalize its outcome from a sample to the population so that inferences can be made about key characteristics of the population (Babbie, 2009). The cross-sectional design was also adopted because the study was meant to find out the overall 'picture' or prevalence of the key variable of the study by taking a cross-section of the data at a particular academic year.

Population

The study was carried out in the Kwadaso Municipality in the Ashanti Region of Ghana. In this study the target population was all the 64 Integrated Science teachers (ISTs) in the four (4) government-assisted SHSs in the Kwadaso Municipality. These participants were chosen because they are major agents in the Integrated Science (IS) curriculum implementation process. The accessible population was the 52 ISTs in Prempeh College, Yaa Asantewaa Senior High School (High-performing schools), Agric Nzema Senior High School and Methodist Technical School (Low-performing schools) during the 2019/2020 academic year.

Sample and sampling procedure

In this study, all the four (4) government-assisted SHSs in the Kwadaso Municipality were purposively selected for the study. In order to observe the practical work instructional practices in the schools, two (2) Integrated Science teachers were randomly selected from each of the four schools. In order to select the two teachers from each of the schools, a sampling frame was developed for each school by writing the names of the Integrated Science teachers on paper. The lottery method was used to select two Integrated Science teachers from the sampling frame of each school. Hence, practical work instructional practices of eight (8) Integrated Science teachers in sixty-four (64) lessons were observed in the classrooms of the four schools. "For content-independent dimensions of instructions, the observation of one lesson per teacher per class was sufficient to reach sufficient reliability levels" (Mikeska, Holtzman, McCaffrey, Liu, & Shattuck, 2018; p. 36). So, since the focus of observation was on the pedagogical dimension of the Enacted practical work, observing eight (8) lessons per teacher could produce reliable data. Again, since the number of schools involved in this study were four and equal number of teachers were expected to be selected from each of them, eight (8) Integrated Science teachers were the most appropriate sample for the classroom observations.

Instrument for Data Collection

The structured, non-participant and direct observation models of observation were adopted for the study. These models were adopted because while non-participant observation minimized interruptions of the usual classroom teaching practices of the teachers, the direct observation provided an opportunity to provide a record of real practical work activities in their natural classroom environment. On behalf of the World Bank Group, Rogers (2015) assessed teacher performance and skills by using observation as one of the key data collection instruments. Also, during one of their formative evaluation processes, the Chesterfield County Public Schools of Virginia, U.S.A (2019) adopted observation as a data collection method for assessing the performance of teachers in the schools.

The Staffordshire University Guidelines for the Observation of Science Teaching Practices (rating scale) was adapted to measure the performances of Integrated Science teachers regarding practical work instructional practices in the schools. Out of the 31 items of the original scale, 23 which were related to practical work activities were extracted and used for the instrument. For the purposes of this study, the scale was renamed as "Classroom Observation Schedule". All the 23 items of the scale were positive four-point Likert-type statements which have been grouped into five, measuring five sub-dimensions of teachers' practical work instructional practices. The first four items (1, 2, 3 and 4) measure the "Organization of practical work", the next seven items (items 5, 6, 7, 8, 9, 10 and 11) measure the "presentation of practical work", items 12 to 17 measure the "level of interaction", items 18 to 21 measure the "content knowledge" sub-dimension and the last two items (22 and 23) measure the "Cognitive demand on the students". All the scale points of the 23 items were labelled, ranging from 1 ("Not observed"), 2 ("Low"), 3 ("Moderately High") to 4 (High"). In this study, the scale points were named as performance categories with the following definitions:

- "Not Observed" means the listed behaviour was not demonstrated.
- "Low" means the science teacher showed little or no planning for its execution.
- "Moderately High" means the teacher showed some level of planning for its implementation.

- "High" means the teacher showed careful planning and classroom flexibility in its implementation.

For each of the dimensions, a blank space was provided for "Other Comments" to record additional detailed information about teacher's practical work activities in the classrooms.

Validity of Instrument

The instrument was reviewed by Heads of Science Department of two of the Senior High Schools. The wording of the items of the instrument was, therefore, revised according to their comments and suggestions. It was pre-tested by observing eight Integrated Science lessons at Ejuraman, a Senior High School in the Ejura-Sekyedumase Municipality.

Reliability of Instrument

Using SPSS version 21, the Cronbach alpha coefficient for the 23 items was determined as 0.79, representing as an acceptable internal consistency reliability of the instrument. An alpha coefficient of 0.7 is regarded as acceptable threshold for reliability (Nunnally as cited in Ary et al., 2010). This scale was used in this study because the focus of the items is also in line with key elements of the guidelines written in the National Teachers' Standards for Ghana which is part of the curriculum package of the Ghana Education Service.

Data Collection Procedure

Observations were conducted randomly during the regular school contact hours based on the time table of the eight selected teachers in the schools. Observations made in the classrooms for the first two lessons of each teacher were not recorded, the period was meant to establish a good working rapport with the teachers and the learners. If a lesson was not integrated with a practical work, each of the 23 items on the schedule would score 1 ("Note Observed"). If a lesson was integrated with practical work, each of the 23 items was scored either 2 ("Low"), 3 ("Moderately High") or 4 ("High"). To determine the reliability of data collected from the observations, each observation was video-recorded and subsequently given to the Head of Integrated Science of Prempeh College for him to rate the performance of the teachers. However, one of the Integrated Science teachers did not allow the researchers to take videos of his lessons due to personal reasons. The Cohen's Kappa coefficient (k) was, therefore, calculated for the remaining fifty-six (56) observations using the formula:

Cohen's Kappa coefficient (k) = $\frac{P_0 - P_e}{1 - P_e}$

Where $\mathcal{P}_o$ = Relative observed agreement between raters

$\mathcal{P}_e$ = Hypothetical probability of chance agreement

The Cohen's Kappa Statistic was 0.94 representing a satisfactory rating agreement between the researcher and the Head of the Integrated Science Department.

Data Analysis

The number of items (23) on the classroom Observation Schedule (COS) and the number of Integrated Science lessons observed (64) yielded a total cumulative frequency score of 1472 (That is, 64 observations x 23 items). In his work "The Perceptions of Adolescents of their Career Guidance and Counselling Needs …", Ocansey (1994) used both the number of items and scale values to yield a total score for each respondent from a symmetrically distributed population. To determine the performance of the ISTs on practical work instructional practices, three main stages were followed: First, the item by item frequency score for each of the four performance categories ("Not Observed", "Low", "Moderately High" and "High") were determined using SPSS version 21. Secondly, the cumulative frequency for each performance category was determined by adding the frequencies of the individual items in the scale. Thirdly, the percentage cumulative frequency for each performance category was determined by dividing the cumulative frequency of each performance category by the total cumulative frequency (1472) and multiplied by 100. Thus, each of the performance categories obtained a percentage cumulative frequency score which determined the performance of Integrated Science Teachers (ISTs) regarding practical work instructional practices in the four schools. These percentages were used to plot a bar graph using Microsoft Excel. For Likert-type scale data that are ordinal in nature, the mode is the most suitable statistics to use for easy interpretation and display of observation in a bar chart (McLeaod, 2019).

On the basis of the percentage cumulative frequencies of the individual performance categories, a decision was made as to whether the practical work instructional practices in the schools were aligned with the standard or not. If the sum of the percentage cumulative frequencies of the "Moderately High" and the "High" fell below 50% of the total cumulative frequency (1472), the enacted practical work was considered to be poorly aligned with the intended practical work. On the other hand, if the sum of the percentage cumulative frequencies of the "Moderately High" and the "High" options equals or is above 50% of the total cumulative frequency, the performance of ISTs regarding practical work instructional practices was deemed to be high. That is, the enacted practical work was considered to be highly aligned with the intended practical work. In his work "Curriculum Alignment among the Intended, Enacted and Assessed Curricula for Grade 9 Science", Seitz (2017) considered a percentage alignment index close to or equal to 100% as full or high curriculum alignment among the intended and enacted curriculum.

Ethical Consideration

An introductory letter was used to seek permission from the Heads of the schools selected for the study. Teachers' anonymities were protected by using a coded number system for the observational schedule. Again, all other identification information such as name of school, etc. were not part of the schedule.

Results of the Study

Figure 1 presents the performance of the Integrated Science teachers regarding their practical work instructional practices.

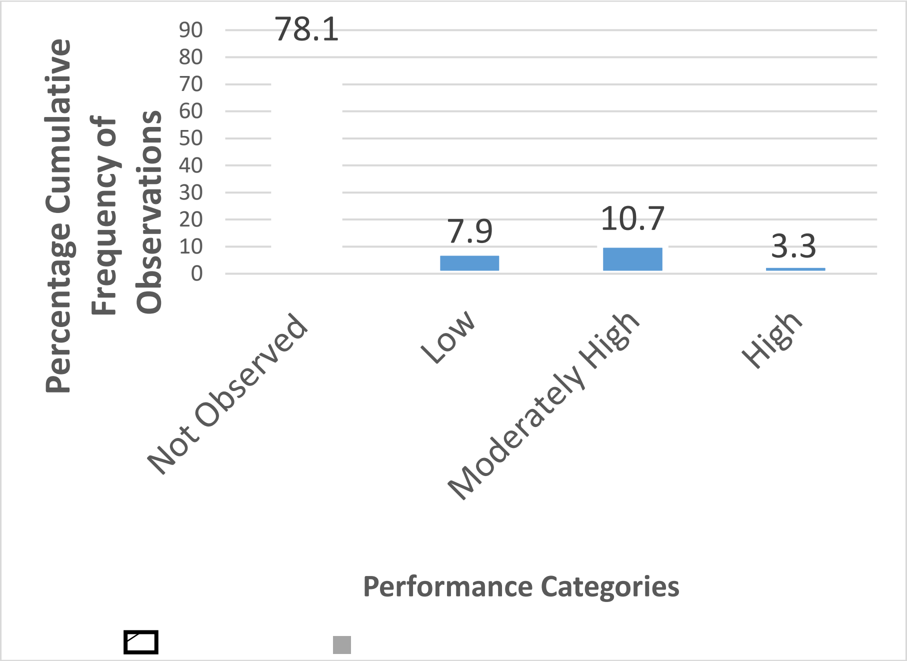

Figure 1: Teachers' performance regarding practical work instructional practices.

As shown in Figure 1, the result shows that the practical work component of the enacted Integrated Science Curriculum was poorly aligned with the intended practical work component of the curriculum. This is because the performance of ISTs with respect to practical work instructional practices was very low. That is, the sum of the percentage cumulative frequencies (14.0%) of the positive performance categories ("Moderately High" and the "High") fell below 50% of the total commutative frequency of 1472. It is also noteworthy that there is a very wide difference (86%-14%= 72%) between the sum of the percentage cumulative frequencies of the negative performance categories ("Not observed" and "Low") and that of the positive performance categories ("Moderately high" and High"). Further, the performance category that recorded the highest percentage cumulative frequency (78.1%) was in respect of the "Not observed" performance category. As was expected, the performance category, "High", recorded the least percentage cumulative frequency of 3.3%. These results suggest that either most of the Integrated Science lessons were not integrated with practical activities or the practical work integrated in these lessons were poorly carried out. A more detailed results, based on the five sub-dimensions of the construct, have been presented in Table 1.

Table 1 Distribution of the Performance of Teachers' Practical work Instructional Practices based on the five dimensions

	Performance Level				
Teachers' Instructional Characteristics	Not observed	Low	Moderately. High	High	Total
Organization of practical work	208 (81.3%)	18 (7.0%)	16 (6.3%)	14 (5.5%)	256 (100%)
Presentation of practical work	348 (77.7%)	49 (10.9%)	39 (8.7%)	12 (2.7%)	448 (100%)
Interaction with students	300 (78.1%)	24 (6.3%)	44 (11.5%)	16 (4.2%)	384 (100%)
Content Knowledge	196 (76.5%)	17 (6.6%)	39 (15.2%)	4 (1.6%)	256 (100%)
Cognitive Demand of practical work on students	98 (76.6%)	8 (6.3%)	20 (15.6%)	2 (1.5%)	128 (100%)
Total	**1150 (78.1%)**	**116 (7.9%)**	**158 (10.7%)**	**48 (3.3%)**	**1472 (100%)**

Note: The figures are row frequencies and row percentages

Another dimension of the results that needs further reflection is the performance of the ISTs regarding the individual sub-dimensions of the construct. It is interesting to note that none of the five sub-dimensions of practical work instructional practices of the ISTs was highly rated. That is, the sum of the percentage cumulative frequencies of the positive performance categories for all the five sub-dimensions;

Organization of practical work (11.8%), Presentation of practical work (11.4%), Interaction with students (15.7%), Teachers' content knowledge (16.8%) and Cognitive demand of practical work on students (17%) were below 50% of the total commutative frequency of 1472. This means that most of the elements under each of the dimensions were either poorly carried out or were not carried out at all. Teachers' commitments towards the various types of practical work carried out in the schools have been presented in Table 2.

Table 2 Frequency distribution of Types of practical work Carried out in the schools

Category of School	Directed Activity	Demonstrations	Skill Development	Laboratory Experiment	Total
High-performing schools	2 (28.6%)	4 (57.1%)	1 (14.3%)	Nil (0.0%)	7
Low-performing schools	Nil (0.0%)	6 (75%)	1 (12.5%)	1 (12.5%)	8
TOTAL	**2 (13.3%)**	**10 (66.7%)**	**2 (13.4%)**	**1 (6.6%)**	**15 (100%)**

Table 2 shows that only a few (15; 23.4%) of the IS lessons were integrated with practical work. Besides, most of the practical work carried out in the schools (66.7%) were in the form of "demonstrations" which were carried out by the Integrated Science teachers themselves instead of the students.

Discussion of Results

The results of the study revealed that the enacted practical work component of the SHSISC was poorly aligned with the intended practical work component of the curriculum. This misalignment confirms Niedderer's (2002) position when he observed that the learning of procedural skills in science practical work is merely a declaration of intention with few examples of successful implementation.

Curriculum over-load and its accompanying limited time-factor may explain this outcome. In accordance with the Senior High School Integrated Science syllabus, ISTs are expected to teach fifty (50) topics within just six (6) semesters. Holidays, days for sporting activities ("Inter-school" and "Inter-house competitions") and the organization of other unplanned events further reduce the contact hours meant for academic work. The fact is that practical work, unlike the lecture-method, demands a lot of time. So, the limited time available and the large number of topics to be taught must have practically discouraged the ISTs from implementing the intended practical work in their lessons. Based on ZiebelL and Clarke's (2018) assertion, the inadequate practical work in the schools could also be attributed to Integrated Science teachers' inability to follow and properly interpret instructional guidelines in the Integrated Science curriculum. The interpretation of the intended objectives of a curriculum at the classroom level is a difficult, complex and dynamic process (ZiebelL & Clarke, 2018).

Another important factor that could have influenced the result is the dependence on past questions for instructional practices. According to Elliott et al. (2010), one critical requirement for the achievement of higher alignment between the intended and enacted curriculum is the extent of agreement between the two components of the educational environment- curriculum and assessment. It can, therefore, be deduced from the above that if the assessed curriculum (Internal or external examination) is not aligned with the intended practical work outlined in the syllabus, teachers and students will not be motivated to respectively teach and learn the contents of the intended curriculum as they are expected to do. Since the inception of the SHS programme the practical work component of Integrated Science (IS) of the West African Senior School Certificate Examination (WASSCE) has never been based on hands-on practical work involving real objects or materials (Personal observation). So, contrary to what is done for students offering science as an elective subject, no laboratory equipment, tools or specimens are brought to the examination hall for the purposes of assessing students in the practical aspect of IS. Instead, the WASSCE papers on IS focus only on the "teacher-directed activity" type of practical work, neglecting other types that are more student-centred. That is, diagrams of equipment, items or set-ups are normally drawn on paper for students to answer questions on them. So, if students are assessed by using diagrams on paper, then they and their teachers will be motivated to only rely on textbooks or workbooks for their practical work instead of carrying out hands-on activities using real specimen. This, among other reasons, may have contributed to the poor alignment between the intended and the enacted practical work component of IS curriculum.

The marks allocated to the practical work aspect of the Integrated Science WASSCE could also be a contributory factor to the seemingly lack of interest in science practical work in the schools. The maximum marks or score allocated to the practical work component of the Integrated Science WASSCE papers each year is only 15%. These marks, in the view of the authors, is inadequate and hence, not motivating enough. Interestingly, the examiners who mark these scripts are also the Integrated Science teachers who are expected to teach the practical work in the schools. Hence, they could not consider the marks as motivating enough to spend enough time to carry out practical work in the schools as outlined in the curriculum.

One element of the results that also needs further reflection is the use of "Demonstrations" as the most frequently carried out type of practical work during Integrated Science lessons in the selected schools. That is, among the fifteen (15) Integrated Science lessons that were integrated with practical work, the practical work in ten (10) of the lessons were in the form of "demonstrations". According to Bradley (2005), demonstration is a type of practical work activity in which an individual (normally, the teacher himself) carries out the practical work for the students to observe. That is, students are expected to learn concepts and process skills by making meaning from the practical work being carried out by the teacher or an expert. In Bradley's view, demonstrations are the least learner-centered type of practical activity since it is normally carried by the teacher himself. This finding tallies with the claim by Gupta (2020) that teachers use demonstrations for most of their practical work activities with their students. Large class size, according to Gupta, influenced the choice of the teachers.

Factors that could explain this finding are numerous. First, demonstrations can be carried out within the shorter period. It avoids the extra time that will be needed to assemble apparatus for all students in the laboratory to carry out their practical activities. Gupta (2020) observed that the choice of what kind of practical work depends on the time and resource constraints. So, since it takes a shorter period to carry out demonstrations in schools, Integrated Science teachers preferred demonstrations to the other types of practical work activities. Second, because it is normally performed by the teacher the students do not handle the equipment and hence avoid the risk of a student damaging the equipment. In this sense, demonstrations help to protect and increase the lifespan of laboratory equipment. This, probably, could be one of the reasons why the Integrated Science teachers in the selected schools were comfortable with demonstrations as compared to other types of practical work activities. Third, carrying out demonstrations is relatively cheaper as compared to other forms of practical work. That is, demonstrations require relatively fewer apparatuses and materials for practical lessons since only one person is undertaking the exercise. So, due to it cost effectiveness to the Science Department and the school as whole demonstrations were adopted as the most preferred form of practical work in the selected schools in the Kwadaso Municipality.

The outcome of this study has a number of instructional, managerial and research implications. To begin with, the misalignment defeats the essence of the practical work outlined in the curriculum. This is because the practical work activities in the curriculum were meant to help the learner to develop its science process skills and facilitate the understanding of concepts. So, if these practical activities are not implemented in the schools as planned then their documentation in the curriculum is of no relevance to the students. It could also be inferred from the results that SHS students in the Municipality will continue to have unsatisfactory academic performance in the practical aspect of the subject if this inadequacy in practical work activities persists. This is because a high degree of alignment among the various forms of curriculum improves students' learning (La Marca et al., 2001; Anderson, 2002).

These results also have serious implications for the efforts of the Education Directorate of the Kwadaso Municipality at implementing the new Standard-Based curriculum in SHSs in the Municipality. This is because curriculum alignment is a fundamental pillar in Standards-Based education (Näsström, 2008). According to Ghana's Pre-tertiary Education Curriculum Framework (2018), the learning of critical thinking and problem-solving skills are the primary competences expected to be fostered in learners under the new Standards-Based curriculum. Based on the outcome of this study, the achievement of this goal is likely to suffer in SHSs in the Kwadaso

Municipality if the new curriculum is implemented. This has also given educational authorities the empirical evidence that the effective implementation of the curriculum in SHSs in the Municipality is likely to fail.

The outcome of this study also has significant implications for the monitoring role of the authorities of the schools and the Education Directorate of the Municipality. The Headmasters, through the Assistant Headmasters in charge of academic work, must continuously monitor Integrated Science lessons in their respective schools to ensure that practical work activities play a central role in the teaching strategies adopted by teachers. This can be achieved by allocating specific time on the schools' timetable exclusively for science practical work activities.

Limitations of the Study

The schools used for the study were public Senior High Schools selected from only the Kwadaso Municipality. Hence, conclusions of the study are limited by these schools. Secondly, since the data were collected with attitudinal scale, the problem of bias normally associated with the use of scales cannot be ruled out completely.

Conclusions

Comparing the intended and enacted practical work component of the SHS Integrated Science curriculum is an innovative idea that can provide some insight into the way the curriculum works in Senior High Schools in the Kwadaso Municipality. This study provided evidence of a misalignment of the intended with the enacted practical work component of the SHS Integrated Science curriculum. It has also confirmed that Integrated Science teachers in the selected schools do not often use practical work as a means of instruction during Integrated Science lessons. More alarmingly, the teachers mostly rely on teacher-cantered type of practical work in the few practical work activities carried out in the schools. These findings could possibly inform officials of the Education Directorate, school authorities and Integrated Science teachers to ensure that science practical work is given the needed attention as stipulated in the Integrated Science curriculum.

Recommendations

Based on the conclusions of this study, the following recommendations are made for consideration:

1. The Kwadaso Municipal Education Directorate should ensure the effective enactment of Integrated Science practical work in Senior High Schools by making the syllabus available to all teachers and students, organizing in-service training for science teachers, providing educational materials for science practical work and instituting quality control mechanisms in the form of monitoring and supervision and follow-up activities.

2. The management of the Senior High Schools in the Municipality should put measures in place to effectively integrate practical work into Integrated Science lessons in Senior High Schools. This can be done by allocating time on the timetable exclusively for Integrated Science practical work with improved duration to allow teachers to work at their own pace.

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