

EXAMINING THE PROFILE DIMENSIONS OF OBJECTIVES IN THE GHANAIAN BASIC SCHOOL SCIENCE CURRICULUM TO PROMOTE SCIENCE LITERACY

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Abstract

The need for scientific literacy is gaining prominence as many nations are reviewing their curriculum objectives to meet the demands of today's world. In Ghana, the objectives for teaching, learning and assessment in science for the basic school level are spelt out in the national curriculum for basic schools and are geared towards addressing three profile dimensions, which are intended to promote scientific literacy. This paper examined the specific objectives in the primary and junior high school Integrated Science curriculum in Ghana and compared how each effectively measured the stipulated profile dimensions outlined by the curriculum developers. The study was conducted using the qualitative descriptive design and data was collected using document analysis. The specific objectives were analyzed using document analysis. In total, 67 primary and 145 junior high school Science units were examined. The findings obtained showed that emphasis has been placed on knowledge and understanding as against application of knowledge and attitude/experimental, and process skills in respect to teaching and assessment than what the curriculum developers intended. It is therefore recommended that a critical review of the two curricula should be made to ensure that basic school learners attain the required level of scientific literacy as envisaged by the curriculum developers.

Key words: scientific literacy, Ghanaian basic school curriculum, profile dimensions, curriculum developers

Introduction

Scientific literacy apotheosizes the issue of being scientifically literate and implies that a person can identify scientific issues underlying decisions and express positions that are scientifically and technologically informed (Kirshenbaum, 2009). According to Ghartey-Ampiah (2006), citizens of both developed and developing nations must be exposed to some level of scientific literacy so as to be effectively equipped to manage the hassles and difficulties that arise from the science-oriented societies today, especially outside the setting of the school. This is one of the main reasons why in all the various Ghanaian educational reforms the issue of scientific literacy is made compulsory (Osei-Asibey & Wulnye, 2011).

Ghartey-Ampiah (2006) revealed that, many nations have been contending with the type of scientific literacy appropriate for its citizens and the extent to which they must learn Science at the various levels of education in order to produce citizens who are creditably scientific literate. There are two perspectives of scientific literacy. Holbrook and Rannikmae (2009) suggest two schools of thoughts: those who advocate a central role for the knowledge of Science; and those who see scientific literacy as referring to society's usefulness. The first school of thought seems to be very prevalent among Science teachers today who limit scientific literacy to the intellectual components (content of Science). The second school of thought comprises the longer-term view, which sees scientific literacy as a requirement to be able to adapt to the challenges of a rapidly changing world. Implying that scientific literacy is for all and having little to do with science teaching focused on career in science. Further, as the knowledge centered perspective emphasises the acquisition of knowledge transmitted through language as preparation for individuals to engage in social activities, the long-term perspective emphasises the use of language as the means for individuals to participate in social activities that employ knowledge (Brown, Reveles & Kelly 2005). These social activities are practical activities that teachers should carry out in their classrooms.

Given the subject matter of Science, it is obvious that learning Science should involve seeing, handling and manipulating real objects and materials (Millar, 2004). According to Acquah (2013) the recent educational reforms in Ghana aim at equipping learners with basic practical skills in Science, thus teachers are encouraged to use practical activities to enable pupils acquire the needed practical skills. However, due to teachers' use of the lecture method, they are not able to involve learners in practical activities, which is detrimental to pupils' acquisition of scientific literacy. In support to this, other descriptions are that the Ghanaian

classrooms are characterised with notes taking and sometimes a practical examination at the end of basic school; whole class teaching at all levels, in spite of the curriculum advising otherwise (Ottenvanfer, Van Den Akker & Feiter, 2005; Akyeampong, 2003; 2017). Additionally, the impact study of the World Bank (2004), on primary education in Ghana revealed that about only a third of teachers use learner-centred approach. Millar (2004) opined that practical experience of observing and intervening in the world is essential to understanding. Even if students are to acquire knowledge related to Science, they still need to engage in practical activities to ensure that the knowledge acquired has a solid foundation to future studies. Doing Science, as opposed to simply hearing or reading about it, engages students and allows them to test their own ideas and build their own understanding (Ewers, 2001).

Every country aims at assisting its citizenry to attain scientific literacy and Ghana is no exception. The curriculum document from the Ministry of Education [MoE] (2012), indicates the attitudes Ghanaian Basic School pupils need to develop through the study of Science. These attitudes are curiosity, perseverance, flexibility in ideas, respect for evidence, and reflection. The process skills that it intends learners to acquire include planning, designing an experiment, observing, manipulating, measuring, evaluating, generalising, and communicating. For each sub-topic in the basic school Science curriculum document, expectations in the form of specific objectives are stated with suggested activities as a guide for the teacher. It is these specific objectives, which are expected to reflect the different percentage weights of profile dimensions as specified in the curriculum. The curriculum also has general objectives for each section (major topic) to guide the teacher. There are also suggested activities to enable children engage in reflective thinking, and hands-on learning, as well as perform experiments. The goal is to promote the acquisition of higher-order thinking skills, and science attitude and process skills in pupils (MoE, 2012).

Ghartey-Ampiah (2006) carried out a research checking on the specific objectives in the Basic School Science curricula and the profile dimensions using the 2002 basic school curriculum, and found out that there was disparity between the profile dimensions stipulated by the curriculum developers and the objectives in the Ghanaian Basic School Science syllabus. Due to reforms in education, the basic school curriculum underwent reviews in 2007 and 2012. However, it seems no research has been conducted to examine how the 2012 science curriculum matches the profile dimensions stipulated by curriculum developers in Ghana. The purpose of the study was therefore to identify specific objectives for Science literacy related to the three profile dimensions specified in the 2007/2012 primary and Junior

High School (JHS) Science curricula and to calculate the percentage of these specific objectives, which reflect the three profile dimensions. The research questions that guided the study were:

1. What proportion of specific objectives address the three profile dimensions in the primary and JHS Science curricula?
2. What is the distribution of the three profile dimensions across grade levels in the primary and JHS Science curricula?
3. What proportion of specific objectives in the evaluation exercises address the three profile dimensions in the primary and JHS Science curricula?

The Ghanaian Basic School Science curriculum

Currently, the Ghanaian Basic School Science curriculum is taught at the lower primary, upper primary and JHS, also classified as grades 1 to 3, grades 4 to 6 and grades 7 to 9, respectively. The first six years is divided into lower primary (3 years) and upper primary (3 years). From grades 1-3, Science is taught as Natural Science and from grades 4-9 it is taught as Integrated Science. In the 2002 syllabus, Science was taught from grades 4 – 9. It was in the 2007/2012 syllabuses that the new designation, Natural Science, was introduced.

The Basic School Science curriculum spells out that, the Science course at this level is to inculcate scientific literacy and culture for all people to make informed choices in their personal lives and approach challenges in the workplace, home and in the environment in a systematic and logical order. The curriculum developers further indicated that, for a meaningful scientific education that develops adequate scientific literacy in children, it is important for pupils to be trained in the investigative process of seeking answers to problems. This requires pupils to physically explore and discover knowledge within their environment and in the laboratory to be able to contribute new scientific principles and ideas to the body of knowledge already existing in their culture (MoE, 2012). This is appropriate because scientific literacy is not only about subject content knowledge but also about critical thinking, cognitive and metacognitive abilities, and communication to share understandings to persuade others (Yore, 2001). It also implies that the 2012 Basic School Science curriculum emphasises both sociological and knowledge-centered perspectives of scientific literacy- comparatively, this is an indication of improvement in the curriculum, because the 2002 curriculum only emphasised knowledge-centered perspective of scientific literacy (MoE, 2012; Ampaih-Ghartey, 2006).

Further, the curriculum document does not specify exactly the level of standards pupils are required to achieve in order to be scientifically literate at the basic

school level. It rather spells out the pre-requisites skills required to study science effectively at the basic school level. For instance, for successful study of Natural Science and Integrated Science at the primary levels of Ghana's education, the pupil should have good observation and communication skills. It is also indicated that children who have gone through studies in Environmental Studies at kindergarten will benefit greatly from this subject. The pre-requisite skills needed to study Integrated Science at the JHS level include an average performance in Integrated Science and Mathematics at the upper primary, which emphasises observational and communication skills (MoE, 2012).

The content of the Basic School Science syllabus covers the basic Sciences includes topics in Health, Agriculture and Industry. The course has been designed to offer a body of knowledge and skills to meet the requirements of everyday living and provide adequate foundation for those who want to pursue further education and training in Science and Science related vocations. The syllabus describes clearly what action verbs constitute each component of the three profile dimensions. Knowledge and Understanding/Comprehension has: list, identify, recall, name and rewrite. Application of knowledge has verbs such as plan, classify, appraise, generate and demonstrate, while attitude/experiment and process skills have verbs such as communicate, record, infer, design and perform.

The syllabus also spells out the profile dimensions expected of pupils, which is a collection of psychological units for describing a particular learning behaviour (MoE, 2012). The profile dimensions for the primary level are classified under; knowledge and understanding, application of knowledge and attitude and process skills. The expected profile dimensions stipulated for the teaching, learning and testing in the Ghanaian lower and upper primary Science syllabi and their respective weights are:

- Knowledge and understanding 20%
- Application of Knowledge 20%
- Attitudes and Process Skills 60%

This shows the relative emphasis that the teacher should give in the teaching, learning and testing. As indicated above, 'Knowledge and understanding' and 'Application of knowledge' have equal weightings (20%), which is lower than the weight for 'Attitudes and Process skills' (60%). This means that the third dimension is considered more important and will therefore need more emphasis in the teaching and testing system.

The dimensions for teaching, learning and testing in Integrated Science at the JHS and their respective percentage weights are as follows:

- Knowledge and Comprehension 20%
- Application of Knowledge 40%
- Experimental and Process Skills 40%

Each of the dimensions above have a percentage weight of objectives that should reflect in teaching, learning and evaluation activities. The weights have a high inclination of the profile dimensions towards “*Application of knowledge*” and “*Experimental and Process Skills*” with equal percentage weights of 40%. This implies that the second and third dimensions are considered more important and will therefore need more emphasis in the teaching and testing system. Knowledge and comprehension was the least weighted with a percentage of 20%.

Examining both curricula, emphasis is on attitude and process skills for the primary level than application of knowledge and knowledge and understanding. For the JHS emphasis is on application of knowledge, and experimental and process skills. The difference in the emphasis on the different profile dimensions is to ensure that at the primary level pupils are equip with the necessary process skills and attitudes that will provide a strong foundation for further study in science and to introduce them to the enquiry processes of Science. The emphasis at the JHS level is to get pupils to physically explore, discover and apply scientific knowledge (MoE, 2012). This is to get pupils to be actively involved in the teaching and learning process. Pupils construct an understanding of the world around them through their experiences (Piaget, 1954). Knowledge is therefore, not a mirror of the world but is created or ‘constructed’ from an individual’s continuous revision and re-organisation of cognitive structures in conjunction with experience (Piaget, 1954). Pupils also develop understanding of future theorems due to exposure to intuitive situations (Bruner, 1966).

Methodology

The research designed used for this study was the qualitative descriptive design and data was collected through the use of document analysis. All Science curriculum materials, which included the Natural Science syllabus for lower primary, and the Integrated Science syllabuses for both upper primary and JHS were used for the study. In total, 67 units for both primary level and 145 units for the JHS level were used. The specifications of the various specific objectives reflecting the three profile dimensions in the Science curricula were done individually by the researchers and later compared for validity of data analysed. The entire Basic School Science curricula were examined to sort out the specific

objectives under the three profile dimensions in order to determine whether the stated specific objectives prescribed within the curricula reflects the actual profile dimensions generated from the document analysis.

The Science syllabuses for the Ghanaian Basic School Level was critically examined and based on the main verbs of the specific objectives stated, the researchers carefully placed the objectives stated under the three main profile dimensions. The specific objective related to a profile dimension was examined by the definitions contained in the curricula. For example, “state” is classified under knowledge and comprehension and so, as many times this word appeared in the specific objectives, it is counted as such.

All the actions verbs noted in the specific objectives were compared to the actions verbs stated under each profile dimensions as indicated in the science syllabus, but there were few action verbs like *relate*, *mention*, *determine*, *write*, *define*, *test*, *group* and *perform*, which were contained in the specific objectives but not stated in the curriculum to describe any of the profile dimensions. Clarity was sought from the teaching/learning activities for the meaning of the action verbs as a way to facilitate how they should be classified under the three profile dimensions. Analysis were also made on the suggested evaluation exercises cited in the Basic School Level Science syllabus and also classified under the three profile dimensions based on the specific action verbs used in the evaluative statements. The data generated were analysed using descriptive statics and frequency counts, simple percentages and bar graphs were used in presenting the results.

Results and Discussions

Proportion of specific objectives addressing the three profile dimensions in the Primary Science curricula

The document analysis showed that the Primary Science curriculum has a total of 67 units (subtopics) with 252 specific objectives and 120 suggested evaluation exercises spread across primary 1 to primary 6. Primary 3 has the most subtopics (16) followed by primary 6 (14), primary 5 (11), primary 1(10), primary 4 (9) and primary 2 (7).

After critically examining the specific objective in the 2012 Science curricula, a summary of how the specific objectives across the Primary Science curriculum match the intentions of the curriculum developers in terms of the three profile dimensions was obtained. The said intentions are presented in Table 1.

Table 1: Actual percentage weights of the three profile dimensions in the Primary Science curriculum

Profile Dimensions	N _e	Percentages (%)
Knowledge and Understanding	164	65.08
Application of Knowledge	57	22.62
Attitudes and Process Skills	31	12.30
Total	252	100

Considering the intentions of the curriculum developers and what actually pertains in the curricula, as shown in table 1 there is a clear mismatch. The figures from Table 1 show that knowledge and understanding in the Primary Science syllabus is more than what the curriculum developers intended it to be. Instead of it being 20%, it shot up to 65.08 %, indicating an upward disparity of 45.08%. The dimension, “application of knowledge” which is expected to be also 20% in the dimension was also more than the expected, showing 22.62% weightings. The last dimension, which is ‘attitudes and process skills’ had the least of weightings. Instead of the expected 60% weight, the actual was 12.30%, indicating a large disparity of 47.70% decline.

As clearly displayed, the document analysis shows that the emphasis is heavily tilted toward the acquisition of knowledge and understanding. Knowledge and understanding in the curriculum is more than what the curriculum developers intended it to be, that of application of knowledge is little more whilst the percentage weighs of attitude and process skills is far less than intended in the Primary Science curriculum. Figure 1 is the graphical presentation of the expected percentage weights against the actual percentage weights.

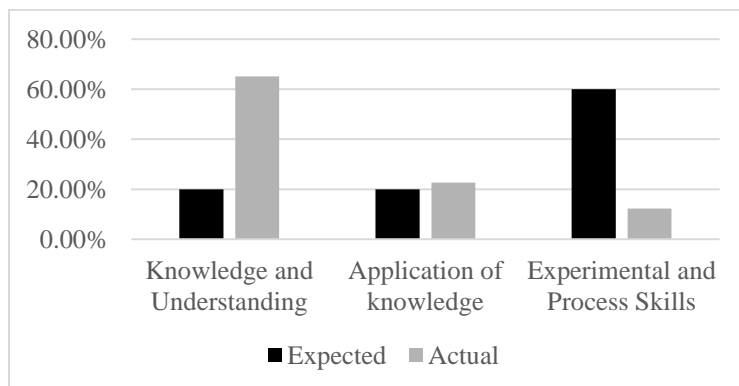


Figure 1: *Expected and Actual percentage weights of profile dimensions in Primary Science curriculum*

The proportion of specific objectives on attitudes and process skills is the least (12.3%) even though it should have been the highest (60%). This finding is consistent with that of Ampiah-Ghartey (2006). In his study of the 2002 basic school science curriculum, it came to light that more emphasis had been placed on knowledge and understanding than the other two dimensions (application of knowledge and attitude and process skills). If the expectation of the curriculum developers was to get primary pupils to be more scientifically literate, that is, to have more scientific attitudes and be also vexed in the process skills of science, it cannot be effectively achieved using the objectives stated in the Ghanaian Primary Science curricula. It would rather be better if the objectives of the curriculum developers were to inculcate more knowledge and understanding into pupils, this is in line with Holbrook and Rannikmae (2009) first school of thought, where scientific literacy is limited to intellectual components. However, according to Piaget (1954) pupils construct an understanding of the world around them through their experiences. Scientific literacy is not only about subject content knowledge but also about critical thinking, cognitive and metacognitive abilities, and communication to share understandings to persuade others as indicated by (Yore, 2001). Analysis of the objectives to determine how they measure up to the profile dimensions has shown a great inclination of the specific objectives in the syllabi towards knowledge and understanding with a distinctive percentage of 65.08%. The MoE also, emphasised that pupils need to learn by exploring the environment through planning, designing and discovering.

Distribution of the three profile dimensions across grade levels in the Primary Science curriculum

The proportion of knowledge and understanding, application of knowledge and attitudes and process skills across class levels in the Primary Science curriculum is shown in the table 2. The curriculum contains 164 specific objectives on knowledge and understanding from primary1 to primary 6.

Table 2: Distribution of percentage weight for profile dimensions across each class level

Profile dimensions	PRY. 1		PRY. 2		PRY. 3		PRY. 4		PRY. 5		PRY. 6	
	N _o	%	N _o	%	N _o	%	N _o	%	N _o	%	N _o	%
Knowledge and understanding	22	66.6	20	47.6	25	53.2	31	79.5	39	75	27	69.2
Application of knowledge	5	15.2	11	26.2	15	31.9	7	17.9	11	21.2	8	20.5
Attitudes and Process skills	6	18.2	11	26.2	7	14.9	1	2.6	2	3.8	4	10.3

It can be seen from table 2 that a greater emphasis has been placed on knowledge and understanding in the Primary Science curriculum than attitude and process skills. This implies that emphasis on knowledge and understanding is relatively over emphasised across the primary curriculum. For instance in primary four, five and six, the percentage weightings on knowledge and understanding were 79.5%, 75% and 69.2% respectively instead of 20%. Then attitudes and process skills, which was supposed to be 60% were rather 2.6%, 3.8% and 10.3% respectively. The idea of promoting attitudes and process skills above knowledge and understanding and application of knowledge is therefore not supported by the distribution of profile dimensions across class level as shown in the table 2. However, the disparity between the intended application of knowledge (20%) and that of the actual was not so great with the exception of that found in primary One(15.2%), two (26.2%) and three (31.9%).

Proportion of specific objectives in the evaluation exercises that address the three profile dimensions in the Primary Science curricula

For effective teaching and assessment, the curriculum developers' intention on the assessment of students on what has been taught, is for teachers to select some of the objectives within the unit and sections, and be able to develop test items that perfectly reflects the importance of the various skills taught in class. An inference can be made that since the emphasis of the specific objectives do not reflect the expected percentage weights of the profile dimensions, it is also likely that teaching and assessment will not follow the expected relative percentage weight if teachers go strictly by the specific objectives for each topic.

Scientific literacy as described in the curriculum demands more emphasis on open ended activities that helps pupils to inquire relevant Science questions; provide opportunities for discussions among students; promoting critical thinking,

experimental skills, and its application to new situations; skills investigation; encourage data analysis and communication among others. All these could be achieved if emphasis is placed on application of knowledge and attitudes and process skills.

The curriculum suggested exercises for evaluating each sub-topic. However, analyses of these exercises under the profile dimension showed that they were dominantly on knowledge and understanding (80%) followed by application of knowledge (19.8%) and attitudes and process skills (4.2%) in the Primary Science curriculum. Table 3 shows the various percentages.

Table 3: Summary of profile dimensions of the evaluation exercises

Dimensions	No. of evaluation exercises	Percentages
Knowledge and understanding	96	80%
Application of knowledge	19	15.8%
Attitudes and process skills	5	5.2%

Table 3 clearly shows that strong emphasis is being placed on knowledge and understanding in these exercises, which does not reflect the intentions of the curriculum developers. According to the curriculum developers, these suggested exercises and similar ones to be used by teachers are expected to challenge students to apply their knowledge to issues and problems as well as encourage them to develop solutions, and positive attitude towards Science. This view demands that more emphasis should be placed on attitudes and process skills in suggested exercises meanwhile the curriculum developers placed more emphasis on knowledge and understanding per the objectives in the syllabus. If teachers should go strictly by the stated objectives then the level of application of knowledge, and attitudes and process skills indicated by the MoE (2012) would not be successfully achieved. The evaluation exercises need to be considered if students' experience with science is to be complete and fulfilling (BouJaoude, 2002).

However, the Primary Science curriculum contains good examples of evaluation exercises as shown in Box 1.

Pupils to draw a simple electrical circuit and label the parts.

Box 1. Example of suggested evaluation on "Electrical circuit"

Source: MoE (2012)

Some of the evaluation exercises in the Primary Science curriculum also help the pupils to develop critical thinking. An example is shown in Box 2.

What is the difference between luminous and non – luminous bodies?
Explain why a kicked ball moves and slowly comes to a stop.

Box 2. Some typical examples of suggested exercises

Source: MoE (2012)

The suggested exercises in the Science curriculum in box 2 provide students with opportunities to develop their critical thinking in Science.

Proportion of specific objectives addressing the three profile dimensions in the JHS Science curricula

The analysis of the JHS Integrated Science syllabus revealed that the curriculum has a total of 145 subtopics, 194 specific objectives and 134 suggested evaluation exercises. The specific objectives were analysed and placed under the various profile dimensions as indicated in the syllabus. This was to find out whether the weightings of the actual specific objects would match numerically and relatively, to the expected weightings in the curriculum. Table 4 shows a summary of the actual percentage weightings the specific objectives stated in the 2012 syllabus generated.

Table 4: Actual percentage weights of the three profile dimensions in the JHS science curriculum

Profile Dimensions	No.	%
Knowledge and Comprehension	120	61.9
Application of Knowledge	62	31.9
Experimental and Process Skills	12	6.2
Total	194	100

Data presented in Table 4 shows a mismatch between the actuals profile dimensions in the JHS Science curriculum and the expected profile dimensions spelt out in the curriculum. The dominant profile dimension as seen on the table is “Knowledge and Comprehension” with a high percentage of 61.9%, constituting 120 objectives out of the total 194 objectives in the curriculum. This is a clear mismatch against the expected 20% weightings on the Knowledge and Comprehension. The next profile dimension in terms of magnitude was

application of knowledge with a rating of 31.9% instead of the expected 40%. Objectives for “Experimental and process skills” counted were 12 representing 6.2%. This is the least of all the specific objectives indicated in the syllabus, but the curriculum developers placed a higher expected rate of 40% on this profile dimension. In general, the content analysis shows that the emphasis is heavily tilted toward the acquisition of knowledge and comprehension. The amount of knowledge and comprehension in the curriculum is more than what the curriculum developers intended it to be whilst the percentage weights on application of knowledge and experimental and process skills is little less than intended in the JHS Science curriculum. This data was also graphically presented in Figure 2 to overtly emphasise the disparity discussed.

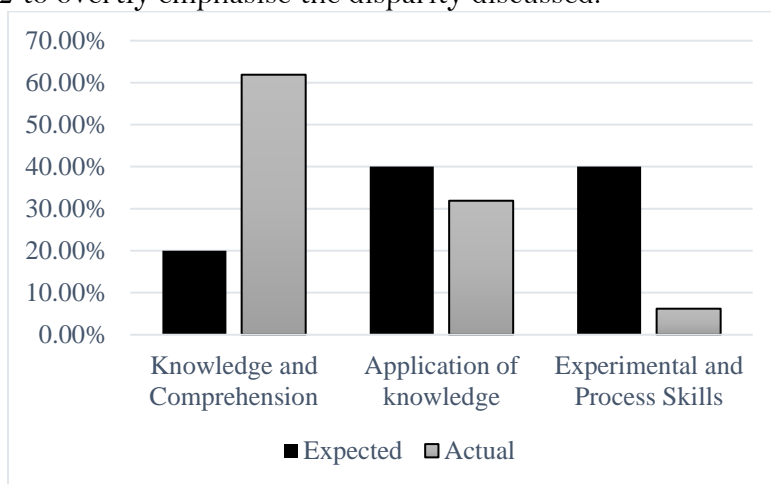


Figure 2: Expected and Actual percentage weights of profile dimensions in JHS Integrated science curriculum

If the expectation of the curriculum developers was to get JHS pupils to be more Science literate by being experimentally oriented and being able to communicate scientifically, then that cannot be achieved with such a percentage weighting on the experimental and process skills. Scientific literacy as described in the curriculum demands more emphasis on open-ended activities that requires relevant Science questioning. Some of these are providing opportunities for discussions among students; promoting critical thinking, developing experimental skills and its application to new situations; promoting investigation skills; encouraging data analysis and communication among others. This could be possible if much emphasis is placed on profile dimensions of application of knowledge and experimental and process skills. Every Ghanaian student must possess some level of scientific literacy (Osei-Asibey & Wulyne, 2011), which included all the three dimensions with specific emphasis on experimental and

process skills as well as application of knowledge and not only the acquisition of knowledge. Yet with such high weightings on knowledge and comprehension the expected level of scientific literacy would not be attained by JHS students. These findings is consistent with Acquah's (2013) view that teachers' inability to use practical activities in their science lessons is detrimental to pupils' acquisition of scientific literacy.

Distribution of the three profile dimensions across grade levels in the JHS Science curricula

The proportion of knowledge and comprehension, application of knowledge and experimental and process skills across class levels in the JHS Science curriculum was also examined to see the weightings of the profile dimensions across the three grade levels. The findings obtained are showed in table 5;

Table 5: Distribution of percentage weightings of profile dimensions across the three JHS levels

Profile dimensions	JHS 1		JHS 2		JHS 3		TOTAL No.
	No.	%	No.	%	No.	%	
Knowledge and comprehension	39	59.1	51	60	30	69.77	120
Application of knowledge	23	34.84	28	32.95	11	25.58	62
Experimental and Process skills	4	6.06	6	7.05	2	4.65	12
Total	66	100	85	100	43	100	194

The JHS Science curriculum contains 194 specific objectives spread across the 3 JHS levels. In all the 3 classes the profile dimensions of knowledge and comprehension dominated from JHS1 to JHS 3 with percentage weightings of 59.1%, 60.0% and 69.77% respectively. This was followed by the dimensions of application of knowledge with percentages of 34.84%, 32.95% and 25.58% for JHS 1, 2 and 3 respectively. Experimental skills which ideally was supposed to reflect equal levels of distribution with application of knowledge was invaluablely the least of all the specific objectives stated showing 6.06% for JHS1, 7.05% for JHS 2 and 4.65% for JHS. The emphasis at the JHS level is to get pupils to physically explore, discover and apply scientific knowledge (MoE, 2012), which involves the use of experimental skills. However, with emphasis on knowledge and understanding the Science syllabus will not get pupils to be actively involved in the teaching and learning process.

Proportion of specific objectives in the evaluation exercises that address the three profile dimensions in the JHS Science curricula

For effective teaching and learning, assessment of students' knowledge on what has been taught, cannot be downplayed. Assessment is intertwined with the teaching and learning process such that, the feedback it provides affects both teaching and learning processes. Curriculum developers expect teachers to develop test items that perfectly reflects the importance of the various skills taught in class. They further made suggestions on some evaluative exercises, based on the specific objectives stated. This presupposes that, the emphasis of profile dimension reflected in the specific objectives will affect the type of assessment items constructed. Therefore, the researchers also examined the suggested assessment exercises in the syllabus to see how they reflect the expected profile dimensions in the syllabus.

The analysis of the exercises in the 2012 Integrated Science Syllabus for JHS showed a total of 134 exercises spread across the grade levels. Based on their action verbs these exercises were classified under the profile dimensions and their percentage weights measured. Table 6 reflects these data.

Table 6: Evaluation exercises

Profile Dimensions	No.	%
Knowledge and Comprehension	96	71.6
Application of knowledge	15	11.2
Experimental and process skills	23	17.2
Total	134	100

From the results obtained it can be seen that the exercises are clearly dominated by items on knowledge and comprehension with a dominant percentage of 71.6%, constituting 96 test items out of the 134 test items. This was followed by experimental and process skills with a percentage of 17.2% and lastly, application of knowledge with a percentage of 11.2% in the JHS Science curriculum. These exercises however do not reflect the intentions of the curriculum developers, which are to challenge students to apply their knowledge to issues and problems as well, encourage them to develop problem solving skills and positive attitude towards Science literacy. This notion demands that, emphasis on the suggested exercises should be placed on application of knowledge and experimental and process skills but instead the curriculum developers placed more emphasis on knowledge and comprehension. If assessment at JHS will promote the acquisition

of higher order thinking skills, and science attitudes and process skills in pupils then more sophisticated evaluation exercises than those associated with learner-centred approaches should be employed.

This notwithstanding, the JHS Science curriculum contains some good examples of evaluation exercises, which focused on application of knowledge and experimental and process skills. Boxes 1 and 2 show some examples of such evaluation exercises.

Box 1. Example of suggested evaluation on “Electrical energy”

Pupils to design and build an electrical circuit and display for class discussion

Source: MoE (2012)

Describe three properties of water.
Why is it advisable to wash clothes with soft water?

Box 2. Some typical examples of suggested exercises

Source: MoE (2012)

The suggested evaluation and exercises in boxes 1 and 2 suggested exercises in the Science curriculum provide students with opportunities to develop critical thinking towards science literacy.

Conclusion and Implications for Practice

The variations in the findings indicate mismatched weightings of the expected profile dimensions and the actual profile dimensions examined. The findings revealed that more emphasis was placed on knowledge and understanding in the specific objectives stated in the basic school primary and JHS science curriculum than the curriculum developers intended. The same findings were also seen across grade levels and in the evaluation exercises examined. When knowledge and understand is emphasised during instruction and assessment it tends to direct the curriculum towards teacher-centered instruction. Since textbooks and teaching and learning materials are also developed in line with the curriculum, it is likely they emphasises teacher-centered pedagogy. Teacher-centered instruction is described as a situation where learners passively receive information. Here, emphasis is on acquisition of knowledge, and the teacher’s role is to be a primary information giver and primarily an evaluator (Huba & Freed, 2000). This finding

is consistent with the view of Holbrook and Rannikmae (2009) that those who advocate a central role for the knowledge of Science seems to be very prevalent among Science teachers today. Reports from Ghanaian research studies, consistently describe the pedagogy that actually dominate the classroom as: largely traditional, teacher-centred and content-driven (Ottenvanfer et al., 2005; Akyeampong, 2003; 2017). Other descriptions are that the Ghanaian classrooms are characterised with notes taking and sometimes a practical examination at the end of basic school; whole class teaching at all levels, in spite of the curriculum advising otherwise (Ottenvanfer et al., 2005; Akyeampong, 2003; 2017). Additionally, the impact study of the World Bank (2004), on primary education in Ghana revealed that about only a third of teachers use learner-centred approach.

If the teaching of science at the basic school level is to make students scientific literate then the enquire approach to instruction should be used since it employs activities that are related to application of knowledge, and attitude, experimental and process skills. The Curriculum Research and Development Division of the Ghana Education Service should review the basic school science curriculum and make it to be in line with the profile dimensions if they really want to create students who are scientific literate.

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