NATURAL SCIENCE TEACHERS' CURRICULUM KNOWLEDGE: A CASE IN THE GOMOA EAST DISTRICT OF THE CENTRAL REGION, GHANA

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Abstract

The main purpose of the study was to explore Natural Science teachers' curriculum knowledge in the Gomoa East District of the Central Region of Ghana. A cross sectional descriptive survey design was used adopting a mixed method sequential explanatory approach. Data was collected through an adapted instrument namely Natural Science Teachers' Curriculum Knowledge (NSTCK) questionnaire which was administered to 232 Natural Science teachers. The quantitative data were analysed using frequency counts and percentages. Semi-structured interview guide was used to collect qualitative data from ten teachers, which was analysed thematically to support the quantitative data. The findings revealed that, majority of the teachers had low knowledge of the Natural Science curriculum and organization of the Natural Science curriculum. It was recommended that in-service programmes, workshops, seminars and short courses should be organized on the Natural Science curriculum to improve teachers' knowledge of the Natural Science curriculum.

Key words: *Natural Science teachers, curriculum knowledge, Natural Science curriculum, Science education*

Introduction

Recent reforms in Science education aims at preparing individuals for the rapidly developing and advancement of technology and industrialization all over the world. This is evident in the 2007 educational reforms in Ghana, which aimed,

among other things, to equip children with the necessary process skills and attitudes that will provide a strong foundation for further study in Science at the upper primary level and beyond. As well as provide the young person with the interest and inclination toward the pursuit of scientific work through developing the spirit of curiosity, creativity and critical thinking (Curriculum Research and Development Division [CRDD], 2007). The government white paper on the Anamuah-Mensah's Educational Review Report in 2002 expanded Universal Basic Education to include two years of Kindergarten. The 2007 educational reforms placed much emphasis on the study of Science right from the kindergarten level by incorporating Science concepts into the environmental studies syllabus (Government of Ghana, 2002). With particular reference to Science education, the reforms absorbed the Environmental Studies, which was taught at the lower primary into the kindergarten curriculum and replaced it with Natural Science. Integrated Science was introduced at the upper primary (4-6) and the Junior High School level respectively.

Curriculum innovations present enormous challenges to teachers who have to quickly adjust to the new content of the curriculum, instructional approaches, materials as well as assessment strategies. The introduction of Natural Science in the Science curriculum reform in 2007 replaced the Environmental Studies at basic one to three. This has a number of implications for teachers. Most teachers at the lower primary are classroom teachers who teach all the subjects in the class. They are mostly generalist teachers from the colleges of education who may not be conversant with the Natural Science content. In other words, most teachers at the lower primary level are not specialist Science teachers. This will therefore pose a major challenge to teachers and they will have to learn the content of Science and adjust to teaching approaches required by the curriculum. The new instructional strategies that are outlined in the curriculum means that teachers have to significantly shift from their old ways of teaching. That is from teacher-centred instructional approaches to leaner-centred approaches if the Natural Science curriculum has to be implemented in the classroom as recommended. The curriculum emphasized enquiry processes of Science teaching (CRDD, 2007). These processes are learner-centred but instructional approaches in Ghanaian Science classrooms are mostly teacher-centred (Ngman-Wara, 2011; Osei, 2004).

Teachers are considered to have a critical role for the realization of the ideas, aims and goals outlined in the Natural Science curriculum (Isler & Cakiroglu, 2009). No matter what the curriculum suggests, it is the teacher who makes the ultimate decisions about what goes on in the classroom, so the teacher has a critical role in the implementation of the Natural Science curriculum. Whenever new content is

introduced into the existing curriculum, there is always a natural apprehension by teachers to accept the proposed change. There is always a feeling of inadequacy in the teacher about his/her teaching method and/or his/her job insecurity (Fullan, 2007). Such imposed curriculum changes have often led to low level of self-efficacy and eventually failed curriculum implementation.

Since the Natural Science curriculum is a new curriculum innovation introduced into the education system of Ghana in 2007, it is important to study teachers' knowledge of all aspect of the curriculum. As stated earlier, in-service teachers may face a number of problems in implementing curriculum innovations. They may not be conversant with the Natural Science curriculum content and demands if they are not well briefed on it before its implementation. They may be required to learn the contents and shift from their old ways of teaching to the new instructional approaches of the new curriculum. It is therefore important for in-service teachers to be conversant with the curriculum content, pedagogy, objectives and assessment strategies. Therefore, in order to bring about effective implementation of curriculum innovation, it is important to narrow the gap between the intended and the enacted curriculum and assist teachers cope with the innovation. It is necessary to resolve the problem of how Natural Science teachers' curriculum knowledge shapes the implementation of the intended Natural Science curriculum. There are limited studies on Science teachers' curriculum knowledge in Ghana (Appiah, 2015). Also, it seems there is no study on Natural Science teachers' curriculum knowledge in the Gomoa East District of the Central Region of Ghana. This study therefore aimed at bridging this gap. To do this, the following research questions were formulated to guide the study:

1. What is the Natural Science teachers' knowledge of the Natural Science curriculum materials?
2. What is the Natural Science teachers' knowledge about the organization of the Natural Science curriculum?

Related Literature

The theoretical framework underpinning the study was hinged on Shulman's theory of pedagogical content knowledge (PCK). PCK involves the combination of content and appropriate pedagogy to understand how topics and issues are organized, represented and adapted to the diverse interests and abilities of learners for effective instruction (Shulman, 1987). The curriculum and its associated materials and pedagogy from which the teacher draws tools for

teaching a particular content and assessment of the students' performance represents teacher curriculum knowledge (Shulman, 1986). According to Shulman, when teachers possess adequate curriculum knowledge of content structure of the subject matter and specific pedagogical approaches associated with the subject matter, they tend to be more effective in their teaching.

Diamond, Maerten-Rivera, Rohrer and Lee (2013) are of the view that teacher curriculum knowledge can have a direct effect on student learning and indirect effect on PCK. Studies however suggest that elementary school teachers tend to have major gaps in their Science curriculum Content Knowledge (SCK) and that these gaps are a major obstacle to effective teaching (Nowicki, Sullivan-Watts, Shim, Young, & Pockalny, 2013). This is largely as a result of poor Science preparation in pre-service teacher programmes (Diamond et al., 2013) and inadequate in-service training for practicing teachers (Leu & Ginsburg, 2011). Kahan, Cooper and Bethea (2003) stated that researchers frequently conclude that students' would learn more Science if their teachers knew more Science. Kallery and Psillos (2001) also found that teachers' content knowledge influenced the way in which they represented the content to students. However, "content knowledge in the subject area alone does not suffice for good teaching" (Kahan, Cooper & Bethea 2003, p.223). Researchers have established that teachers may feel uncomfortable teaching Science to children due to their lack of content and pedagogical knowledge. This would hinder their ability and motivation to create meaningful Science experiences for children (Watters, Diezmann, Grieshaber, & Davis, 2001; Fayez, Sabah, & Oliemat, 2011). Garbett (2003) and Hedges (2003) suggested that it is essential for teachers to develop vast Science content knowledge base to support children's scientific thinking.

According to Tekkaya, Cakıroglu and Ozkan (2004), even though pre-service primary teachers often feel confident in their teaching of Science, they can have poor knowledge and understanding of scientific concepts. Khwaja (2002) found that weak content knowledge contributes to low self-efficacy and poor pedagogical skills. This implies that, teacher's self-efficacy can be undermined and this can cause them to avoid teaching Science, or to do so in more instructional ways, such as using a textbook, placing heavy reliance on kits and worksheets, avoiding practical work and depending on the assistance of external experts (Grossman, Wilson & Shulman, 1989). Primary teachers' inadequate content knowledge and understanding of Science therefore may affect their teaching methodologies and their ability to teach Science effectively (Murphy & Smith, 2012; Harlen, 2013).

Research on teacher content knowledge indicates that teacher's knowledge of subject content influences the teacher's instructional practices across subject areas and at different grade levels (Brophy, 1998; Lee, 1995; Shulman, 2000). In contrast, teachers with inadequate content knowledge rely heavily on the textbook as the primary source of subject matter content (Feiman-Nemser, 2001) and tend to minimize students' participation in a class discussion. This means that teachers' content knowledge and pedagogy shape how the teacher might respond to students' questions and inquiries as the lesson unfolds in the Science classroom (Crawford, 2007). Also, if the teachers' knowledge of other curricular demands are inadequate to meet the new content associated with curriculum innovations, then they may be reluctant to implement it (Ngman-Wara, 2011). Therefore, in order to ensure successful implementation of the Natural Science curriculum, which is a curriculum innovation in Ghana, there is a need to consider factors such as curriculum knowledge of the Natural Science teacher. Teachers should know how to teach their students by focusing on subject matter, content, and incorporated pedagogy to achieve classroom objectives. There is a need for Natural Science teachers to combine knowledge in content and pedagogy to effectively teach Natural Science in their classrooms.

There are studies that attempted to directly study teachers' knowledge of Science curriculum. For example, Voss (2014) and Nuangchalerm (2011) found that knowledge of curriculum was an essential component of pre-service teachers' pedagogical reasoning around lesson planning and instruction. Also, there is a limited study of teachers' existing Science curriculum knowledge and its relationship to planning and instruction (Abell & Lederman, 2007). The teacher's activities in the classroom come from the decisions taken during both the planning and implementation (Voss, 2014). These decisions depend on the teacher's knowledge in pedagogical strategy and content knowledge, curriculum knowledge, knowledge of the students' understanding of the topic and knowledge of specific methods suiting the cognitive goals to be achieved.

The Ghanaian Natural Science curriculum requires the teacher to carefully study the syllabus and plan ahead the activities the pupils will carry out during particular periods (CRDD, 2012). Natural Science teachers' curricular knowledge is an important factor influencing the methods a teacher selects prior to instruction and assessment. According to Harris and Sass (2011), years of teaching experience in the classroom was the only teacher factor found to improve teachers' curriculum content knowledge and student learning. However, Ngman-Wara (2015) found that no statistically significant relationship exists between Science teachers' years of teaching experience and their knowledge of contextualized

Science instruction. Other studies emphasized that curriculum knowledge was influenced by practice and experience (Marton, 2014; Marton & Pang, 2006).

The more experience the teachers gather in the classroom, the more the teachers get acquainted with the curriculum and also professional development programmes add to the teachers' curriculum knowledge base. This implies that professional qualification and continuous professional development as well as years of teaching may have influence on teachers' content knowledge of the Natural Science curriculum. Curriculum knowledge of Natural Science teachers is likely to influence the type of instructional approach they will adopt in their teaching. It therefore plays a critical role in their ability to successfully implement the 2007 Natural Science curriculum.

Methodology

Cross-sectional survey method was employed in the study. In cross-sectional studies, measures of variables are taken at the same time or in practice over a relatively short period of time (Robson, 2002). Sequential explanatory mixed method approach was adopted for the study. The sample for this study consisted of 232 Natural Science teachers who taught at the lower primary level (class 1- 3) in the Gomoa East District of the Central Region of Ghana at the 2016/2017 academic year. Purposive sampling technique was used to select all lower primary teachers in the District. The purposive sampling technique was used because, Natural Science is taught only at the lower primary, that is, primary one to three and lower primary teachers are classroom teachers and by extension, they teach Natural Science. So the teachers would be able to provide the information needed to achieve the objectives of the study. The sample was distributed among 10 circuits in the Gomoa East District; Obuasi (21), Afransi (30), Aboso-Benso (18), Ekwamkrom (23), Pomadze (26), Potsin (21), Buduatta (21), Ojobi (24), Bududuram (25) and Nyanyano (23). Out of the 232 Natural Science teachers, 28.9% (67) were males and71.1% (165) were females. Out of the 232 teachers, 10 were randomly sampled and interviewed.

The Natural Science Teachers' Curriculum Knowledge Questionnaire (NSTCKQ), which was adapted from Appiah (2015) was used to gather data for the study. The instrument sought to elicit information on the participants' knowledge on the Natural Science curriculum materials, including the rationale for teaching Natural Science, themes and topics outlined in the curriculum, suggested teaching strategies, other curriculum materials as well as knowledge of

organization of the curriculum. The Cronbach alpha value of the NSTCK questionnaire was 0.72 close to that of Appiah (2015), which was 0.77. This indicated that the instrument was reliable and therefore suitable for the study. The questionnaire was randomly administered and the participants were guaranteed confidentiality and anonymity. The participants completed the questionnaire within a day to prevent them from referring to the syllabus and other sources for information. Interview guide was used to collect qualitative data. The open-ended items allowed for further probing based on the responses given by the participants. The NSTCK data was analysed using frequency counts and percentages. Qualitative data were analysed using emerging themes to support the quantitative findings.

Results

Research Question 1: What is Natural Science teachers' knowledge of the Natural Science curriculum materials?

Table 1 summarises Natural Science teachers' knowledge of the Natural Science curriculum materials. The results indicate that 75.9% (176) of the teachers had the syllabus in their schools while 56.9% (132) teachers had the teachers' guide in their schools. In addition, 87.1% (202) teachers indicated that there were pupils' textbooks in their schools. Also, 72.8% (169) teachers said they did not have charts and pictures in their schools for teaching Natural Science. Furthermore, as many as 92.7% (215) of the teachers said that they did not have other supplementary materials for teaching Natural Science. This means that majority of teachers had the main curriculum materials such as syllabus, textbooks and teachers' guide in their schools. However, greater number of them did not have other supplementary teaching and learning materials.

This is supported by the following excerpts from an interviewee:

> *"We have some materials but they are not sufficient. The whole upper primary had only one syllabus for science. We don't have a syllabus for lower primary. I also don't have teachers' guide. I don't also have charts. It involves money and if I want then, I have to use my own money. I only have one textbook and the children don't have textbooks. I sometimes go to the teacher in the next school to take her syllabus and use. And this is very difficult. The government should supply syllabus to us".* (T1, Interview)

Table 1: Natural Science teachers' knowledge of the Natural Science curriculum materials

Curriculum materials	Responses	Frequency	Percentage (%)
Type of curriculum materials in schools			
Presence of syllabus	Yes	176	75.9
	No	56	24.1
Presence of Teachers' Guide	Yes	132	56.9
	No	100	43.1
Presence of Pupils' textbook	Yes	202	87.1
	No	30	12.1
Presence of Charts/Picture	Yes	63	27.2
	No	169	72.8
Presence of Other materials	Yes	17	7.3
	No	215	92.7
No teaching –learning materials	Yes	4	1.7
	No	228	98.3
Topics in teachers' guide and textbook correspond to those in syllabus	Yes	171	73.7
	No	20	8.6
	Not sure	41	17.7
Teaching and learning activities in teachers' guide and textbooks correspond to that of syllabus	Yes	163	70.3
	No	22	9.5
	Not sure	47	20.3
Use of curriculum materials in lesson preparation and delivery	Yes	212	91.4
	No	20	8.6
How often materials are used for lesson preparation and presentation	Sometimes	44	19.0
	Often	33	14.2
	More often	25	10.8
	Always	119	51.3
	No response	11	4.7

Another interviewee asserted that:

> *"All the textbooks we have for children are torn. I think this is the best that we have so I am using it"* (Referring to an old Natural Science textbook). (T2)

Even though majority (91.4%) of the respondents indicated that they used curriculum materials in their lesson preparation and delivery, only about half of them (51.3%, 119) always used curriculum materials in their lesson preparation and presentation.

One interviewee stated:

> *"I don't have the syllabus but I have teacher's guide and textbook. I use the textbook and the guide for lesson preparation. We have about 10 textbooks for 36 pupils. I don't have charts and other materials"* (T6).

Only one interviewee had the syllabus, textbooks and the teachers' guide.

> *"Yes I have a syllabus, teachers' guide and textbooks. But all the textbooks are torn and so pupils don't have it"* (T7).

This means that some of the teachers teach without the use of curriculum materials such as syllabus, teachers' guide and textbooks. These situations are likely to have adverse effects on the implementation of the natural science curriculum especially in situations where the teachers do not have the complements of the curriculum materials. As to whether topics in the syllabus corresponded to those in the textbooks and teachers' guide, 73.7% (171) teachers responded in the affirmative. Furthermore, 70.3% (163) of the teachers indicated that, the learning activities in the textbooks corresponded to those of the syllabus while 20.3% (47) of the teachers were not sure whether the learning activities in the textbooks corresponded to those in the syllabus. For instance, one teacher asserted that during the interview that,

> *"I don't know whether the topics in the syllabus correspond with the ones in the textbook since I don't have any means to compare because we were not given syllabus but the office had been bringing us weekly forecast so at times we use that one"* (T6).

The teachers were not sure whether the activities in the syllabus corresponded to those in the textbooks, because some of them did not have all the materials. This situation could contribute to their lack of adequate knowledge of the curriculum especially where they do not also have an in-service training or workshop on the curriculum materials. This has implications for implementing the natural science curriculum.

Research Question 2: What is Natural Science teachers' knowledge about the organization of the Natural Science curriculum?

Research question 2 sought to find out Natural Science teachers' knowledge about the organization of the syllabus. The descriptive statistics on the responses are presented in Table 2. The results show that 83.5% (193) of the teachers were able to correctly give the number of themes of the natural science curriculum. Also, majority of teachers were able to name the themes of the curriculum. For example,

between 84% and 86.2% of the teachers correctly named all the themes of the curriculum. This means that majority of teachers have knowledge of the number of themes in the Natural Science syllabus.

Also, about 63% (145) of the teachers successfully mentioned the number of periods allocated for teaching natural science. Furthermore, with regards to the weights of the profile dimension of knowledge and comprehension, a little over half of the participants (52.2%, 118) correctly gave the weight for the dimension. Also, only 49.1% (111) of the teachers were able to provide the correct weight for application of knowledge while 48.4% (109) of the teachers gave correct weight for the profile dimension of attitude and process skills. This means that on the average, the teachers had low knowledge on the weights for profile dimensions specified for teaching, learning and testing. The implication is that, majority of the teachers are likely not to emphasize the weight of the profile dimensions in their teaching and assessment practices.

The natural science syllabus dictates that, the weight of the profile dimension of knowledge and understanding should be 20%, application of knowledge, 20% and attitude and process skills 60%. When asked how the profile dimensions influenced their teaching and assessment of Natural Science in the classroom, 13.3% (30) of the teachers responded that they are used to develop critical thinking skills among the pupils. Again, 7.9% (18) of the teachers said they used the profile dimensions because it is in the syllabus while 9.3% (21) of the teachers indicated that they helped them to know pupils' level of understanding of the content among others. However, the profile dimensions give a direction as to the relative emphasis that the teacher place on the teaching, learning and testing of the topics taught. Greater emphasis (60%) has been placed on "attitude and process skills" to give pupils the necessary scientific process skills to enable them build their store of scientific concepts and principles.

Also, 20% emphasis has been placed on knowledge and understanding and application of knowledge respectively. The results from teachers showed that they lacked knowledge on the essence of the profile dimensions. This is likely to have serious implications for Natural Science teaching and assessment. About 49% (114) of the teachers indicated that the instructional approach recommended for teaching Natural Science is pupil-centred approach while 10.3% (24) of the teachers said the recommended instructional approach is teacher-centred.

Table 2: Natural Science teachers' knowledge on the organization of the syllabus

Component		Correct Responses	Frequency	Percentage (%)
1.	Number of themes of natural science syllabus	5	193	83.5
2.	Identification of the themes	-		
	Diversity of matter	-		85.3
	Cycles	-	201	86.0
	Systems	-	200	86.2
	Energy	-	200	86.2
	Interactions of matter	-	195	84.1
3.	Number periods for teaching natural science	6	145	62.5
4.	Weight of profile dimension of Knowledge and Understanding	20%	118	52.2
5.	Weight of profile dimension of Application of Knowledge	20%	111	49.1
6.	Weight of profile dimension of Attitude and Process Skills	60%	109	48.4
7.	How the profile dimensions influence teaching of Natural Science	Develop critical thinking skills	30	13.2
		To know pupils ability to express themselves	20	8.8
		It is in the syllabus	18	7.9
		Helps to know pupils level of understanding	21	9.3
		To satisfy each profile dimension	24	10.6
8.	Instructional approach recommended in Natural Science teaching	Pupils centred	114	49.1
		Teacher centred	24	10.3
		Others	94	40.5
9.	Form of assessment recommended in Natural Science syllabus	Summative	51	22.6
		Formative	53	23.2
		SBA	128	54.2

*One participant did not provide a response.

However, about 40% (94) of teachers gave other responses such as experiments, investigation, demonstration, group work, etc. as the recommended instructional approach for Natural Science. This means that less than half of the teachers (49%) know that the recommended instructional approach recommended for teaching Natural Science is child-centred. Finally, a little over half (54.2%, 128) of the participants indicated School Based Assessment (SBA) as the recommended assessment approach followed by formative assessment (23.2%, 53) and summative (22.6%, 51). This means a good number of Natural Science teachers exhibited fair knowledge of the assessment approach recommended in the curriculum. The Natural Science curriculum recommends the use of both formative and summative assessment procedures based on the profile dimensions. However, the SBA forms an integral part of assessment in schools and it emphasizes more on practical aspect of assessment, which is expected to be administered over the term. This means that they are likely to implement the formative and summative assessments as well as the SBA effectively as outlined in the syllabus.

Results from the interview indicated that some teachers see the SBA as a form of test given to pupils and not practical assessment. For example, one participant asserted that:

> *I organize SBA by writing test on the board for them to answer. The SBA is okay because it helps me to know how my children are performing (T10).*

Another participant claimed that:

> *Every four weeks we assess the children to find out what we have taught them how they have understood and how best they can reproduce. So the SBA is a kind of periodic assessment which helps the teacher to know how the children are progressing or retrogressing (T2).*

This means that these teachers had fair knowledge about the SBA and other assessment approaches outlined in the Natural Science curriculum.

Discussion

The findings indicate that majority of teachers had the main curriculum materials such as syllabus, textbooks and teachers' guide in their schools. However, greater number of them (92.7%) did not have other supplementary teaching and learning materials. Also, it came to light that all teachers lacked at least one curriculum material or the other in their schools, which adversely affected their teaching and assessment. Furthermore, only about half of them 51.3% (119) always used curriculum materials in their lesson preparation and presentation. This means that

such teachers teach without the use of curriculum materials such as syllabus, teachers' guide and textbook. The curriculum is the key reference point for teachers, particularly in a developing country like Ghana, where it is encoded in the official textbook and teacher guides (Alexander, 2009). It therefore poses a major hindrance to effective teaching of Natural Science if teachers lacked these materials. Also, about 38% (87) of teachers did not know the number of periods allocated for teaching Natural Science while majority of teachers (71.1%, 165 & 58.2%, 135) did not know the number of periods allocated to the teaching of theory and practical respectively. This means that majority of teachers will teach without recourse to the dictates of the curriculum which states that four periods out of the total of six periods per week should be allocated to teaching practical while the remaining periods allocated for teaching theory (CRDD, 2007). Also, about 50% of the teachers did not know the weight of profile dimensions that have been specified for teaching, learning and testing. This is in line with Nowicki, Sullivan-Watts, Shim, Young and Pockalny (2013) view that elementary school teachers tend to have major gaps in their Science curriculum Content Knowledge. The Natural Science syllabus dictates that, the weight of the profile dimension of knowledge and understanding should be 20%, application of knowledge, 20% and attitude and process skills 60%. The implication is that, majority of the teachers are likely not to emphasize the weight of the profile dimensions in their teaching and assessment (CRDD, 2007). The profile dimensions give a direction as to the relative emphasis that the teacher should give in the teaching, learning and testing. Greater emphasis (60%) have been placed on "attitude and process skills" to give pupils the necessary scientific process skills to be able to build their store of scientific concepts and principles. Also, 20% emphasis has been placed on knowledge and understanding and application of knowledge respectively (CRDD, 2007).

The findings also revealed that less than half of the teachers (49%) know the right instructional approach recommended for teaching Natural Science, which is child-centred. It is essential for teachers to develop vast Science content knowledge base to support children's scientific thinking (Garbett, 2003; Hedges, 2003). The Natural Science curriculum emphasizes enquiry processes of Science instruction (CRDD, 2007). Inquiry-based instruction promotes child-centred instruction where children are actively engaged to develop scientific concepts. A good number of Natural Science teachers (54.2%) exhibited fair knowledge of the assessment approach recommended in the curriculum. The Natural Science curriculum recommends the use of both formative and summative assessment procedures based on the profile dimensions. However, the SBA forms the practical test aspect of assessment.

Generally, Natural Science teachers in the Gomoa East District of the Central region of Ghana had not taken time to study the curriculum to know and understand its requirements and content structure. It is therefore evident from the findings that, majority of the teachers teach without adequate recourse to the requirements of the curriculum which means there is a gap between the intended and enacted Natural Science curriculum. If the teachers' knowledge of other curricular demands are inadequate to meet the new content associated with curriculum innovations, then they may be reluctant to implement it as indicated by (Ngman-Wara, 2011) or may not implement it at all.

Conclusion and Recommendations

In order to narrow the gap between the intended curriculum and enacted curriculum, teachers who are the actual implementers of the curriculum need to possess adequate knowledge of the curriculum. The findings suggest that, there is a gap between the intended Natural Science curriculum and implemented Natural Science curriculum in terms of instruction and assessment. The implication is that, teachers will distort the original intention of the curriculum developers and expectations of the curriculum will not be achieved. It is likely to have adverse effect on Science education in the District. Based on the findings, it has been recommended that Gomoa East directorate of the Ghana Education Service should organize in-service programmes, workshops, seminars and short courses on the Natural Science curriculum to improve teachers' knowledge of the Natural Science curriculum.

References

Abell, S.K., & Lederman, N.G. (2007). What is inquiry? Stories from field. *Australian Science Teachers Journal, 45(8), 33-40.*

Alexander, R. J. (2009). *Culture and pedagogy: International comparisons in primary Education.* Boston: Blackwell.

Appiah, A. A. (2015). *The impact of Ghanaian Junior High School Teachers' curriculum knowledge on pupils performance in Abura Asebu Kwamankese District.* Unpublished Thesis submitted to the School of Graduate Studies, University of Education, Winneba.

Botha, M. L., & Reddy, C.P.S. (2011). In-service teachers' perspectives of pre-service teachers' knowledge domains in science. *South African Journal of Education*, 31, 257- 274.

Brophy, J. (1998). *Motivating students to learn.* Boston: McGraw-Hill.

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching*, (4), *4*, 613-642.

Curriculum Research Development Division (2007). *Teaching syllabus for natural science*. Accra: Ministry of Education.

Curriculum Research Development Division (2012). *Teaching syllabus for natural science*. Accra: Ministry of Education.

Diamond, S. D., Maerten-Rivera, J., Rohrer, R. & Lee, O. (2013). Elementary teachers' science content knowledge: Relationships among multiple measures. *Florida Journal of Educational Research* (51) 1-20

Fayez, M., Sabah, S.A., & Oliemat, E. (2011). Jordanian early childhood teachers' perspectives towards science teaching and learning. *International Research in Early Childhood Education*, 92(1), 76-96.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record*, 103(6), 1013–1055.

Fullan, M. (2007). *The new meaning of educational change*. (4th ed.). New York: Teachers College Columbia University.

Garbett, D. (2003). Science education in early childhood teacher education: Putting forward a case to enhance student teachers' confidence and competence. *Research in Science Education, 33*, 467-481.

Government of Ghana (2002). *Educational Review Report*, Accra, Ghana.

Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. New York: Teacher College Press.

Grossman, P. L., Wilson, S. M., & Shulman, S. (1989). Teachers' substance: subject matter knowledge for teaching. In O. Lee (1995). Subject matter knowledge, classroom management, and instructional practices in middle school science classrooms. *Journal of Research in Science Teaching*, *32* (4), 423-440.

Harlen, W. (2013). *Assessment and inquiry-based science education: Issues in policy and practice*. Trieste: Global Network of Science Academies Science Education Programme.

Harris, A., & Sass, J. (2011). Effective teaching: A review of the literature, *School Leadership &Management*, *18* (2), 169-183.

Hedges, H. (2003). A response to criticism and challenge: Early literacy and numeracy Aotearoa/New Zealand. *New Zealand Research in Early Childhood Education*, 6, 13-21.

Isler, I., & Cakiroglu, E. (2009). *Teachers'efficacy beliefs and perceptions regarding the implementation of new primary mathematics curriculum*. Proceedings of CERME 6, January 28th-February 1st 2009, Lyon France.

Kahan, J.A., Cooper, D.A., & Bethea, K.A. (2003). The role of mathematics teachers' content knowledge in their teaching: A framework for research applied to a study of student teachers. *Journal of Mathematics Teacher Education*, (6) 3, 223-252.

Kallery, M., & Psillos, D. (2001). Prnge-school teachers' content knowledge in science: Their understandings of elementary science concepts and of issues raised by children's questions. *International Journal of Early Years Education*, 9(3), 165-177.

Khwaja, C. C. (2002). *The role of subject knowledge in the effective teaching of primary science*. Doctoral school Poster Conference, Institute of Education, University of London, Dec. 2002.

Lee, O. (1995). Subject matter knowledge, classroom management, and instructional practices in middle school science classrooms. *Journal of Resfearch in Science Teaching*, *32*(4), 423-440. Retrieved on 22nd June, 2017 from http://dx. doi.org/ 10.1002/tea.3660320409

Leu, E., & Ginsburg, K. (2011). *The patterns and purposes of school-based and cluster teacher professional development programs*. Equip working paper 2. Washington, DC: USAID.www.equip123.net/docs/working-p2.pdf.

Marton, F., & Pong, W. Y. (2006). On the unit of description in phenomenography. *Higher Educational Research and Development*, 24(4), 335-348.

Marton, F. (2014). *Learning and awareness*. New Jersey: Lawrence Erlbaum Associate.

Murphy, C., & Smith, G. (2012). The impact of a curriculum course on pre-service primary teachers' science content knowledge and attitudes towards science. *Irish Educational studies*, (31),1, 23 -67. accessed on 25/08/2017 from *http://dx.doi.org/10.1080/03323315.2011.634061*

Ngman-Wara, E. I. D. (2011). *Ghanaian junior high school teachers attitudes, knowledge of contextualised science instruction*. A doctorial thesis submitted to the University of Education Winneba.

Ngman-Wara, E. I. D. (2015). Ghanaian junior high school teachers' knowledge of contextualised science instruction. *Journal of Curriculum and Teaching*, *4(1)*, 167-178.

Nowicki, B.L, Sullivan-Watts, B., Shim, M.K., Young, B., & Pockalny, R. (2013). Factors influencing science content accuracy in elementary inquiry science lessons. *Research in Science Education*, (43)3, 1135 - 1154.

Nuangchalerm, P. (2011). In-service science teachers' pedagogical content knowledge. *Studies in Sociology of Science*, 2 (2), 33-37. Retrieved, 27/06.2017 from: *http://www.cscanada. net/index*.

Osei, G. M. (2004). The 1987 junior high school reform in Ghana: Vocational or pre-vocational in nature? *International Review of Education*, 50 (5), 425-446.

Robson, C. (2002). *Real world research*. Oxford: Blackwell.

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, *15* (4), 4-14.

Shulman, L.S. (1987). Knowledge-base and teaching: Foundations of the New Reform. *Harvard Educational Review*, 57 (1), 1-22.

Shulman, L. S. (2000). Teacher development and teaching: Roles of domain expertise and pedagogical knowledge. *Journal of Applied Development Psychology*, *21* (1), 129-135.

Tekkaya, C., Cakıroglu, J., & Ozkan, O. (2004). Turkish pre-service science teachers' understanding of science and their confidence in teaching it. *Journal of Education for Teaching: International Research and Pedagogy*, 30 (1), 57-66.

Van Driel, J.H., & Berry, P. (2012). Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, *35 (6)*, *673-695*

Voss, T. (2014). Teachers' general pedagogical knowledge: Conceptualization and test construction. Retrieved from *https://scholar. google.com/scholar?*

Watters, J., Diezmann, C., Grieshaber, S., & Davis, J. (2001). Enhancing science education for young children: A contemporary initiative. *Australian Journal of Early Childhood*, *26*(2