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EXPLORING BIOLOGY TEACHERS' DEVELOPMENT OF PEDAGOGICAL CONTENT KNOWLEDGE FOR TEACHING GENETICS USING PARK'S PENTAGON MODEL

Introduction

A major concern in science teacher education is the development of teachers "knowledge base for improving students" learning, According to [1] concern of pedagogical content knowledge (PCK) has come about, first, as a result of studies that show a strong relationship between what teachers know (content knowledge)and how they teach (pedagogical knowledge). Secondly, constructivist views on science teaching and learning suggest that teachers" knowledge base must of necessity include knowledge of students' preconceptions or alternative frameworks which could be used as the basis of a good teaching point on students' behalf. The three types of teacher knowledge, namely, content knowledge (CK),pedagogical knowledge(PK) and pedagogical content knowledge(PCK), relate to what [2] [3] have collectively referred to as pedagogical content knowledge (PCK). Pedagogical content knowledge has been simply described as that teacher knowledge which allows teachers to assist students to access specific content

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knowledge in meaningful way [4]. The three types of teacher knowledge, namely, content knowledge (CK),pedagogical knowledge(PK) and pedagogical content knowledge(PCK), relate to what [2] [3] have collectively referred to as pedagogical content knowledge (PCK). Pedagogical content knowledge has been simply described as that teacher knowledge which allows teachers to assist students to access specific content knowledge in meaningful way [4]. Therefore, the research study will adopt two parks components model to see how the biology teachers' teaching genetics develop their PCK using knowledge of assessing science learning, knowledge of students understanding in science.

Genetics is an important topic in biology because understanding it serves as a basis for many scientific careers that require its application [5] [6]. Despite its important, many learners, as indicated in the West African examination Council [7], they perform below expectation in the topic both at school level [8] [9] [10], and that is a reason for selecting the topic for study. In light of recent developments in which genetics has become increasingly related to human affairs such as genetic engineering, including genetically modified food and cloning, learners need to have an understanding of basic concepts of genetics for participation as scientifically literate citizenry [11]. Therefore, the study intent to explore biology teacher's development of PCK for teaching genetics science to understanding how science teachers develop PCK and use it to make science content accessible to learners and improve learner achievement in science would be useful

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information for teacher education programs to enhance teaching quality particularly in genetics.

Statement of the Problem

Biology students encounter challenges with regards to understanding of genetics topics, and this have been attributed to the teachers' inadequate knowledge and hence teachers' poor knowledge of relating and development of pedagogical content knowledge as manifested in National Examination Council NECO chief examiners report [12a, 12b] in biology also indicates that student's performance in genetics is really not significant. [13]. Studies on PCK in different countries examined its nature, model, measurement, teachers' knowledge in relating and development of concepts in teaching genetics going by the speculation of many teachers on teaching by relating the components of PCK such as orientation toward science teaching, knowledge of science curriculum is limited.

Purpose of the Study

The main purpose of this study is to explore secondary school biology teacher's development of PCK for teaching Genetics using two components of park's pentagon model in plateau central zone. Specifically, the study will determine

I. Examine the biology teachers' knowledge of assessing science learning using park's components model.

II. Determine the content knowledge biology teachers' have and demonstrate for teaching genetics using park's components model

Research Questions

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I. What knowledge of assessment do biology teachers' use in teaching genetics?

II. What content knowledge do biology teachers' have?

Significance of the Study

This research work looks into the quality of biology teaching in terms of teachers pedagogical content knowledge and will be beneficial to teachers by improving their practice and enlightening them on the significance of developing a high level of pedagogical content knowledge and relating its components in teaching and invariably improve the senior secondary students' conceptual understanding of the biology concepts. Examination body and Government will be able to make judgment about teacher's quality in transforming rich knowledge or learning in the classroom, while curriculum planners and text book developers will put more consideration on Pedagogical skills require for effective teaching of biology concepts for student's conceptual understanding.

Conceptual Framework

The current study will use two component of park's components model and pedagogical content knowledge that was first introduced by Shulman as a form of knowledge that connects a "teacher's cognitive understanding of subject matter content and the relationships between such understanding and the instruction teachers provide for students" [2]. In its original context, PCK represents that particular amalgam of content and pedagogy that is uniquely the province of teachers and distinguishes a teacher from a subject matter specialist [14]. This author further argued that this amalgamation of subject matter knowledge and pedagogical knowledge empowers a teacher to help

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learner's construct appropriate understandings. In other words, according to Shulman, PCK results from the blending of content knowledge with pedagogical methods. Therefore, the framework was used as fundamental types of teacher knowledge a researcher used as guide for data collection, data analysis and discussion of what and how PCK in genetics teaching was developed.

Methods

The procedure for data collection follows simple stages. Firstly

Stage One: a pre-lesson interview and lesson observation

Stage Two: classroom observation (non-participant-observer)

Stage Three: post-lesson interview and finally through document analysis

The procedure for data collection follows a simple pattern; a pre-observation interview followed by classroom observation (non-participant-observer) and finally post interview, the researcher visited the teachers in their school to have conservations with the school administrators regarding the study plan.

The researcher took the interview questions to two 2 biology teachers, when they complete the pre-lesson interviewed, after the interview the researcher conducted a classroom observation (non-participant-observer) in their classes, when they finished their teaching, the researcher gave them post interview questions.

Research Design

The design of this research is qualitative case study design was used so as to facilitate the exploration of a problem in order to generate a complex detailed understanding of the issue [15]. As is the case for mixed research, this research study for exploring secondary

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school biology teachers' development of pedagogical content knowledge for science teachers for teaching genetics, in order to make sense of and interpret phenomena in terms of the meanings they brought to them [16]. Additionally, qualitative research is an appropriate design for study since it sought to "describe pedagogical content knowledge (PCK) and problematic moments and meanings in individuals' lives" [16]. A qualitative approach to this research will support understanding of an individual's point of view; understanding their live and extend experiences through generating thick descriptions of these experiences [16, 17]. The qualitative approach provide the means to study how these experiences provide meaning to participants and Explanations of how such experiences emerged [16, 18, 17].

Result and Discussion

Case Study of Participant A Lesson

Description of Participant A Second Lesson (dominant character, dominant genes, recessive character and recessive genes):

Four PCK Line were also identified in this second lesson, namely: the first line which is very brief and lasts about six minutes deals with the introduction of the lesson by a brief evaluation of the previous lesson, the second line lasts about fourteen minutes and which basically covers where the teacher define dominant character, dominant genes, recessive character and recessive genes, the third line lasts for 16 minutes and deals with the teacher explaining the concepts mentioned above and fourth line lasts for about 7 minutes which deals with the evaluation and conclusion of the lesson.

Research Question one: What knowledge of assessment do biology teachers' use in

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teaching genetics

Base on pre-observation Q6 below

How do you plan to assess the students learning on this unit? What evidence are you looking for that the students have been successful in addressing the goal for the lesson? (Pre-observation interview Q6)

Participant A: because the lesson is progressive, I have to ensure that at every step the students understood me before going to the next step so as not to assume that they are understanding only but to asked questions after each step, I will wait and observe their concentration level and level of their participation to be sure that they are actually following. I will ask questions on the topic discuss before ending the lesson for the day.

Research Question two: What content knowledge do biology teachers' have?

Base on pre-observation Q4 below

What subject matter or concepts do you expects difficulties with the students and how would you help them? (Pre-observation interview Q4)

Participant A: the lesson is simple but most of the students, been that they had misconception on genetics topic that make it a bit difficult, so I have to take my time and gradually explain each step in the concepts and write them down together so that they can easily compare and contrast the concepts.

Intervention in Participant (A) Lesson

Sir you do always asked some few students by calling their names, how could know whether the rest has understood the lesson or not, the questions should be thrown to whole students, anyone who know the answer should be given room to answer the question.

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In the presentation stage, you could have been asking the class do you understand or are following with me, find out whether all students are gotten the message or not.

The teaching aid you presented in the class, some students are not seeing the label clearly because the color of the text is not visible, and you could have used a visible color to enable them seeing the text clearly.

Case of Participant B Lesson

Description of Participant B first lesson (Genetic, heredity and variation)

The lesson has four PCK lines which are: first line lasted for about 6 minute and which focuses on the background for the lesson, definition and explanation of the concept of genetic, second line lasted for 15 minutes and it reflects the following; the definition and explanation of the concepts of dominant and recessive character. The third scene lasted for 12 minutes and covers the definition and explanation of the concept of heredity and forth scene lasted for 12 minutes and deals with the explanations of variation and conclusion to the lesson.

Research Q one: *How do you plan to assess the students learning on this unit? What evidence are you looking for that students have been successful in addressing the goal for the lesson? (Pre-observation interview Q6)*

Participant B: I will evaluate the lesson at every step, asking questions to know whether they are following, give room for them to ask questions. In the class, there are certain students with unique challenges and I will be particular about asking them questions in the class to assess the general class responses.

Participant B has already planned the lesson from the beginning with the nature of her students in mind. She is familiar with weakness and strength and also familiar with weak and good students, so she do always planned the lesson around certain students' expectation as the target,

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if they get it, definitely others will get it. This scene particularly reflect students centered and the evaluation is systematically done and not at the end of the lesson. Her questioning technique was like more of getting the attention of the students and to help them recall what they already know.

Intervention in Participant B Lesson

In your previous lesson you had with your students, before proceeding to the next topic, you have asked the students questions to find out whether the previous knowledge had been understood or not While teaching, some students are seeing playing in the class you could have using the students for illustrating in the class in order to keep them busy in the class.

Discussion of Findings

This study aimed at exploring two (2) biology teachers' using two park's component model which is knowledge of assessing science learning, knowledge of instructional strategies for teaching as guide. It attempts to develop the components coherence amongst them. The finding from the study also shed more light to finding from other researches undertake by scholars by a way of adding empirical evidences to assertions, giving new understanding to literatures and drawing attention to salient points not mentioned in previous works.

To begin with, the finding is in complete agreement with assertion that development of the PCK components in a coherent way is achieved through complementary and continuous readjustment motivation by both reflection in-practice and reflection on-practice [19, 20, 21].

Exposing the teachers to educational training on PCK component development resulted in a change in the dynamics and interplay of the components development and more so

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an improvement in the individual component which resulted in a total improvement in the quality of PCK component development. This shows that well-structured educational training or workshops can improve the whole framework of PCK component development. This finding will gives support to assertions made by others scholar that professional development programs such as educational coursework, workshops, conferences etc are viable means for development and enactment of PCK [22, 23, 24].

The educational coursework, workshop for this study focuses on the pentagon model of PCK which has five components in the manner which they are displayed. It makes it easy for the teachers to develop with their weakest component and focus on improving it in line with the holistic development of their PCK.

The second finding shows that, there is an increased in the overall teacher's development of their PCK components. For a balanced and efficient PCK development, the components are supposed to link with each other in a coherent manner. The two teacher's shows an increased in the average development of the components which thought does not reflect a perfect PCK blending but an improvement from what they used to know and practice. This study also gives support to the possibility of using PCK model for teaching science as an efficient methodological tool in analyzing the dynamics of development of PCK components [25, 26]..

Conclusion

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In concluding, the study has been an attempt to explore the PCK in genetics teaching of two biology teachers and how they each developed it. The findings of the study led to the Following conclusions:

- The development of the PCK components in the light of park's pentagon model shows an average involvement of more components development after the class room observation session.
- There was an average increased in the five components development in the light of park's components model.

Recommendations

The conclusions that was drawn from the research study suffice for the following recommendations PCK components development should be adequately included in planning secondary schools biology curriculum in teachers training by curriculum planners to equip them with a strong development of PCK and improve its overall quality Educational coursework, workshop should be organized for teachers to improve the coherence in the development of their PCK components

Suggestion for Further Study

This research work was not keen on the quality of each component that is developing with other components, researches can be conducted further to assess the quality of each component and the nature their development with other components. Other researchers can also use the PCK model in other biology topics that students are likely having educational challenges to assess how teachers pedagogical content knowledge (PCK) can be used to improve in that area.

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