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RESEARCH PAPER

INVESTIGATING FACTORS AFFECTING PEDAGOGICAL CONTENT KNOWLEDGE (PCK) OF PHYSICS TEACHERS

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ABSTRACT

This study intends to find out the factors affecting the pedagogical content knowledge of physics teachers. Two research questions were answered using survey research design. A total of 60 Bauchi State secondary school physics teachers constituted the population for the study and 20 teachers were selected using stratified random sampling techniques out of the population. Questionnaire with five point Likert Scale was used for answering the research questions and the outcome of the questionnaire was analyzed using simple statistical tools of mean and standard deviation. The findings thus, revealed that teachers' attitude, textbooks content, curriculum content and teacher motivation affect the pedagogical content knowledge PCK of physics teachers.

KEYWORDS: Pedagogical Content Knowledge, Physics Teachers, Teaching

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INTRODUCTION

Teaching is a complex activity. Researchers try to understand factors that influence teachers' activities in classrooms. A way of understanding the act of teaching is to investigate factors affecting the pedagogical content knowledge of teachers that are believed to be an accumulated wisdom with respect to teaching practices. This activity is founded on the assumption that there is a set of knowledge related to teachers' practices (Gardner, 2003). This knowledge leads to the development of subject matter mastery and acquisition of relevant teaching methods known as 'pedagogical content knowledge' (Adeyemo, 2010). Shulman (1987) defined pedagogical content knowledge (PCK) as interwoven pedagogy and subject matter knowledge necessary for a good disciplinary teaching. Pedagogical content knowledge produces effective behavior on the part of the teacher who possesses it. The military version of wisdom concerns utilization of both strategies and tactics and provides a metaphor to wisdom in teaching. PCK has been identified as an important component of teachers' professional knowledge. PCK is defined as the blend of knowledge of content to be taught and knowledge of pedagogy that results in teachers' understanding of how the teaching content can be best organized, adapted, and presented to students of diverse abilities and interests (Shulman, 1987). PCK can be understood as the knowledge that can be used by teachers to transform their subject matter knowledge into teachable content knowledge (Geddis, Onslow, Beynon, and Oesch, 2002).

Physics teachers at all levels are bounded with problem of PCK understanding which affects their teaching activities. In the last three decades, research efforts have been geared towards improving the teaching and learning situation and pupil's cognitive achievement in physics (Gallagher, 2007). Such research efforts still show significantly low improvement of the teaching/learning situation in physics. For instant, the area of teaching methodology which dominates science research scene in the sixties has revealed, according to (Gallagher, 2007) that science is poorly taught.

The methods of science teaching (physics inclusive) as observed by Park and Oliver (2008) do not encourage to any appreciable and significant extent, the development and sustenance of process skills among science teachers. It is also widely accepted among science educators that science teaching should be activity oriented; Hence, teaching method such as guided discovery, demonstration, laboratory inquiry and project among others are now fully recognized as being potent in science teaching. However their usage by science teachers is still worrisome (Ogunleye, 2009). Development of positive attitude toward science, scientist and learning science which has always been a consistent with science education is increasingly a subject of concern (Olaleye, 2011).

Several international studies on PCK have been conducted (Huang and Moon, (2009). Researches seeking to understand PCK have also revealed sources that contribute to the development of PCK, (Shulman, 1987) in Niess and Scholz (2005) identify the following sources:

- **Disciplinary Study**: This is the study of the knowledge and skills that are to be learned by school students Shulman (1987) in Niess and Scholz (2005) identified this source as scholarship in content discipline. Meanwhile, (Grossman 1990) labels this source as 'disciplinary background'.

  Disciplinary study provides a basis for the knowledge of content, syntactic structure, as well as substantive structure understandings. According to Grossman, disciplinary understanding influences teachers' decisions about the selection of the relative importance of particular content and the selection and sequencing of the content.

The influence of disciplinary study on pre-service teachers' PCK was revealed in a study conducted by (Adams 1997) in Niess and Scholz (2005) who studied the origin or beginning of science teacher cognitions. In the research, he found that teachers relied on their curricular knowledge based on disciplinary study, which included college course work, high school course work, and college and high school textbooks.

- **Educational Study:** The second source of PCK is educational study; this includes study about teaching, learning, student development, and philosophical and ethical foundations of education. Educational study provides a basis for teachers' knowledge and skills of teaching strategies, classroom management, and modes of assessment.
- **Teacher Experience:** The third source of PCK is teacher experiences (Shulman 1987) in Niess and Scholz (2005) pointed out the importance of experience on the development of teachers' PCK He maintained that the 'wisdom of practice' provides reflective rationalization for the teachers. A knowledge base for teaching is not fixed or final. Teachers should continuously reconstruct and develop an understanding of teaching-based on teaching experience through a reflective process. Comparative analysis between novice and expert teachers indicates that expert teachers have more understanding about PCK than their novice counterparts. This finding leads to the conclusion of the importance of experience in the development of PCK.

Literature reviewed so far on the sources of PCK development revealed that all science teachers (physics teachers inclusive) are expected to acquire all the three identified sources that contribute to the development of PCK for effective teaching and learning (Balogun, 1999 and Yong, 2007) Therefore, the need to investigate factors affecting the PCK of physics teachers.

Purpose of the Study

The main purpose of this study is to investigate the factors affecting pedagogical content knowledge (PCK) of physics teachers. The research aim at achieving the following objectives:

1. To find out the factors affecting PCK of physics teachers.
2. To find out the physics teachers` opinion on factors affecting PCK.

Research Questions

The researcher aimed at finding answers to these questions

1. What are the factors affecting physics teachers pedagogical content knowledge PCK.
2. What are the physics teachers` opinions on factors affecting the PCK?

METHODOLOGY

A survey research design was used to conduct the study. This is because it involves the gathering of data from a relatively large number of cases at a particular time (Abimbola and Baba, 1996). A total of 60 Bauchi State secondary school physics teachers constituted the population for the study spread through 68 public secondary schools. A Stratified random sampling techniques was used to select twenty (20) teachers for the study.

The instrument used for the study was questionnaire with five point Likert Scales of strongly agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) Undecided (UD) used in scoring the items in the questionnaire. Strongly agreed was scored 5 points, Agreed was scored 4 points, Disagreed was scored 3 points, strongly disagreed was scored 2 points and undecided was scored 1 point. The validity and reliability of the instrument were determined. The validation of the instrument was obtained by giving the instrument to five science education experts and the reliability was found to 0.83 using Pearson product moment correlation coefficient.

For the purpose of data analysis, the questionnaire copies were distributed and collected by the researcher immediately, whereby the data gathered using the questionnaire were analyzed using simple statistical tools of mean and standard deviation. The analysis hold that any mean ($\bar{x}$) score less than 3.0 represented disagreed while any mean ($\bar{x}$) that are 3.0 and above stands for agree.

Data Presentation and Analysis

Table 1: Teachers Opinion on Teachers Attitude as Factor Affecting the PCK of Physics Teachers.

S/N	Factors	$\bar{x}$	Decision
1.	Physics Teaching should be based on real phenomena	3.40	Agree
2.	You give room for questions during lessons	3.35	Agree
3.	Teaching physics regularly enable me to develop good teaching skills/strategies	2.71	Disagree
4.	Time/period of the lesson affects teachers	3.15	Agree
5.	Proper use of instructional materials improves teaching strategies.	3.05	Agree
6.	Teachers should be well prepared before coming to class	2.85	Disagree
7.	Teachers should ensure the achievement of objectives stated in their lesson plans through proper evaluation	3.20	Agree
	AVERAGE	**3.10**	Agree

Source: Field Survey2013

Table 1 revealed the mean calculated average of 3.10 which is greater than 3.00 (3.10> 3.00) therefore, teachers attitude is a factor that affects pedagogical content knowledge of physics teachers.

Table 2: Teachers Opinion on Classroom Condition as Factor Affecting the PCK of Physics Teachers.

S/N	Factors	$\bar{x}$	Decision
1.	The class is so large that the students cannot see or hear the teacher	2.15	Disagree
2.	Instructional materials are always available during lesson presentation.	2.61	Disagree
3.	Good and equipped laboratories help the teacher in his methodology in physics	3.20	Agree
4.	The population of students determines the methods used in teaching	3.30	Agree
5.	Lack of comfortable classroom furniture affects the teachers and the students computability	3.10	Agree
6.	A good and conducive environment for learning and teaching, improves the teacher technically.	2.10	Disagree
7.	There is available of power supply in your school.	2.76	Disagree
	AVERAGE	**2.75**	**Disagree**

Source: Field Survey2013

Table 2 shows the mean calculated average of 2.75 which is less than 3.00 (2.75 < 3.00), therefore classroom condition is found to be a factor that has no effect on pedagogical content knowledge of physics teachers.

Table 3: Teachers Opinion on Textbook Content as Factor Affecting the PCK of Physics Teachers.

S/N	Factors	$\bar{x}$	Decision
1.	Having personal physics textbooks enable teacher to develop PCK in physics	3.05	Agree
2.	The examination questions are in agreement with textbook contents	3.25	Agree
3.	There are enough textbooks for teachers to use in the library in your school.	2.90	Disagree
4.	The content of the textbook is in agreement with what the teacher teaches in the class.	3.10	Agree
	AVERAGE	**3.08**	**Agree**

Source: Field Survey2013

Table 3 shows the mean calculated average of 3.08 which is greater than 3.00 (3.08 > 3.00) therefore, textbook content is a factor affecting P.C.K of physics teachers.

Table 4: Teachers Opinion on Curriculum Content as Factor Affecting the PCK of Physics Teachers.

S/N	Factors/Opinion	$\bar{x}$	Decision
1.	Following the school curriculum will also help the physics teachers to know the method he/she will use in teaching	3.20	Agree
2.	All the topics suggested in the curriculum must be taught	3.10	Agree
3.	Teaching content is mainly taken from the school textbook	3.05	Agree
4.	Familiarity with the school physics curriculum improves teaching/learning	3.10	Agree
	AVERAGE	**3.11**	**Agree**

Source: Field Survey2013

Table 4 also shows mean calculated average of 3.11 which is greater than 3.00 (3.11> 3.00) which implies that curriculum content is one of the main factors affecting PCK of physics teachers.

Table 5: Teachers Opinion on Motivation as Factor Affecting the PCK of Physics Teachers.

S/N	Factors	$\bar{x}$	Decision
1.	You have always been motivated to teach	3.10	Agree
2.	Motivation will develop teachers physically and educationally	3.15	Agree
	AVERAGE	**3.13**	**Agree**

Source: Field Survey2013

Table 5 revealed the mean calculated average of 3.13 which is greater than 3.00 (3.13 > 3.00) this shows that motivation as a factor affects PCK of physics teachers.

DISCUSSION

The purpose of the study was to determine the factors affecting the pedagogical content knowledge of physics teachers. From the interpretation of the physics teachers' opinion, Table 1result with 3.10 >3.00 shows that teachers attitude affects the pedagogical content knowledge of physics teachers which agrees with the findings of (Yenilmez, Sungur and Tekkaya, 2006) that the procedural understanding of physics that pre-service teachers typically exhibit in university physics courses is not adequate for the teaching of physics according to many proposed innovations involving deep changes in content and pedagogical methods. It is also similar to the findings of the research conducted by Magnusson, Krajcik and Borko (1999), which found that one of the most significant concerns of beginning teachers is discipline. It is also related to the finding of Park, and Oliver (2008), Balogun (1999), Huang and Moon (2009) which states that teacher educators do not always teach in the way they preach. The result of Table 2 gives the mean calculated average of 2.75 (2.75 < 3.00) this shows that classroom condition has no effect on

the pedagogical content knowledge of physics teachers. This is contrary to the statement of Adeyemo, (2010) who found that classroom atmospheric condition affects both teachers and student performance. The result of Table 3 also revealed mean calculated average of 3.08 which is greater than 3.00 (3.08 > 3.00) this shows that textbook content is a factor affecting PCK of physics teachers. This statement is in agreement with statement of (Yilmaz and Alp, 2006) who states that in order to be able face the challenges of scientific and technological advancement in schools teachers and students should be provided with adequate and relevant current textbooks and other learning materials. According to Table 4 the mean calculated average is 3.11 which is greater than 3.00 (3.11> 3.00), and this implies that curriculum content is one of the main factors affecting PCK of physics teachers. This agrees with Ogunleye, (2009) and Yip, (1996) findings which indicates that the transformation of general knowledge into pedagogical content knowledge is not a straightforward matter of having knowledge; it is also an intentional act in which teachers choose to reconstruct their understanding to fit a situation.

SUMMARY AND CONCLUSION

Based on the finding of this study the following conclusion was reached:
The factors that affect PCK of secondary schools physics teachers are teachers' attitude, textbooks content, curriculum content and teacher motivation.

RECOMMENDATION

Based on the findings of this study, the following recommendations were made:

1. Physics teachers should be encouraged to incorporate Pedagogical Content Knowledge in their teaching.
2. The government should utilize the services of various bodies such as Science Teachers Association of Nigeria (STAN); All Nigerian Conference of Principals of Secondary Schools (ANCOPSS) and National Union of Teachers (NUT) to organize seminars, workshops, conference and in-service training to inform and train physics teachers on the significant of Pedagogical content knowledge in teaching.
3. Teacher Training Institutions should include Pedagogical Content Knowledge in their method of teaching physics course content. This will ensure that the physics teachers are adequately trained on pedagogical knowledge and subject matter knowledge.
4. Textbook writers on physics should generally reflect the background of atypical Nigeria society. The Pedagogical Content Knowledge should reflect our educational background, culture and philosophy.

REFERENCES

Abimbola, I.O. and Baba, S. (1996). Misconceptions and alternative conceptions in science textbooks: The role of teachers as filters. *The American Biology Teachers. 58*(1), 14-19.

Adeyemo, S. A. (2010). Teaching/ learning physics in Nigerian secondary school: The curriculum transformation, issues, problems and prospects. *International Journal of Educational Research and Technology.* 1 (1), 99-111.

Balogun, T. A. (1999). Interest in science Technology Education in Nigeria. *Journal of Teachers Association of Nigeria.* 23 (1&2), 92-99.

Gallagher, J. (2007). *Teaching science for understanding: A practical guide for middle and high school teachers.* Upper Saddle River, NJ: Pearson Prentice Hall.

Gardner W. (1989). Preface in M.C. Reynolds (Ed.), Knowledge Base for the beginning teacher oxford: Pergamon Press.

Geddis, A. N., Onslow, B., Beynon, C., and Oesch, J. (1993). Transforming content knowledge: Learning to teach about isotopes. *Science Education. 77*(6), 575-591.

Grossman P. L. (1990). The making of teacher: teacher education. New York: Teachers College Press.

Huang, F.L. and Moon, T.R. (2009) Is experience the best teacher? A multilevel analysis of teacher characteristics and student achievement in low performing schools. *Educ Asse Eval Acc* 21:209–234.

Magnusson, S., Krajcik, J, S., and Borko, H. (1999): Nature, sources and development of pedagogical content knowledge for science teaching. In J. Gess Newsome and N.G. Lederman (Eds), examining pedagogical content knowledge, the construct and its implications for science education.

Niess and Scholz, (2005): Incorporating subject matter specific teaching strategies into secondary science teacher preparation. In J. Gess-Newsome & N.G. Lederman (Eds.), Examining pedagogical content knowledge. Dordrecht, the Netherlands: Kluwer.

Ogunleye, A. O. (2009) "Teachers' And Students' Perceptions Of Students' Problem-Solving Difficulties In Physics: Implications For Remediation. *Journal of College Teaching & Learning*, *6,* 785-796.

Olaleye, F.O. (2011) Teachers Characteristics As Predictor Of Academic Performance Of Students In Secondary Schools In Osun State –Nigeria. *European Journal of Educational Studies 3(3),*pp 505-511

Park, S., and Oliver, J. S. (2008). Revisiting the conceptualization of pedagogical content knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research in Science Education, 38*(3), 261-284.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(1), 4-14.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review. 57*(1), 1-22.

Yenilmez, A., Sungur, S., and Tekkaya, C. (2006). Students' achievement in relation to reasoning ability, prior knowledge and gender. *Research in Science & Technology Education, 24*(1), 129-138.

Yilmaz, A. and Alp, E. (2006). Students' understanding of matter: The effect of reasoning ability and grade level. *Chemistry Education Research and Practice, 7*(1), 22-31.

Yip, D.Y. (1996). Misconceptions of biology teachers and the implication for teacher education programmes. Paper presented at the International Conference on Basic Education, Hong Kong.

Yong, B.C.S. (2007). Relationship between reasoning abilities and students' achievement in science: a case study. *Journal of Applied Research in Education, 11,* 108-119.