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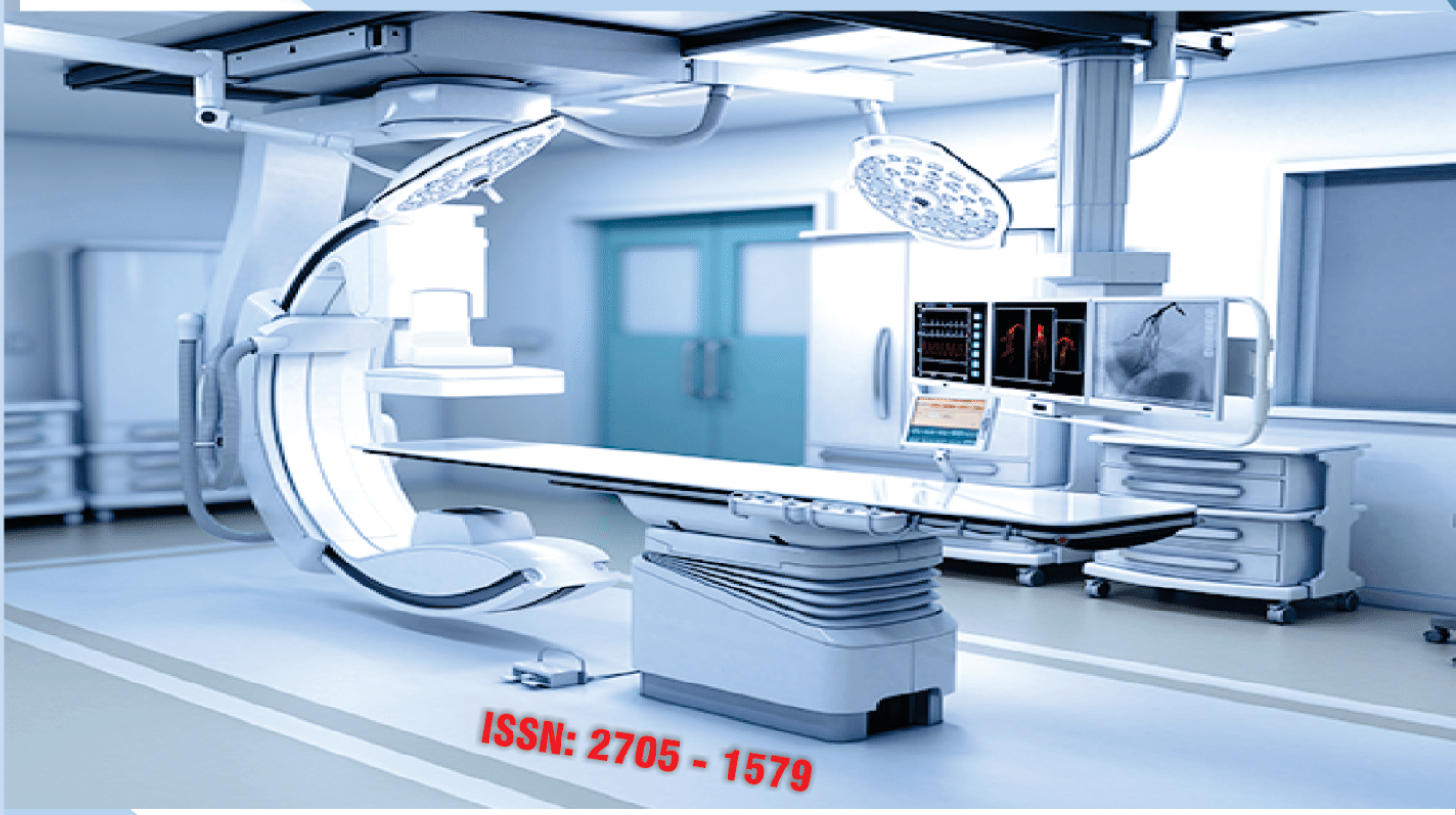

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EDITORIAL

The task of effectively applying Science, Technology, Engineering and Mathematics (STEM) education research of utmost importance to STEM educators and other stakeholders, even the survival of any nation depends on the sustainability of its STEM education programme.

Currently, we are facing the challenges of COVID-19 pandemic. Our country Nigeria did not anticipate such disease and as such caught up with the pandemic. Hence the un-preparedness of our nation led to the closure of public places including schools.

Therefore, Science Teachers' Association of Nigeria (STAN) Anambra State Chapter dedicated this 2nd Biennial State conference hold on decencies 8th-9th, 2021 at Federal Science and Technical College, Awka, Anambra State, Nigeria to COVID-19 and Emerging issues in STEM Education.

The editorial board had welcomed our members whose papers - articles were extracted from conference.

Happy Reading.

Prof. Rita N. Nnorom
Editor-In-Chief

TEACHING EXPERIENCE AND QUALIFICATION AS CORELLATES OF PEDAGOGICAL CONTENT KNOWLEDGE OF CHEMISTRY TEACHERS

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Abstract

The study investigated the teaching experience and qualification as predictors of Pedagogical Content Knowledge of Chemistry Teachers in Anambra State, South East Nigeria. Seven research questions guided the study, the sample of the study consisted of all four hundred (400) chemistry teachers in the state. The study measured the Pedagogical Content Knowledge of chemistry teachers in terms of 'knowledge of subject matter', 'knowledge of the instructional strategies' and 'knowledge of the curriculum'. Related literatures were reviewed. The research design was a correlation survey design study. The instrument used for data collection was a structured questionnaire. The instrument was validated by two experts. Using Cronbach Alpha, the reliability coefficient was found to be 0.83. The data were analyzed using Pearson Product Moment Correlation and Simple Regression Analysis. The study found out that years of teaching experience and academic qualification accounted for the pedagogical content knowledge level of chemistry teachers. Based on the findings, the researchers recommend that academic qualification of teachers should be considered while employing teachers who teach chemistry in public secondary schools and new teachers should be given training that has practical classroom relevance to boost their experience in teaching the subject matter.

Keywords: Teaching experience, Qualification, Pedagogical content knowledge, chemistry teachers

Introduction

Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, morals, beliefs and habits (Merriam Webster, 2018). Education is an exclusive property of man and is very central in man's development of himself and his environment. The purpose of education is to provide knowledge that will integrate individuals and make them more skillful individuals in the society, capable of solving their problems (Okechukwu, 2010). This explains why there have been efforts in Nigeria and even at the global level to foster education at all levels especially at the grassroots. The goal is to help individuals to learn new things so as to bring about a desirable change in behaviour. This means education is about being proactive in identifying and removing the barriers and obstacles learners encounter in attempting to access opportunities for quality education (UNESCO, 2013). Good education and academic performance guarantee skilled and dynamic citizens, no nation can afford to neglect education especially science education at any level and hope to thrive in any field of human endeavor. Science education is a field of study concerned with producing a scientifically literate citizens as well as producing a potential of scientific and technological manpower. It is the bedrock upon which scientific and technological development depend. Science education significantly occupies the central position in producing resources needed for socio-economic, scientific and technological development and growth of any nation (Okigbo & Okoli, 2016, Osuafor & Okonkwo, 2013).

Chemistry is one of the core branches of pure science which students learn in the senior secondary schools. Chemistry is the study of matter; their properties, structure, composition and changes they undergo. The aims of the chemistry curriculum are to enable students to: develop interest and maintain a sense of wonder and curiosity in chemistry, construct and apply knowledge of chemistry, and appreciate the relationship between chemistry and other disciplines. It also aims to make the learners to appreciate and understand the evolutionary nature of science and develop skills for making scientific inquiries. Chemistry is a science subject that has practical relevance to daily life experiences because it deals with life in general and is very important in the scientific and technological development of any nation. In fact, chemistry is the heart of science and science is the foundation on which technology is built in developing a nation (Chemical Society of Nigeria (CSN), 2010).

As a subject of study, chemistry is very vast and multi-faceted since it consists of varied concepts, facts and theories which the students are expected to internalize. It is, therefore, imperative that a chemistry teacher should employ diverse strategies to enable students to acquire the content knowledge, the laboratory skills, and appropriate scientific attitudes and be able to apply the scientific knowledge and skills so acquired in solving the problems of their daily lives. The outcome of every learning process, therefore, depends to a great extent on the methodology adopted by the teacher. The primary purpose of teaching at any level of education is to bring a fundamental change in the learner; as a result, teachers are expected to apply appropriate instructional strategies that will meet the needs of the learners (Tebabal & Kahssay, 2011). The quality and effectiveness of a teacher in the teaching-learning process at all levels of education are highly important to the learning outcomes of learners. This explains why Federal Republic of Nigeria (2013) affirmed that teachers are indispensable to any education system and no education system can rise above the quality of its teacher. The effectiveness of the teacher is endangered if he has no good grasp of teaching methods and teaching skills. To buttress this point, the Teachers Registration Council of Nigeria –TRCN (2010) stated that all teachers in educational institutions in Nigeria shall be professionally trained. The responsibility of the classroom teacher is to help students attain maximum achievement in their learning tasks (Lamidi, Oyelekan & Olorundare, 2015). Also, the ability to use the appropriate instructional strategies in teaching is among the competencies expected of a teacher.

One of the characteristics of a good teacher is that he/she possesses a substantial amount of specialized knowledge which is referred to as Pedagogical Content Knowledge (PCK). PCK consists of three basic components; knowledge of content, knowledge of teaching and knowledge of curriculum. Knowledge of content implies a good grasp of the subject matter; knowledge of teaching implies being conversant with related teaching skills and techniques and knowledge of curriculum deals with the perfect understanding of the expected learning outcomes. Pedagogical Content Knowledge (PCK) is the knowledge of how to transform formal subject matter knowledge into meaningful learning outcomes for students. It also involves an understanding of a particular topic and how teachers explain the topic or concepts so as to make sense to the students in the classroom (Adedoyin, 2011). This means that teachers are always expected to exhibit a basic set of pedagogical knowledge and skills in the classroom, which involves a good knowledge of their teaching subjects, teaching methods, skills and knowledge of child development. Pedagogical Content Knowledge

(PCK) is an academic construct that represents an intriguing idea. It is an idea rooted in the belief that teaching requires considerably more than delivering subject content knowledge to students, and that students' learning is considerably more than absorbing information for later accurate regurgitation. To effectively determine the PCK level of the teacher, the different aspects of PCK have to be considered.

The first is to determine the level of mastery of the subject area that is the level of his knowledge of the subject matter. This is necessary since lack of knowledge or inadequate knowledge of chemistry concepts may make one see chemistry as impossible and its knowledge unattainable. Recent trends in education emphasize a learner-centered form of education affected by the teacher. A good knowledge of each of the students will help the teacher to adequately meet their learning needs at the individual level. Teaching experience, number of years a teacher has spent in teaching a subject is also associated with his/her PCK level in teaching the subject (Sarpong & Apaak, 2016; Mthethwa-Kunene, 2014). There seems to be evidence that years of teaching experience can affect the PCK level of a teacher.

Teachers play crucial role in education attainment because teachers are responsible for translating educational policies into action during their interaction with the learners and also use innovative instructional strategy to sustain higher positive influence on the attitude of the learner to any subjects (Bilesanmi-Awoderu, 2012). Good teachers are necessary for good education which in turn is indispensable for social change and national development (Ajayi, 2017). This makes it the case that for teachers to effectively play their role in the entire scheme of learning, their PCK level must be good otherwise it would translate to negative outcomes in the learning achievements of the students. If the students are underachieving in their learning of chemistry, it could be an indication that the PCK level of their teachers is not adequate.

Although, theoretical and empirical evidence suggest that teaching experience and qualification contribute to teachers' development of PCK, little research attention has been given to it in the context of chemistry teachers in Nigeria. This presents a need for investigation into factors that may be linked to chemistry teachers PCK so that appropriate intervention strategies can be initiated to improve the teaching of the subject. Hence, the justification for the researchers' interest in examining the extent teaching experience and teacher qualification predict chemistry teachers' pedagogical content knowledge among chemistry teachers in Anambra state.

The teacher is at the center of implementation of all educational policies at the classroom level, his/her experience and qualification in the teaching of any subject has been given considerable attention in Nigeria. The policy on the minimum qualification for teaching in secondary schools has been significantly implemented which have led to increase in the number of qualified teachers in secondary schools, including those teaching chemistry. In addition, teaching experience has been given priority in teacher employment, promotion, payment and assignment to classes. These actions are based on the premise that teaching experience and qualification are believed to be essential as they influence the teachers' knowledge on the different topics in the subject areas as well as their level of knowledge of the subject matter and teaching strategies.

These are all associated with the teachers' pedagogical content knowledge which is expected to increase students' performance on their subjects including chemistry. The qualification of a teacher can go a long way in shedding light on the knowledge base of the teacher in the subject area. This is given credence by the fact that no one can give what he does not have; in the same vein, the teacher cannot teach what he himself has not learnt. Research results have shown that despite the importance attached to chemistry, students' academic achievement in the subject at the secondary school level in Nigeria has been abysmally poor, with little or no appreciable improvement over the years (WAEC 2013-2020, Omoregbe & Ewansiba 2013, Olorundare 2014) has become a persistent public outcry as regards the falling standard of chemistry education. Students' achievement in chemistry subject in Senior Secondary Certificates Examination (SSCE) has been unsatisfactory over many years (Ali, Toriman & Gasim 2014). This informs the choice of the present study to investigate probable reasons for such failures in chemistry in Anambra State.

Chemistry is very central in science of matter and related disciplines. This informs several efforts geared towards enhancing students' performance in chemistry at the secondary level of education. Akinfe (2012) opined that chemistry is one of the science subjects one must pass to qualify to offer science related courses at tertiary level of education. However, despite the increase in the number of qualified teachers, the increase in teachers' acquisition of further degrees and their growing experience in the teaching of the subjects, students' performance in chemistry remained poor. This suggests possible problem with the pedagogical content knowledge of chemistry teachers in secondary schools which includes knowledge of what to teach, and how to teach the subject matter effectively and knowledge of the curriculum (Chonjo, Osaki, Possi & Mrutu, 2013; Mushashu, 2010; Sichizya, 2014).

Statement of the Problem

A number of scholars have tried to address the teacher factor in the teaching of chemistry in the Nigeria context by examining chemistry teacher's instructional strategies, laboratory practices and explored their opinions regarding their ability and competence in teaching the subject. Although these have made meaningful contributions to the understanding teaching of chemistry, most of their works were either too narrow as such did not address the holistic nature of pedagogical practices in the teaching of chemistry such as pedagogical content knowledge (PCK). In addition, methodological deficiencies in measuring teacher's knowledge of the subject using survey obscure the real situation. In view of the vital place of chemistry teachers' PCK to students' performance in the subject and as well as the prominence given to teaching experience and qualification in the consideration of teacher subject knowledge, knowledge of the curriculum and instructional strategies, the problem of the study is to ascertain how teaching experience and qualification correlate with chemistry teachers' pedagogical content knowledge (PCK) in secondary schools in Anambra State.

Research Questions

The following research questions guided this study;

1. What is the relationship between teaching experience and subject matter knowledge of chemistry teachers in secondary schools in Anambra State?
2. What is the relationship between teaching experience and chemistry teachers' knowledge of instructional strategies in secondary schools in Anambra State?
3. What is the relationship between teaching experience and chemistry teachers' knowledge of chemistry curriculum in secondary schools in Anambra State?
4. What is the relationship between academic qualification and subject matter knowledge of chemistry teachers in secondary schools in Anambra State?
5. What is the relationship between academic qualification and chemistry teachers' knowledge of instructional strategies in secondary schools in Anambra State?
6. What is the relationship between academic qualification and chemistry teachers' knowledge of science curriculum in secondary schools in Anambra State?
7. How do teaching experience and academic qualification correlate with chemistry teachers' pedagogical content knowledge in secondary schools in Anambra State?

Method

The study adopted a correlation research design. The degree of the relationship is expressed as a coefficient of correlation and the presence of a correlation does not indicate a cause-effect relationship primarily because of the possibility of multiple confounding factors (Upgade & Shende, 2012). This is appropriate for this study because the researchers evaluated academic qualification of teachers and their years of experience as a correlate of the pedagogical content knowledge of chemistry teachers in Anambra State.

The decision to use Anambra State for the study was informed by the fact that the area has a significant number of secondary schools coupled with the fact that there seems to be no extensive study on how teaching experience and qualification predict pedagogical content knowledge of secondary school chemistry teachers in the area. This provided an opportunity for the researcher to determine how teaching experience and qualification correlate with Pedagogical Content Knowledge of secondary school chemistry teachers in Anambra State. The population for this study comprised of four hundred (400) chemistry teachers in the existing 264 public secondary schools in Anambra State of Anambra State (Source: Post Primary School Service Commission, Awka, 2021).

No sampling was taken for the study because the population was considered manageable. The entire study population of 400 chemistry teachers was used as the sample size for the study. This according to Nworgu (2015), makes the study a census survey.

The instrument that was used for the study is a questionnaire. The instrument has four sections. Section A contained items on the demographic data of the respondents. Section B contained 20 twenty questions on chemistry, centered on chemistry teachers' knowledge of the subject matter. Section C contained 10 items on chemistry teachers' knowledge of instructional strategies with response pattern of VA- Very Adequate, A- Adequate, SA- Strongly Adequate and NA- Not Adequate. Section D consisted of five items on chemistry teachers' knowledge of the curriculum as they relate to pedagogical content knowledge of chemistry teachers in Anambra State with response pattern of SA- Strongly Agree, A- Agree, D- Disagree, and SD- Strongly Disagree. The questionnaire as designed by the researchers comprised a total of 38 question items.

Face and content validation of the instrument was conducted by two experts. The reliability of the instrument was established using Cronbach alpha method which yielded correlation coefficients values of 0. 77, 0.89 and 0.82 for sections B, C and D respectively with an overall reliability coefficient of 0.83, which is high enough for the instrument to be adjudged reliable as suggested by Nworgu (2015) that an instrument is reliable when its reliability co-efficient is close to one. The copies of the questionnaire were administered by the researchers by hand. Thereafter, the distributed copies were collected after one week. The researcher was aided by two research assistants who were adequately briefed on the modalities for the administration of the instrument in an appropriate way. The respondents were allowed to complete the questionnaire and return them to the researchers while the research assistants' follow-up respondents with text messages and visited them in their schools to retrieve the remaining copies. This exercise of data collection took a total of two weeks. Out of the 400 copies of the questionnaire distributed, 340 were correctly completed and returned, 28 were incorrectly completed and 32 unreturned. This number accounted for 85 percent returned rate. Pearson product moment correlation and regression analysis were used to answer the research questions. Pearson product moment correlation was used to answer the research questions 1 to 6 while simple regression analysis was used to answer the research question 7. The coefficients of correlation were classified as follows as means of classifying them into the form of relationship they exhibit:

High correlation	$\pm$ 0.70 – 1.00
Moderate correlation	$\pm$ 0.30 – 0.69
Low correlation	$\pm$ 0.00 – 0.29

Results

Research Question One: How does teaching experience correlate with subject matter knowledge of chemistry teachers in secondary schools in Anambra State?

Table 1: Summary of Pearson's correlation between teaching experience and subject matter knowledge of chemistry teachers

N=340

	1	2
Teaching experience	1	
Subject matter knowledge	.824**	1

r. (.824**)= High Positive Relationship

Table 1 indicates a correlation value of .824 showing a high positive relationship between the dependent (subject matter knowledge) and independent (teaching experience) variables. This means that chemistry teachers' teaching experience was a strong factor in predicting their subject matter knowledge of chemistry. This further means that as chemistry teachers' teaching experience increases, their subject matter knowledge of chemistry also increases.

Research Question Two: How does teaching experience corelate with chemistry teachers' knowledge of instructional strategies in secondary schools in Anambra State?

Table 2: Summary of Pearson's correlation between teaching experience and teachers' knowledge of instructional strategies

N=340

	1	2
Teaching experience	1	
Knowledge of instructional strategies	.711**	1

r. (.711**) = High Positive Relationship

Table 2 indicates a correlation value of .71 showing a high positive relationship between the dependent (knowledge of instructional strategies) and independent (teaching experience) variables. This means that chemistry teachers' teaching experience was a strong factor in predicting their knowledge of instructional strategies. This further means that as chemistry teachers' teaching experience increases, their knowledge of instructional strategies also increases.

Research Question Three: How does teaching experience correlate with chemistry teachers' knowledge of science curriculum in secondary schools in Anambra State?

Table 3: Summary of Pearson's correlation between teaching experience and knowledge of science curriculum

N=340

	1	2
teaching experience	1	
knowledge of science curriculum	.782**	1

r. (.782**)= High Positive Relationship

Table 3 indicates a correlation value of .782 showing a high positive relationship between the dependent (knowledge of science curriculum) and independent (teaching experience) variables. This means that chemistry teachers' teaching experience was a strong factor in predicting their knowledge of science curriculum. This further means that as chemistry teachers' teaching experience increases, their knowledge of science curriculum also increases.

Research Question Four: How does academic qualification correlate with subject matter knowledge of chemistry teachers in secondary schools in Anambra State?

Table 4: Summary of Pearson's correlation between academic qualification and subject matter knowledge

N=340

	1	2
academic qualification	1	
subject matter knowledge	.903**	1

r. (.903**) = High Positive Relationship

Table 4 indicates a correlation value of .90 showing a highly positive relationship between the dependent (subject matter knowledge) and independent (academic qualification) variables. This means that chemistry teachers' academic qualification was a strong factor in predicting their subject matter knowledge. This further means that as chemistry teachers' academic qualification increases, their subject matter knowledge of chemistry also increases.

Research Question Five: How does academic qualification correlate with chemistry teachers' knowledge of instructional strategies in secondary schools in Anambra State?

Table 5: Summary of Pearson's correlation between academic qualification and knowledge of instructional strategies

N=340

	1	2
Academic qualification	1	
Knowledge of instructional strategies	.884**	1

r. (.884**) = High Positive Relationship

Table 5 indicates a correlation value of .88 showing a high positive relationship between the dependent (knowledge of instructional strategies) and independent (academic qualification) variables. This is to say that chemistry teachers' academic qualification was a strong factor in predicting their knowledge of instructional strategies. This further means that as chemistry teachers' academic qualification increases, their knowledge of instructional strategies also increases.

Research Question Six: How does academic qualification predict chemistry teachers' knowledge of science curriculum in secondary schools in Anambra State?

Table 6: Summary of Pearson's correlation between academic qualification and knowledge of science curriculum

N =340

	1	2
Academic qualification	1	
Knowledge of science curriculum	.930**	1

r. (.930**) = High Positive Relationship

Table 6 indicates a correlation value of .93 showing a high positive relationship between the dependent (knowledge of science curriculum) and independent (academic qualification) variables. This means that chemistry teachers' academic qualification was a strong factor in predicting their knowledge of science curriculum. This further means that as chemistry teachers' academic qualification increases, their knowledge of science curriculum also increases.

Research Question Seven: How do teaching experience and academic qualification predict chemistry teachers' pedagogical content knowledge in secondary schools Anambra State?

Table 7: Regression analysis of the relationship between teaching experience and academic qualification predict chemistry teachers' pedagogical content knowledge

N	R	R Square	Adjusted R Square	%	Cal. F	Df	P-value	Remark
340	.097	.009	.008	.8	8.50	32	.000	Significant

Table 7 shows that at .05 level of significance, 2 df numerator and 32df denominator the calculated F 8.50 with p-value .000 ($p < .05$). This means that teaching experience and academic qualification relates strongly with chemistry teachers' pedagogical content knowledge in secondary schools Anambra State and the relationship is significant.

Discussion

A correlation value of .824 shows a high positive relationship between teaching experience and subject matter knowledge. More specifically, more experience in teaching positively contributes to chemistry teachers' knowledge of subject matter. This is in line with the findings of Cochran, DeRuiter and King (2013) who found out that novice teachers often are not grounded in their knowledge of the subject matter and this makes them to rely completely on textbooks in their lesions. Elif and Sibel (2007) also had a similar finding that inexperienced teachers have incomplete and superficial levels of pedagogical content knowledge. These findings also agree with Rice (2010) who observed that experienced teachers are effective than their less experienced counterparts. However, this study's finding did not agree with the finding earlier reported to Olfos, Golrine and Estrella (2014) who did not record any difference in the subject knowledge of experienced and less experienced mathematics teachers.

Findings from the study also indicated that teaching experience was a strong factor in the chemistry teachers' knowledge of instructional strategies with a correlation value of .71 showing a high positive relationship between teaching experience and chemistry

teachers' knowledge of instructional strategies. More specifically, more experience in teaching positively contributes to the chemistry teachers' knowledge of instructional strategies. This is in line with the recent findings reported by other scholars in the Nigerian setting such as Bello (2015) who found that teachers' ability to use laboratory equipment in the teaching of chemistry depended on their years of teaching experience. However, contrary to the findings of the present study reported by Sarpong and Apaak (2016) is that no significant relationship existed between teaching experience of fitness instructors and their knowledge of instructional strategies. The non-significant contribution of teaching experience in explaining teachers' knowledge of instructional strategies may be linked to younger generation teachers' exposure to information through the internet more than the older and more experienced teachers.

The results reported in Table 3 showed that teaching experience was a strong factor in predicting the chemistry teachers' knowledge of curriculum with a correlation value of .78 showing a high positive relationship between teaching experience and chemistry teachers' knowledge of science curriculum. This finding supports the findings reported by Mthethwa-Kunene (2014) who noted that chemistry teachers developed their knowledge of nature of mathematics through classroom experience. This suggests that the teacher is with more experience in the teaching of the subject; there would be more knowledge of curriculum.

One of the aims of this study was to find out how academic qualifications relates to chemistry teachers' knowledge of subject matter. The result showed that academic qualification was a strong factor in relating with the chemistry teachers' knowledge of subject matter with a correlation value of .90 showing a high positive relationship between academic qualification and chemistry teachers' knowledge of subject matter. This finding agrees with Na'Omi (2013) who found that academic achievement of students taught by chemistry teachers with B.Sc (Ed.) was significantly higher than the academic achievement of the students taught by NCE teachers. This suggests that the higher the teachers' qualification the better the subject matter knowledge and the greater impact on students' academic achievement. Although teaching experience was a significant predictor of teachers' subject matter knowledge, academic qualification made greater contribution than teaching experience. This disagrees with Rice (2010) observation that teaching experience makes greater impact on teachers' effectiveness than teaching qualification.

This study also found that the academic qualification has a strong relationship with chemistry teachers' knowledge of instructional strategies according to the result, with a correlation value of .88 showing a high positive relationship between academic qualification and knowledge of instructional strategies. Therefore, it means that the more qualified a teacher is, the more likely the teacher will have better knowledge on how to teach chemistry. This finding agree with the findings reported by Bello (2015) which showed that chemistry teachers' qualification affect their ability to use laboratory equipment in teaching of chemistry. This does not agree with the observation reported by Grossman (1990 cited in Yinna, 2015) that teacher qualification and teaching experience are not sufficient in the improving of teachers' pedagogical content knowledge, but more subject-specific courses in supporting teachers' understanding of the subject is important. Therefore, teachers' engagement in continuing professional development might moderate the predictive power of teacher qualification for knowledge of instructional strategies.

The study found that academic qualification is a strong factor in predicting chemistry teachers' knowledge of science curriculum according to the result reported in table 6 with a correlation value of .93 showing a high positive relationship between academic qualification and knowledge of science curriculum. This means that the higher the academic qualification the more the teacher has knowledge of science curriculum. This finding disagrees with the findings reported by Mthethwa-Kunene (2014) which showed that there are other factors that teachers identified as contributing to their knowledge of chemistry which included peer support and school characteristics.

The main aim of this study was to ascertain how well both teaching experience and academic qualification predict chemistry teachers' pedagogical content knowledge (PCK). The findings show that these two predictors made significant contribution to teachers' pedagogical content knowledge with the result in Table 7 (Cal F 8.50, $p<0.05$). This suggests that it is likely that a teacher with more years of teaching experience as well as a higher academic qualification will have greater PCK than the teacher with lower teaching experience and qualification. This finding agrees with the previous studies (Abd-El-Khalick, 2006) and the theoretical proposition by Shulman (1989) that experience and qualification influence the development of teachers' pedagogical content knowledge. However, the finding is not consistent with the findings reported by Sarpong and Apaak (2016). This difference could be explained by

small sample size used by the researchers which could have led to their not getting a significant relationship when, in fact, there was a significant relationship.

Conclusion

The study set out to ascertain how teaching experience and academic qualification predict Pedagogical Content Knowledge (PCK) of chemistry teachers in Anambra State. It was found that at .05 level of significance, the calculated F 8.50 with p-value .00 (< .05), teaching experience and qualification predict chemistry teachers' PCK and also significant. It was therefore concluded that teaching experience and qualification are significant predictors of chemistry teachers' pedagogical content knowledge in Anambra State.

Recommendations

Based on the implications of the study highlighted above, the following recommendations are made;

1. Since teaching experience predicts chemistry teachers' pedagogical content knowledge, training programme for pre-service teachers and new teachers should be made to be experiential. This involves giving them ample opportunities for classroom teaching environment.

2. Chemistry teachers with lower educational qualifications like NCE and B.Sc (Ed) should be supported to go for further training to acquire their Masters' degree and PhD. This support could be informed of study leave and financial support by the State government. This will enable them develop their pedagogical content knowledge in the subject.

3. Teaching experience and qualification should be considered in the promotion and other teacher-related decisions.

4. Chemistry teachers' qualification and experience should be applied in the selection of teachers for the mentoring of novice chemistry teachers.

5. Government should send teachers on advanced programme and studies to get them better equipped for the challenges of teaching chemistry in the contemporary global village.

6. The time allotted to chemistry in the school time table should be increased. This is to give room for the use of relevant teaching methods and aids for the subject.

7. Schools should be provided with good structures especially libraries by the government as this will accord the learners the opportunity of learning from variety of sources.

8. The government should try to provide schools with modern ICT and internet facilities for learning. This is because of the high cost of these materials and left on their own, individual students and schools cannot afford such materials.

References

Abd-El-Khalick (2006). Specific Subject Matter Structures: *Implications for Conceptions of Pedagogical Content Knowledge.* Junior Secondary School Pupils. *European Journal of educational. Eurasia Journal of Mathematics, Science and Technology Education, 2(1);* 1 - 29 Retrieved April 21, 2013 from http://www.ejimste.com/012006/dl.pdf.

Adebajo, Y.A. (2017). Teacher Education and Practice in Nigeria: *Challenges and the way forward*. A paper presented at the 2nd matriculation ceremony of National Teachers Institution Degree Programme, Ilese Study Centre, Ogun State, 1-2.

Adedoyin, O. O. (2011). The Impact of teacher's in- depth pedagogical mathematical content knowledge on academic performance: As perceived by *Botswana Studies 3(2);* 201-220.

Afolabi, Folashade, (2009). Teachers' Attitude and Gender Factor as Determinant of Pupils' Performance in Primary Science. *African research review*: *An International Multi-Disciplinary Journal, 3 (1);20-29.*

Agusbo, B. C. (2008). *Laboratory and Resources Utilization: Finding by Integrated Science Teacher,* Education Journal, Enugu: Choice Publishers.

Ajayi, E. O. A. (2017). *Global Trends and emerging Issues in Teacher Education in Nigeria.* Keynote address delivered on the 2nd Teachers' Registration Council of Nigeria (TRCN) Induction for Graduates of Education, Olabisi Onabanjo University.I.

An, S.,Kulm, G., & HiWu, Z., (2004). The pedagogical Content Knowledge of Middle school, mathematics teachers in China and the U.S. *Journal of Mathematics Teacher Education, 7,145-172.*

Ball, D.L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education, 51, (3);241-247.*

Bello,S. (2015). Effect of some teachers' factors on the conduct of effective chemistry practical lesson. *Journal of Educational Research and Review,4(3); 048 - 054.*

Berliner, D.C. (1988). In pursuit of the expert pedagogue. *Educational Researcher, 15,5-3*.

Berliner,D.C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research, 35, 463-482.*

Bilesanmi-Awoderu, J.B. (2012). *Science Education in Nigeria; Drawing but Waving*, 52nd Inaugural Lecture, Olabisi Onabanjo University, Tunfas Printing Press, Nigeria. 10-11.

Bogdan, R.C., & Biklen, S. R. (1992). *Qualitative Research for Education: An introduction to Theory and methods* (2nd ed.), Boston, MA: Allyn & Bacon.

Bond- Robinson J. & Rodriques R.A.B. (2005). Instruments to drive effective constructivism laboratory teaching, *The Chemical Educator,* 10, 1-9, Center.

Borko, H. & Putnam, R. (1996). Learning to teach. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology*. New York : MacMillan.

Buamert, J., & Kunter, M. (2006). Stichwort: Professionelle Kompetenz von Lehrkräften (Keyword: Professional competencies of teachers). *Zeitschrift fürerziehungswissenschaf (9);* 469 – 520.

DeBoer, G. E. (1991). *A history of ideas in science education: Implications for practice.* New York, NY: Teachers College Press.

Elif, B. Turnuklu and Sibel Yesildere (2007). *The pedagogical Content Knowledge in mathematics: Perspective Primary Mathematics Teachers' Perspectives in Turkey. IUMPST: The Journal, vol. 1 (Content Knowledge),* October 2007. Retrieved on February 25, 2013 from http://www.k-12prep.math.ttu.edu.

Ernest, P. (1989). The impacts of beliefs on teaching of mathematics. In P. Ernest (Ed.), *Mathematics* teaching: The state of Art (pp. 249-245). New York: Falmer.

Federal Ministry of Education (2008). *National Curriculum for Senior Secondary School Chemistry.* Lagos: Government Press.

Federal Republic of Nigeria (2004). *National Policy on Education, Lagos:* Heinemann Educational Books

Fouad Abd- El- Khalick (2006). Preservice and Experienced chemistry Teachers' Global and Specific Subject Matter Structures: Implications for Conceptions of Pedagogical Content Knowledge. *Eurasia Journal of Mathematics, Science and Technology Education, 2,* Number 1, February 2006.

Gess- Newsome, J., & Lederman, N.G. (1993). Pre-service chemistry teachers' knowledge structures as a function of professional teacher education: A year- long assessment. *Science Education, 77(1);* 25-45.

Glynn, S. M., Yeany, R.H., & Britton, B.K. (1991). A constructive view of learning science. In S. M. Glynn, R. H. Yeany, & B. K. Britton (Eds.), *The pyschology of learning science* (pp. 3-19). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Grossman, P. L. (1990). *Marking of a teacher: Teacher Knowledge and Teacher Education.* New York: Teachers College Press.

Grouws, D. & Schultz, K. (1996). Mathematics teacher education. In J. Sikula (Ed) *Handbook of Research on Teacher Education,* 2nd edition. USA: Macmillan.

Hill, H. C. Ball, D. L. & Schilling, S. G. (2094). Developing measures of teachers' mathematics knowledge for teaching. *Elementary School Journal,* 105; 11-30.

Hill, H. C. Rowan, B., & Ball, D. L. (2005). Effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement. *American education Research Journal, 42;* 371-406.

Judy M, Alister J and Bronwen C (2006). Developing Pedagogical Content Knowledge for the New Sciences: The example of biotechnology. *Teaching Education, 17(2);143-155.*

Kember, D. (1998). Teaching beliefs and their impact on students' approach to learning. In B. Dart, & G. Boulton-Lewis, *Teaching and Learning in Higher Education. Melbourne;* Australian Council for Educational Research.

Koballa, T. R., Glynn, S. M., Upson, L., & Coleman, D. C. (2005). Conceptions of teaching science held by novice teachers in an alternative certification program. *Journal of Science Teacher Education, 16,* 287-308.

Krauss, S., Brunner, M., Kunter, M., Baumert, J., Blum, W., Neubrand, M., et al. (2008). Pedagogical Content Knowledge and Content Knowledge of Secondary Mathematics Teachers. *Journal of Educational Psychology, 100(3)*; 716-725.

Lamidi, B.T., Oyelekan, O.S. & Olorundare, A.S (2015). Effects of mastery learning instructional strategy on senior secondary school students' achievement in the mole concept. *Electronic Journal of Science Education, Southwestern University/ Texas Christian University, 19(5); 1-20.*

Lee, E., Brown, M. N., & Luft, J. A. (2007). *Assessing beginning secondary science teachers' PCK: Pilot year results*. A paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA.

Lee, E., Brown, M.N., & Luft, J. A. & Roehrig, G. H. (2007). *Assessing beginning secondary science teachers' PCK:* Pilot year results. *School Science and Mathematics, 107;* 52-68.

Loughran, J., Berry, A., & Molhall, P. (2006). *Understanding and developing science teachers' pedagogical content knowledge,* Rotterdam: Sense Publications.

Loughran, J.J., Mulhall, P., & Berry, A. (2004). In search of pedagogical content knowledge in science: Developing ways of articulating and documenting professional practice. *Journal Research in Science Teaching, 41;* 370 -391.

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources and development of pedagogical content knowledge for science teaching. In J. Gess - Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge: The construct and its implications for science education* (pp. 95-132). Boston: Kluwer.

Marion, R., Hewson, P. W., Tabachnick, R., & Blomker, K. B. (1999). Teaching for conceptual change in elementary and secondary science methods courses. *Science Education, 83,* 275-307.

Mthethwa- Kunene, K. F. (2014). *Exploring science teachers' pedagogical content knowledge in the teaching of genetics in Switzerland*. A Doctoral Dissertation submitted to University of South Africa, Pretoria.

Munby, H., Russell, T., & Martin, A. K. (2001). Teachers' Knowledge and how it develops. In V. Richardson (Ed.), *Handbook of Research on Teaching* (fourth ed., pp. 877-904). Washington; American Research Association.

Nworgu, B. G. (2015). *Educational research: Basic issues and methodology*. Nsukka: University Trust Publishers.

Okigbo, E.C & Okekeokosisi, J.O.C. (2014). Nature and History of Science. Awka: Fides Communications.

Okigbo, E. C. & Okoli, J.N. (2016). Techniques use by Science, Technology and Mathematics (STM) teachers for controlling undesirable classroom behaviours in Anambra State secondary schools. *Educational Research and Review, 11(11);* 1025-1034.

Okpala,N. P. and Onocha, C. O. (1995). *The Effect of Systematic Procedures on Students' Achievement in Mathematics and Science Subjects.* UNESCO-AFRICA. (A six month journal of Darkar UNESCO, Regional office in Africa) no 10 55-61.

Olfos, R., Goldrine, T. & Estrella, S. (2014). Teachers' pedagogical content knowledge and its relation with students' understanding. *Revista Brasileira de Educação,* 19 (59).

Olorundare, A.S. (2014). Theory into Practice: Beyond surface curriculum in science education. *The 147th inaugural lecture, University of Ilorin, Ilorin, Nigeria.*

Omoregbe, E. & Ewansiba, J.C. (2013). The challenge of effective science teaching in Nigerian secondary schools. *Academic Journal of Interdisciplinary Studies, 2, (7);*181-188.

Osuafor, A. & Okonkwo, I. (2013). Influence of family background on academic achievement of secondary school Biology students in Anambra State. *An International Multidisciplinary Journal, Ethiopia, 7(30);* 156-167.

Piaget, J.(1959b). Apperrentissage et connaissance. (Learning and Knowledge). Etudes d' Epistemologie Genetique, volt 10. Paris: Presses Universitaires de France.

Rice, J. K. (2010). The impact of teacher experience: Examining the evidence and policy implication. United States. *National Center for Analysis of Longitudinal Data in Education Research.*

Sarpong, E. O., & Apaak, D. (2016). Assessing the predictors of content and pedagogical knowledge of fitness instructors in the Greater Accra Region of Ghana. *Journal of Education and Practice, 7(5);* 1-6.

Schwartz, C. V., & Albert M. (1998). Developing a learning progression for scientific modeling: Making scientific modeling accessible and meaningful for learners. *Journal of Research in Science Teaching, 46,* 632-654.

Shkedi, A. & Laron, D. (2004). Between idealism and pragmatism. A case study of student teachers' pedagogical development. *Teaching and Teacher Education, 20;* 693-711.

Shubert, W. H. (1992). Personal theorizing about teacher personal theorizing. In E. W. Ross, J. W. Cornett, & G. McCutcheon (Eds.) *Teacher personal theorizing: Connecting curriculum practice, theory and research* (257-277). Albany, NY: State University of New York Press.

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

Teachers Registration Council of Nigeria (2010). *Teacher Professionalism: The Role of Teachers Registration Council of Nigeria.* University Press.

Tebabal, A. & Kahssay, G. (2011). The effects of student-centered approach in improving students' graphical interpretation skills and conceptual understandiong of kinematical motion. *American Journal of Physical Education, 5(2);* 374-381.

UNESCO (2013) Education: Inclusive education, Retrieved 11 /06/2017 from www.//portal.unesco.org/education.

Upgade, V and Shenda, V. (2012). *Research Methodology.* Second Revised Edition. New Delhi: SChand and Company Ltd.

Van Driel, J. H., & Berry, A. (2010). Pedagogical Content Knowledge. In P. Peterson, E. Baker & B. McGaw (Eds.), *International Encyclopedia of Education* (pp. 656-661). Oxford: Elsevier.

Veal, W. R. & MaKinster, J. G. (1999) Pedagogical Content Knowledge Taxonomies *Electronic Journal of Science Education.*Retrieved December 20, 2012 from http://unr.edu/homepage/ crowther/ejse/vealmak.html.

WAEC Chief Examiners Reports (2005, 2006, 2007, 2008, 2009 and 2010). *Publication of WAEC office,* Lagos.

West Africa (WAEC) (2015). *May/June 2013 WASSCE Chief Examiner's Report.* Lagos: WAEC.

Yinna, Z. (2015). Pedagogical Content Knowledge in Early Mathematics: What Teachers Know and How It Associates with Teaching and Learning (2015). *Dissertations.* Paper 1499. Retrieved from http://ecommons.luc.edu/luc_diss/1499.