Teachers' Knowledge Indices as Predictors of Secondary School Students' Academic Achievement in Kwara State, Nigeria

Felicia Olasehinde-Williams
University of Ilorin, Nigeria

Lasiele Yahaya
University of Ilorin, Nigeria

Henry Owolabi
University of Ilorin, Nigeria

Abstract

That less than 40% of candidates who took the Senior School Certificate Examinations in Nigeria between 2009 and 2015 had credits and above in English language and Mathematics has become a source of worry to all stakeholders. Results of research efforts to provide plausible explanations to the problem have been inconclusive. Also, not much had been done to assess the contribution of teachers' knowledge indices as likely sources. This study therefore investigated the predictive value of Teachers' Depth of Subject Content Knowledge and Depth of Pedagogical Knowledge on Students' Academic Achievement in English Language and Mathematics. Specifically, the study investigated which category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc) had the deepest Depth of Subject Content Knowledge; the deepest Depth of Pedagogical Knowledge; the deepest Depth of Subject Content and Professional Knowledge; and the predictive ability of Depth of Subject Content and Professional Knowledge for Students' Academic Achievement. The sample comprised seventy-eight English Language and Mathematics teachers from thirty-two randomly selected secondary schools in Kwara State; and the intact SS II classes taught by the teachers. Quantitative data were collected through tests, observations and vignettes; and analysed using descriptive and inferential statistics. Findings showed that teachers with B.Sc. demonstrated the deepest Depth of Subject Content Knowledge, Depth of Pedagogical Knowledge and Depth of Subject Content and Professional Knowledge. Also, pedagogical and subject content knowledge of teachers were found to be significant predictors of Students' Academic Achievement. Significant differences were observed between the Depth of Subject Content Knowledge and Depth of Pedagogical Knowledge of the English Language and Mathematics teachers in favor of Mathematics teachers. Similarly, students' performance in English Language was lower than that of Mathematics, though not statistically significant. These findings raised concerns of profound implications for teacher education curriculum in Nigeria.

Keywords: teacher knowledge, subject content, pedagogical content, academic achievement, teacher attributes, teacher education curriculum

Introduction

Secondary education has remained a major gateway to higher education and employment for those who may not proceed beyond that level. Most citizens attending schools have thus not considered themselves to have been sufficiently prepared to function in the Nigerian society until they have graduated from secondary schools. Successful completion, and particularly having credit passes in English Language and Mathematics, are necessary for all secondary school graduates. Policy on education has made these subjects compulsory to be offered and passed, as well being required to advance to higher levels of education. There is, however, unsatisfactory performance in certificate examinations at this level as the rate of failure has been considered high by stakeholders.

The high rate of students' failure in Senior Secondary Certificate Examinations (SSCE) has become a perennial source of worry to all stakeholders in the education sector in Nigeria. The same is true of its equivalents, such as the General Certificate Examination (GCE), and the University Tertiary Matriculation Examination (UTME). In 2015, for instance, more than 60% of students failed English Language in the SSCE; while only 38.6% candidates obtained credit in five subjects including English and Mathematics (West African Examination Council, 2015). There is a need to reverse this trend because poor performance in SSCE leads to colossal wastage of educational investment and reduction in quantity and quality of candidates accessing tertiary education. It also limits students' learning effectiveness which, in turn, compromises quality of tertiary education products in terms of cognate ability and service delivery competence.

Various efforts by education researchers to provide a valid explanation for the trend have not yielded conclusive results. For instance, Tella (2007) investigated the impact of motivation on secondary school students' Mathematics achievement in Nigeria. He reported that there was a significant difference in Mathematics achievement of students on the degree of their motivation. McDonald (2001) also found that two thirds of high school students appeared to have experienced an uncomfortable level of test anxiety which consequently had a negative effect on their academic performance.

Any solution to the problem of high failure rates in SSC Examinations should also involve critical assessment of the contributions of teacher quality in the discharge of their responsibilities as learning facilitators. Although learning can take place without teaching, the roles of the teacher as facilitator of learning are indispensable in the field of education (Figure 1).

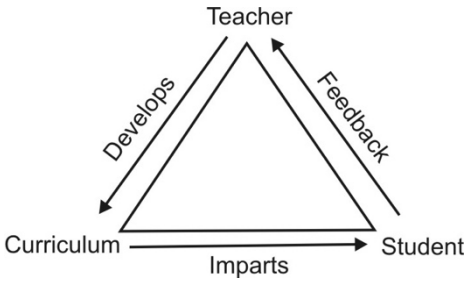

Figure 1: Components of the teaching-learning relationship
(Source: Olasehinde-Williams, 2012)

As shown in Figure 1, teachers have responsibilities to gather information to determine what subject content to teach, develop curriculum, determine the strategies and methods for teaching, impart knowledge, evaluate teaching and learning and finally provide feedback. Teachers can only teach "what" they know in the ways they know "how" to teach. Thus, the significance of having high quality teachers in the teaching-learning relationship cannot be over-emphasised. Indeed, the pivotal roles of quality teachers in providing quality education are well documented in the National Policy on Education (Federal Republic of Nigeria, 2013). The Teachers Registration Council of Nigeria (TRCN) also noted that "no education system can rise above the quality of its teachers" (TRCN, 2004, p.8).

Agoro and Akinsola (2013) and Ladipo (2013), for instance, suggested that poor teacher quality is one of the significant factors responsible for the consistently poor performance of secondary school students in public examinations in the country. Teacher quality is generally believed to be basically dependent on the nature of the training that teachers receive and there is no doubt that teachers differ in their depth of knowledge of the "what" to teach and the "how" to teach basically because of disparities in their own pre-service training. In Nigerian secondary schools, for example, two categories of teachers (qualified and non-qualified teachers), from three different learning paths, are responsible for preparing students for public examinations.

Two of the three learning paths qualify individuals for the teaching profession in Nigeria. Firstly, during training, individuals may combine core teacher education courses (Pedagogical Knowledge) with minor teaching subject courses (Subject Content Knowledge) for a period of three to four years, for the award of the Bachelor in Education Degree. Secondly, individuals may first obtain an Honors degree (Bachelor of Science or Bachelor of Arts) in one or two subjects (Subject Content Knowledge) and later undertake a one-year Postgraduate Diploma in Education (PGDE) Certificate (Pedagogical Knowledge). Although the proportions of teaching subject and education courses both groups undertake are not the same, it is generally assumed that both include sufficient proportions to produce competent teachers (Abimbola, 2012). Consequently, both categories of teachers are accorded professional teacher status and are qualified for formal admission into the teaching profession upon registration with the TRCN. Non-qualified teachers, on the other hand, are individuals who also teach in Nigerian secondary schools with Honors Degrees in Science, Social Sciences and Arts-related courses without undertaking any education course at all in the university. Since such teachers have exposure to Subject Content Knowledge only, without Pedagogical Knowledge, they are categorised as non-professional teachers and are not qualified for formal admission into the teaching profession.

These categories of teachers, professional and non-professional, have been receiving criticisms from major stakeholders in the education sector. In respect to the learning paths to teacher certification, there are concerns that the teaching subject courses offered by B.Ed/B.Sc. Ed. /B.A. Ed. graduates, and the pedagogical content knowledge in the PGDE format may not be sufficiently adequate to make for sufficiently competent and effective teachers. For instance, education students minor in their teaching subjects and devote a substantial part of their training to pedagogical knowledge and skills. In the same way, PGDE students would have acquired more of subject content knowledge since they had earlier obtained their degrees and have thus also obtained less pedagogical knowledge and skills. Similarly, there are concerns that unprofessionally trained persons recruited as teachers in Nigerian secondary schools are mostly graduates in various disciplines that may or may not even be related to the subject that they were recruited to teach.

It was assumed in this study that such discrepancies in the professional and academic qualifications of teachers will likely be reflected in the teachers' depth of subject content and pedagogical knowledge; in the ways they discharge their roles as facilitators of learning (Henze, Driel & Verloop 2008); and consequently in the ways they impact their students' academic achievement.

High rates of failure will be unexpected when the teachers and their teaching are very positive, and the results obtained contradict their input. It is unwanted when effort by the teacher is not strong enough to bring about expected success. Though the study of secondary school students in Kenya by Waseka, Simatwa and Okwach (2016) showed the expected result that teachers with the Bachelor of Education qualification significantly influenced their students' performance, it also revealed the unexpected outcome with the discovery that teachers with the Master of Education or Diploma qualifications did not significantly influence the performance of their students. There is a contradiction when holding a higher degree like Master of Education does not contribute significantly to the prediction of students' performance. It is necessary to clarify contradictions like this with research and to particularly determine whether the teachers have deficiency in subject content or pedagogical knowledge.

The holistic learning theory stressed by psychologists such as Piaget and Bloom provide the theoretical underpinning for this assumption. Piaget (1936) and Bloom (1956) identified three learning domains to which students must be exposed: Cognitive Learning (acquisition of knowledge through direct teaching); Affective Learning **(**acquisition of feelings, values, motivation and attitudes through the process of observation); and Psychomotor Learning **(**acquisition of skills through observation and practice). However, effective and holistic learning must involve all the three: that is stimulate critical thinking, stimulate interest and develop skill.

For instance, Hill, Rowan and Ball (2005) explored whether and how teachers' mathematical knowledge for teaching contributes to gains in students' mathematics achievement. Findings of the study showed that teachers' mathematical knowledge was significantly related to students' achievement gains in both first and third grades; and provided support for policy initiatives designed to improve students' mathematics achievement by improving teachers' mathematical knowledge. Baumert et al. (2010) investigated teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. Findings of the study showed that teachers with a higher PCK score created better lessons, which had positive effects on the students' content knowledge and test results.

Adediwura and Bada (2007) investigated perception of teachers' knowledge, attitude and teaching skills as predictors of academic performance in Nigerian secondary schools. They found that students' perception of teachers' knowledge of subject matter, attitude to work and teaching skills were significantly related to students' academic performance. In an ongoing study related to teacher professional knowledge, Olasehinde-Williams, Yahaya, Sanya, Owolabi & Jimoh are investigating the comparative effectiveness of teaching strategies (Collaborative, Critical thinking and Technology-integrated teaching strategies) in reducing secondary school students' failure in Senior School Certificate English Language Examination in Kwara State, Nigeria. Preliminary findings of the study suggest the superiority of each strategy over the traditional teaching strategy.

Studies by Abell (2007) and Baumert et.al. (2010) have focused on the impact a single teacher variable on students' academic achievement. Abell (2007), Park and Oliver (2008) Lee and

Luft (2008), and Baumert et.al. (2010) have investigated the impact of teacher variables on students' academic achievement in one subject only and they focused especially on Science subjects. Findings of most of the studies are generally inconclusive (Park & Oliver, 2008). Besides, most of the studies were conducted in other settings and as such their findings are not directly applicable to Nigeria because of socio-cultural differences. Thus, the apparent dearth of studies on the extent to which teachers' subject content knowledge and pedagogical knowledge relate to students' academic achievement in Nigeria made this study imperative.

Literature Review

Critical insights for the study were gleaned from extant literature related to teacher professional knowledge, data gathering techniques and study approach as conceptualized in this study. As early as 1987, Shulman had distinguished seven categories teachers' professional knowledge: content knowledge; curricular knowledge; pedagogical content knowledge; general pedagogical knowledge; knowledge of learners and their characteristics; knowledge of educational contexts; and knowledge of educational ends, purposes and values (1987). Subsequently, researchers identified specific components for study, which also informed their choice of measurement techniques. For instance, Kirschner, Borowski and Fischer (2010) focused on three levels of teachers' knowledge areas (i) declarative knowledge, (ii) procedural knowledge and (iii) conditional knowledge including teachers' reactions to critical teaching situations, which they measured through experiments, teaching strategies and vignettes (that is, describing short situations in a classroom).

Baumert et al. (2010) focused on teachers' knowledge of science and the teaching/learning process as components of teacher professional knowledge and gathered data through paper and pencil tests as well as observation of videotaped lessons. Henze, Driel and Verloop (2008) focused on teachers' knowledge about instructional strategies concerning a specific topic; students' understanding of the topic; ways to assess students' understanding of the topic; and goals and objectives for teaching the specific topic in the curriculum. To measure these components, in the Netherlands, the researchers followed nine teachers for a period of three years in their natural settings to see if, and how, their initial Pedagogical Content Knowledge (PCK) developed while they were teaching a new subject.

The Research Study

To address some of the gaps in our current understanding of the important factor of student academic achievement, this preliminary study investigated the relative contributions of teachers' training background to their depth of subject content and pedagogical knowledge as well as the extent to which teachers' subject content and pedagogical knowledge improve students' learning outcomes in two core subjects, English Language and Mathematics ,which are compulsory for all secondary school students in Nigeria. The goal of the study was to establish the impact of teacher professional knowledge on students' learning outcomes. Specifically, 4 research questions were addressed and 3 hypotheses tested in the study.

Research Questions

1. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the deepest Subject Content Knowledge?
2. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the most adequate DPK?

3. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the strongest DSCPK?
4. What is the predictive ability of teachers' DSCPK for students' success in examination?

Hypotheses

1. There is no significant difference in the depth of pedagogical knowledge between sampled English Language and Mathematics teachers.
2. There is no significant difference in the subject matter content knowledge between sampled English Language and Mathematics teachers.
3. There is no significant difference in the performance between sampled senior secondary school English Language and Mathematics students.

To these researchers' minds, empirically determining what mix of teacher subject content and pedagogical knowledge best predicts students' learning outcomes is critical to reversing the current trend of high failure rate of students in public examinations in Nigeria. Such a reversal, it was hoped, would enhance the quality and quantity of candidates accessing tertiary education, enhance the quality of tertiary education products in terms of cognate ability and service delivery competence and, consequently, boost the nation's developmental status.

In this study, three components of teachers' professional knowledge and the extent to which they impact student learning outcomes were investigated:

1. Depth of Subject Content Knowledge (DSCK);
2. Depth of Professional Knowledge (DPK);
3. Depth of Subject Content and Professional Knowledge (DSCPK), patterned after Gess-Newsome's (1999) integrative knowledge category;
4. Students' Academic Achievement (SAA);
5. Differences in DSCK and DPK of teachers and their SAA in English Language and Mathematics; and
6. Difference in students' academic achievement in English Language and Mathematics.

Figure 2, developed by the researchers, presents the schematic representation of how the variables were controlled.

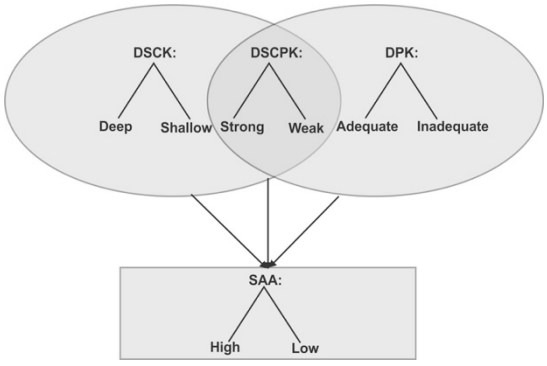

Figure 2: Schematic representation of DSCK, DPK, DSCPK and SAA

(Note:
DSCK: Depth of Subject Content Knowledge, whether Deep or Shallow
DPK: Depth of Pedagogical Knowledge, whether Adequate or Inadequate
DSCPK: Depth of Subject Content and Pedagogical Knowledge, whether Strong or Weak
SAA: Student Academic Achievement, whether High or Low)

Methodology and Methods

The research design adopted for the study was descriptive survey because of its capacity to allow assessment of certain attributes, properties or characteristics in a situation at one or more point in time (Hassan, 1995). Originally, the plan was to sample two hundred Senior Secondary II (SSII) English Language and Mathematics teachers from 10 randomly selected secondary schools across the three Senatorial Districts of Kwara State (that is, Kwara North, Kwara Central and Kwara South), but the reality of the situation in the field altered this plan because most of the schools had only 1 teacher each for SSII English Language and Mathematics. Consequently, the number of secondary schools was increased to 32, randomly selected across the three Senatorial Districts of the State. This was done to ensure fair representation of every part of the State. Thus, all the available SSII teachers of English Language and Mathematics in each of the 32 schools, totaling 78, participated in the study. These purposively sampled participants provided data on DSCK and DPK for the study. At the learners' level, classes of SSII students of each teacher-participant took part in the study so that their test scores could be readily matched with their teachers' DSCK, DPK and DSCPK.

Instruments employed for data collection were paper and pencil tests, used to measure teachers' DSCK and students' achievement in both subjects, and observation of teaching strategies and vignettes, that is short classroom situations to which teachers responded to measure their DPK, because of the potential of such multiple data sources to yield valid, rich, comprehensive and reliable data. Face and content validity, as well as test-re-test reliability measures of the objective tests and vignettes were determined. Observation of class teaching and management were subjected to inter-rater validity. The internal consistency reliability measures of the DSCK and DPK objective tests were 0.94 and 0.82 respectively, while 0.62 and 0.63 were obtained for the English Language and Mathematics objective tests respectively. All the instruments yielded quantitative data.

Members of the research team and trained research assistants, comprising lecturers and Ph.D. students of Educational Measurement and Evaluation, were involved in the data collection. Ethical guidelines for research and data collection were carefully observed. Data gathering spanned three weeks and occurred in the second school term to enable substantial coverage of the syllabus to enhance the validity of students' academic achievement. Measures of students' academic achievement were obtained about one week into the schools' official examination period so as not to disrupt the school program and to fall within a period when students naturally prepared for end-of -term examinations. The maximum possible score on the test of teachers' DSCK and DPK was 100%, where 60–100% indicated Deep Knowledge and less than 50% indicated Shallow Knowledge. Similar rating was adopted for the students' Academic Achievement Test, with 60–100% indicating high achievement and less than 50% indicating low achievement.

Results

Seventy-eight SSII teachers of English Language and Mathematics were sampled as participants in the study from the three Senatorial Districts of Kwara State, Nigeria. However, only 75 of them participated fully in the study by making their lesson notes available for inspection, subjecting their lessons to observation, completing the paper and pencil test, responding to the vignettes and having the students taught by them assessed. The 75 participants comprised 33 female and 42 male teachers. Thirty-nine of the participants were English Language teachers while the other 36 taught Mathematics. Their ages ranged from 21–

60 and they had between 1 and 30 years of teaching experience. Answers to the four research questions are presented below.

1. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the deepest Subject Content Knowledge (DSCK)?

Assessment of the sampled teachers' DSCK was carried out through observation of the content of lessons, taught using the Faculty of Education's, University of Ilorin, teaching practice assessment format, and also by responses to a cognate test scored in percentage. The mean score on both measures was calculated and each category of teachers compared with the mean. A summary of the assessment is presented in Table 1.

Table 1: Mean Scores of teachers' Depth of Subject Content Knowledge (DSCK)

Qualification	**Frequency**	**Mean Score in Percentage**
PGDE	2	44.00
NCE	4	44.75
B.A. Ed.	21	49.43
B.Sc. Ed.	11	57.83
B.A.	16	59.69
Others	8	62.19
B.Sc.	13	65.42
Total	75	Grand Mean = 56.59

As shown in Table 1, the grand mean of DSCK among teachers was 56.59%. The lowest mean score was observed among teachers with a PGDE (44%); mean score of 49.43% was obtained by holders of a B.A. Ed and this was lower than the grand mean. Teachers having a B.Sc. Ed. degree with a mean score of 57.83% were better than their B.A, Ed counterparts (49.43%); while teachers with a B.Sc. had the deepest mean DSCK of 65.42%.

2. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the most adequate Depth of Pedagogical Knowledge (DPK)?

Sampled teachers were exposed to an assessment of DPK through observation of their involvement in classroom processes, responses to vignettes and personal interview. Based on their responses, each of them was scored in percentage and the mean score for each category of teachers was calculated. A summary of the assessment is presented in Table 2.

Table 2: Mean Scores of tTeachers' Depth of Pedagogical Knowledge (DPK)

Qualification	N	Mean Score
B.A.	16	41.13
NCE	4	44.75
Others	8	49.63
B.A. Ed.	21	50.90
PGDE	2	53.00
B.Sc. Ed.	11	54.73
B.Sc.	13	56.08
Total	75	Grand Mean = 49.87

Table 2 shows that, despite generally low levels of depth of pedagogical knowledge, of the mean scores demonstrated by the sampled teachers, those holding the B.A. degree had the poorest mean score of 41.13%; while B.A. Ed., PGDE, B.Sc. Ed. and B.Sc. teachers recorded above average mean scores of 50.90%, 53%, 54.73%, and 56.08% respectively. The teachers with the most adequate depth of pedagogical knowledge were those holding the Bachelor of Science degree (56.08%).

3. What category of teachers (B.Ed. /B.Sc.Ed. /B.A.Ed.; PGDE; or B.A. /B.Sc.) has the strongest Depth of Subject Content and Pedagogical Knowledge (DSCPK)?

Scores on the measures of DSCK and DPK were added and the mean score for each category of teachers summarized as presented in Table 3.

Table 3: Mean scores of teachers' Depth of Subject Content and Pedagogical Knowledge (DSCPK)

Qualification	Frequency	Mean score out of 200
NCE	4	89.50
PGDE	2	97.00
B.A. Ed	21	100.33
B.A.	16	100.81
Others	8	111.81
B.Sc. Ed.	11	112.55
B.Sc	13	121.50
		Grand Mean KSCPK = 106.45

The mean DSCPK score was found to be 106.45 as shown in Table 3. Holders of a B.Sc. demonstrated the strongest DSCPK of 121.50 and they were followed by those with a B.Sc. Ed. with 112.55. On the other hand, NCE holders had the weakest depth of DSCPK (89.50).

4. What is the predictive ability of teachers' DSCPK for students' success in examination?

Students taught by the 75 teachers who participated in this study were tested in those same subjects and their scores regressed on the assessment of their teachers' subject content and pedagogical knowledge to determine their predictive value. The results of the regression analysis are summarized in Table 4.

Table 4: Prediction of students' performance by teachers' Depth of Subject Content and Pedagogical Knowledge

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.327[a]	.107	.082	14.43578	.107

Table 4 shows a coefficient of multiple correlations (R) of 0.327 which indicated that both pedagogical and subject content knowledge of sampled teachers were significant predictors of students' success in examinations. Findings of the study further revealed that the two variables accounted for 10.7% of the total variance of students' success in examinations as shown by the R^2 of 0.107. An analysis of variance was carried out to ascertain the significance of the prediction of students' success by their teachers' subject content and pedagogical knowledge (Table 5).

Table 5: ANOVA of prediction of students' success by teachers' Depth of Subject Content and Pedagogical Knowledge

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1768.126	2	884.063	4.242	.018
	Residual	14795.820	71	208.392		
	Total	16563.946	73			

As shown in Table 5, the F ratio of 4.242 and df of 2, 71 was significant at 0.018 indicating that the sampled teachers' depth of subject content and pedagogical knowledge significantly predicted their students' performance. Table 6 contains the summary of the test of the contribution of each predictor in the regression analysis.

Table 6: Strength of teachers' Depth of Subject Content and Pedagogical Knowledge in the prediction

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	44.944	6.859		6.552	.000
	Pedagogical Scores	-.186	.114	-.186	-1.633	.107
	Knowledge Scores	.219	.082	.304	2.669	.009

As shown in Table 6, the unstandardized regression coefficients of pedagogical and subject content knowledge were -0.186 and 0.219 respectively and their standardized regression coefficients were -0.186 and 0.304. Though the two variables were joint predictors of students' achievement, pedagogical knowledge did not contribute significantly to the prediction with a t-value significant at 0.107.

Hypothesis 1: There is no significant difference in the depth between pedagogical knowledge of sampled English Language and Mathematics teachers.

The F-ratio of the Leven's test of equality of variances revealed a difference between variances of depth of pedagogical knowledge of English Language and Mathematics teachers (5.668, $p < 0.05$) as shown in Table 7. It was further observed that difference existed between the mean of the depth of pedagogical knowledge of teachers of English Language and that of Mathematics teachers ($t = -2.034$, $p < 0.05$). These results indicate that there was significant difference between the depth of pedagogical knowledge of English Language and Mathematics teachers.

Table 7: Results of Independent Samples Test of Depth of Pedagogical and Subject Knowledge of Teachers of English Language and Mathematics and their Students' Scores

		Leven's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig 2tailed	Mean Diff	Std. Error Diff	Lower	Upper
Pedagogical Scores	Equal variances assumed	5.668	.020	-1.998	73	.049	-6.7735	3.39077	-13.53130	-.01571
	Equal variances not assumed			-2.034	64.389	.046	-6.7735	3.33091	-13.42699	-.12002
Knowledge Scores	Equal variances assumed	15.712	.000	-2.871	73	.005	-13.1880	4.59359	-22.34304	-4.03303
	Equal variances not assumed			-2.826	60.087	.006	-13.1880	4.66657	-22.52229	-3.85378
Students' Scores	Equal variances assumed	0.411	.524	-1.855	72	.068	-6.4000	3.45006	-13.27758	.47758
	Equal variances not assumed			-1.854	70.934	.068	-6.4000	3.45250	-13.28419	.48419

The summary in Table 8 shows that the teachers of Mathematics demonstrated a deeper level of pedagogical knowledge compared to the teachers of English Language.

Table 8: Group statistics of teachers' Depth of Pedagogical and Subject Content Knowledge and their students' scores

Variables	Subject Taught	N	Mean	Std. Deviation	Std. Error Mean
Pedagogical Scores	English Lang.	39	46.6154	17.44407	2.79329
	Mathematics	36	53.3889	10.88716	1.81453
Knowledge Scores	English Lang.	39	50.2564	15.66545	2.50848
	Mathematics	36	63.4444	23.61016	3.93503
Students' Scores	English Lang.	39	45.0000	14.72735	2.35826
	Mathematics	35	51.4000	14.91781	2.52157

Hypothesis 2: There is no significant difference in the subject matter content knowledge between sampled English Language and Mathematics teachers.

The F-ratio of Leven's test of equality of variances indicated a significant difference for English Language and Mathematics teachers' subject matter content knowledge (15.712, $p < 0.001$). There was also a significant difference between the mean of depth of subject content knowledge of English Language and Mathematics teachers ($t = -2.826$, $p < 0.05$). Table 8 also shows that Mathematics teachers had a significantly deeper knowledge of their subject matter.

Hypothesis 3: There is no significant difference in the performance between sampled senior secondary school II English Language and Mathematics students.

The Leven's test of equality of variances revealed no significant difference in the variances of students' performance of senior secondary school II in English Language and Mathematics (0.411, $p > 0.05$) as shown ion Table 7. Also, no significant difference was observed in the mean scores of students in English Language and Mathematics ($t = -1.854$, $p > 0.05$). Students' performance was found to be better in Mathematics than English Language.

Discussion

Findings in this study suggest that teacher training tends to have a debilitating influence on subject content knowledge as those who obtained their degree in the same or even a related subject to the ones they teach tend to have lower scores in the test of knowledge of subject matter content. This may also question the observation by Abimbola (2012) that the exposure to courses in Faculties of Education is adequate to produce competent teachers. It should be noted that a subject in which one majors at the university level carries the heaviest weight in terms of credits offered and hours spent for lectures and practical sessions. The other subjects or courses are subsidiary and thus the hours spent receiving lectures or being exposed to practical are lower thus informing the use of major and minor to describe them. Viewed from this perspective therefore, the offering of education courses in the university as their major tends to make it difficult for education students to accommodate as many courses and hours as those of their counterparts that major in the teaching subjects like English Language and Mathematics investigated in this study. At the point of graduation, those who obtained degrees in the teaching subjects are more knowledgeable and skilled in those subjects than their counterparts whose major is education because they have actually offered more courses and have been exposed to more practical sessions in the subjects. The question of adequate

knowledge comes in only when considering issues of competence to teach at the secondary school level. What is considered adequate for use by them in teaching students needs proper analysis.

In relation to teachers' DPK, the results of this study generally fell in the expected direction as the DPK of most untrained teachers was found to be weak. It is, however, surprising that a category of untrained teachers, for example those holding the Bachelor of Science degree, still had the most adequate depth of DPK. Though it was discovered that a few of those with a B.A. or B.Sc. as their highest educational qualifications had earlier gone through the Nigeria Certificate in Education (NCE) training, which is also a professional teacher qualification, the fact that the Bachelor of Science or Art in Education curriculum offers deeper professional exposure should imply that products still perform better. Could the fact that many teachers of English Language and Mathematics might have had some measure of pedagogical knowledge passed through specialized seminars, workshops and other training programmes, which are regularly organized to stem the tide of mass failure in schools, have been responsible for this unexpected result? The critical issue here is that professionally trained teachers are expected to be clearly better and more competent in DPK. There is a problem when trained teachers and the untrained have comparable depth of pedagogical knowledge. The exposure of the untrained to specialized seminars and workshops may not be sufficient factor to explain this observation.

Findings in this study also indicated that teachers who had received professional training demonstrated weaknesses in subject content and pedagogical knowledge combined with mean scores just barely half of the mark obtainable. Plausible explanation could be that these very important skills are treated with levity when teachers start practicing thus supporting reports of studies by Harris and Sass (2007), Agoro and Akinsola (2013), and Ladipo, (2013), pointing in the direction of poor quality of teachers in secondary schools. The role of teachers as researchers may be threatened by the absence of good libraries to support their preparation for instruction. Merely obtaining teacher's copy of recommended textbooks and access to it cannot be afforded in some institutions, not to talk of having access to alternative textbooks for cross referencing, depth and balance. Reading and revising topics to be taught to students (which the teachers themselves learned many years earlier) may thus be taken for granted. Coupled with this is the years of teaching experience during which teachers have repeatedly taught the same topics. The teachers may then be working under the assumption that the topic is known and proceed without serious preparation. When this happens, teachers rely on residual knowledge and thus weakens their effectiveness and delivery. This implies that the teachers may downplay the basic principles of instruction in their preparation for the lessons they need to deliver. Amid these, teachers of Mathematics and English Language have the tendency to have many more lessons to teach which places more demand on their time for preparation.

As expected, the subject content and pedagogical knowledge of teachers significantly predicted students' performance in English and Mathematics examinations. However, the variance of students' performance accounted for by both variables was found to be 10.7%. This suggested that there are several other variables that account for students' level of success traceable, for instance, to the students themselves, their teachers, the school, home environments and such other sources.

Teachers of Mathematics were observed to be having deeper pedagogical and subject matter content knowledge. The differences in the depth of their knowledge in these two components were found to be significant. Whereas a wider selection of graduates of related fields could feel competent to teach English, it is not so with Mathematics. Not many teachers are ready to

accept teaching Mathematics as could happen to English Language. There is therefore the tendency to have teachers from varied related fields teaching English Language but not Mathematics.

The grand mean of students' performance in English Language was found to be lower than that of Mathematics. This outcome seems to be the likely combined effect of a deeper pedagogical and subject matter content knowledge observed among teachers. It confirms the initial hunch that informed this study and the general feeling that teachers with better knowledge of the subject they teach will likely impact performance of students more than those with little knowledge. The same applies to pedagogical knowledge.

Conclusions

Main Findings

1. Teachers with Bachelor of Science degrees had the deepest subject content knowledge (DSCK) with a mean of 65.42%.
2. Teachers with the most adequate depth of pedagogical knowledge (DPK) were those holding the Bachelor of Science degrees, with a mean of 56.08%.
3. Holders of B.Sc. degrees demonstrated the strongest DSCPK, with a mean of 121.50.
4. Sampled teachers' depth of subject content and pedagogical knowledge significantly predicted their students' performance in examinations.
5. Sampled teachers of English Language were significantly weaker in terms of DPK and DSCPK compared with teachers of Mathematics.
6. Sampled SSII students were generally better in Mathematics than English Language although the difference in their academic performance was not statistically significant.

Implications

The overall mean score of 56.59% in DSCK showed that the sampled teachers were generally weak. Without being strong in this skill, their competence to teach the subject is also affected. Their delivery of instruction to learners may not be sustainable and many times, questions raised by inquisitive and intelligent learners may not be well addressed. To probe deeper into the causes of this low performance may require taking a look at the training received by the teachers in Faculties of Education. What is considered as adequate knowledge in their teaching subjects and courses offered in them must be thoroughly investigated. Knowledge may be taken for granted especially if one had gone through school and had acquired certificates or qualifications as proof.

Also, the finding indicating that the DPK of professionally trained teachers holding B.A. Ed. and B.Sc. Ed. fell close to the mean calls to question what happened to the teachers while in training and after they had been certified. It also calls to question whether they are in position to utilize their professional training while practicing in the school system. If training and skills acquired are inadequate, delivery is weakened even before the product of such institutions begin to work. A national study across many other school subjects should be helpful in determining the validity of the current findings.

Limitations

A preliminary study was embarked upon to achieve the following objectives: identification of the category of teachers (B.Ed. /B.Sc. Ed /B.A.Ed.; PGDE; or B.A. /B.Sc.) that has the deepest DSCK; the most adequate DPK; and the strongest DSCPK. The study also investigated the

predictive ability of teachers' DSCPK for students' performance in English Language and Mathematics. Seventy-eight teachers of Senior Secondary II English Language and Mathematics in thirty-two randomly secondary schools in Kwara State and classes of SSII students taught by the teachers who constituted the sample. Data were collected through tests, observations and vignettes, patterned after Kirschner, Borowski and Fischer (2010) and Baumert et al. (2010); and analysed using descriptive and inferential statistics to compare the teachers' DSCK /DPK/DSCPK in both subjects. Findings of the preliminary investigation showed that teachers with B.Sc. demonstrated the deepest DSCK; the most adequate DPK; and the strongest DSCPK. Findings of the study further indicated that both pedagogical and subject content knowledge of sampled teachers were significant predictors of students' success in examinations; and the two variables accounted for 10.7% of the total variance of students' success in examinations.

However, illuminating as the findings of this study may appear, the fact that it was only a preliminary study, limited in scope and subject coverage, means that no conclusive statements about the findings reported here can be made. Neither can the findings be taken as valid representation of the depth of subject content and pedagogical knowledge of SSII English Language and Mathematics teachers in Nigerian secondary schools. A large-scale national study is therefore imperative.

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Corresponding author: Felicia Olasehinde-Williams
Contact email: olabisi@unilorin.edu.ng