International Journal of Informatics, Technology & Computers
ISSN: 2317-3793, Volume 4, Issue 1, page 1 - 16
ISSN 2317-3793
Zambrut

International Journal of Research & Review
Proceeding & Conference
Thesis & Antithesis
Novelty & Findings
Sciences; Economics & Business; Social, Politics & Humanities; Law; Engineering & Industry; Biology, Physics & Matematics; Agriculture & Agribusiness; Health, Nursing, & Medicine; Informatics, Technology & Computers; Food & Nutrition
Zambrut®

# An Appraisal of the Content Knowledge of Primary Teacher Trainers' of Information and Communication Technology (ICT) and Student Teachers' Academic Achievement In ICT

## (Studied In The South-West Region Of Cameroon)

**Maureen Lum Akumsi**

Maureen Lum Akumsi
Faculty of Education, University of Buea
Cameroon, West Africa

***Abstract:*** *This study sought to find out the extent to which Primary Teacher Trainers' Content knowledge of Information and Communication Technology (ICT) influences Student teachers' Academic Achievement in ICT. A sample comprising of 268 student teachers and 10 teacher trainers in ICT selected from three Government teacher training colleges in Fako and Meme Divisions of the South West Region of Cameroon was used in this study. The data collected by use of questionnaire items, observation check list and interview guide were analyzed using frequency percentages, Spearman's Rho and Chi-square tests. Findings revealed that there is a significant strong and positive correlation between primary teacher trainers' knowledge of ICT content and student teachers' examination scores in ICT. It was thus concluded that the ICT content knowledge of ICT teacher trainers is an indicator of student teachers' academic achievement in ICT. This thus calls for the need for in-service training to equip teacher trainers with the knowledge they need to be able to effectively teach ICT.*

***Keyword:*** *Appraisal, Primary Teacher Trainers' content knowledge, Student Teachers' Academic Achievement, Information and Communication technology (ICT), South-West Region of Cameroon.*

## 1. INTRODUCTION

Information and communication technology (ICT) provides innovative tools for restructuring the teaching and learning process so as to adequately prepare students for 21st century skills; Haji,

Moluayonge & Park (2017). In order to be capable of adequately preparing student teachers, teacher trainers who teach ICT need to have a command of the subject matter or ICT content. UNESCO (2002) stipulates that, to be able to effectively harness the power of the new information and communication technologies (ICTs) to improve learning, teachers must have the knowledge and skills required to be able to use the new digital tools and resources effectively so as to help all students achieve high academic standards. Effective teachers thus ought to have a command of the subject matter or content to be taught. In addition to being knowledgeable in the subject matter, an effective teacher should also be able to select the subject matter according to the level and other characteristics of the learners.

UNESCO (1998) World Education Report, on Teachers and Teaching in a changing world, stipulates that, for education to reap the full benefits of ICTs in learning, it is essential that both pre-service and in-service teachers have basic ICT competencies. Telewa (2008), points out that, teacher effectiveness can only be guaranteed when the teacher trainer possesses the needed skills, knowledge, instructional resources, attitudes and dispositions towards the pedagogy of ICT. Telewa (2008) however regrets the fact that teachers with little or no knowledge are assigned to teach ICT in some teacher training Colleges.

Teacher quality appears to be a priority area in education policy. For example, the Federal 'No Child Left Behind' Act of 2001, stipulates the need for every state to put a highly qualified teacher in every classroom. Similarly, the Elementary and Secondary Education Act (U.S. Department of Education, Sec. 1119) defines a highly qualified teacher as someone who holds at least a bachelor's degree, is a state certified/ licensed teacher, and has demonstrated competence in the academic area in which he or she teaches.

Feiman- Nemser (2001:1015) opines that "what students learn depend on what teachers teach; and what and how teachers teach depends on the knowledge, skills and commitments they bring to their teaching" (p.1015). Similarly, Hattie (2003) states that "it is what teachers know, do and care about which is very powerful in the learning equation" (p.2). Content knowledge could thus be considered as strong determinant of teacher effectiveness.

## 1.1 STATEMENT OF THE PROBLEM

Despite the great importance of ICT in the acquisition of knowledge worldwide, in Cameroon there are problems which seem to be inhibiting its effective teaching at all levels of education including the Primary Teacher Training Colleges. A majority of teachers, who were trained in the 1990s and backward, do not have knowledge and skills in the field of ICT (Aina 2013). Yet some of such teachers are posted to teach ICT in Teacher Training Colleges in Cameroon. Furthermore, most primary government teacher trainers are graduates from the department of Sciences of Education, at the General Higher Teacher Training Colleges. ICT is not amongst the disciplines taught to student teachers under this department while on training, thus no provision is made for the preparation of would-be teachers towards the teaching of ICT as a subject. Yet on the field, graduates from this department are assigned to teach it despite the fact that they have not been exposed to any formal training on it. It is thus common to find teachers grappling with the teaching of this discipline. Such teachers; who were not exposed to ICT education during training might not have acquired adequate ICT content knowledge and knowledge of how to appropriately use ICT instructional materials in the teaching learning process thus rendering the teaching of ICT abstract and at the jeopardy of the student teachers (Onyejekwe 2006). The lack of trained teachers for ICT seems to compromise the quality of ICT taught in teacher training colleges in Cameroon. It is thus based on this back drop that this study seeks to investigate the extent to which primary teacher trainers' ICT content knowledge influences student teachers' academic achievement in ICT.

## 1.2 Research Question/ Hypotheses

This study set out to answer the following question: To what extent does primary teacher trainers' ICT Content Knowledge influence student teachers' examination scores in ICT?

The following research hypothesis was formulated to guide the study:

**Ho:** There is no significant relationship between primary Teacher Trainers' ICT content knowledge and student teachers' examination scores in ICT.

## 2. CONCEPTUAL AND THEORETICAL FRAMEWORK.

Mihra and Koehler (2007) define content knowledge (CK) as the knowledge about the subject matter to be learnt and taught. Similarly, Cochan, King, and DeRuiter (1991) differentiated between a teacher and content knowledge specialists by stating that the difference that exists between teachers and other professionals such as biologists, scientists and educational researchers does not necessarily lie in the quality or quantity of their subject matter knowledge, but rather on how that knowledge is organized and used. Teachers' lack of a comprehensive base of CK can be prohibitive to Students' understanding of lessons taught and hence detrimental to the academic achievements of the students. This is due to the fact that when students are opened to receiving incorrect information from their teachers they can develop misconceptions about the subject matter (National Research Council, 2000; Pfundt, & Duit, 2000)

According to the glossary of Education reform (2016), content Knowledge refers to the body of knowledge that teachers teach hence what the students are expected to learn in a given subject area. In order for teachers to be effective, they need to acquire and be able to demonstrate command of subject matter or content to be taught, as well as command of theoretical and pedagogic knowledge about learning and human behavior. Teachers thus need to be highly knowledgeable in the subject, and should be able to select the subject matter taking into consideration the class size, level, age and other characteristics of the learners. (Anthony and Walshaw (2007).

Teacher content knowledge is an important factor that determines how effective teachers of ICT and those of all other disciplines at all levels of education are, in the accomplishment of their tasks. Talking about the importance of teachers' knowledge in the teaching of mathematics, Anthony and Walshaw (2007) point out that what teachers do in classrooms is very much dependent on what they know and believe about Mathematics and what they understand about the teaching and learning of Mathematics. Similarly, Walshaw (2012) points out that teachers with limited subject matter knowledge have been shown to focus on a narrow conceptual field rather than on forging wider connections between the facts, concepts, structures and teaching of Mathematics.

Still as concerns the influence of teachers' knowledge on the teaching of mathematics, Ball and Bass (2000) point out that teachers' content knowledge is critical for effective teaching. They add that pedagogical content knowledge influences the connections teachers make between aspects of mathematical knowledge, the interaction between the teacher and the students, as well as the teacher's professional reflections within the classroom. They conclude by stating that a sound content and pedagogical knowledge provide the resources for an on-the-spot synthesis of actions, thinking, theories and principles within classroom episodes, hence may enhance student achievement. Similarly, a sound content and pedagogical knowledge may enable teacher trainers to teach ICT concepts more efficiently, thus will likely lead to an increase in the level of attainment of lesson objectives by teachers.

### 2.1 THEORETICAL FRAMEWORK

Theoretically, this study utilizes Shulman's (1986, 1987) Pedagogical Content Knowledge (PCK) theory and Koehler & Mishra's (2006) theory of Technological, Pedagogical and Content Knowledge (TPACK).

#### 2.1.1 Shulman's (1986, 1987) Pedagogical Content Knowledge (PCK) theory

The notion of Pedagogic Content Knowledge was first introduced in the field of education by Lee Shulman in 1986. Schulman (1986) identified a special domain of teacher knowledge, which he referred to as pedagogical content knowledge (PCK). Shulman (1986) opined that for meaningful learning to occur, teachers must possess knowledge of subject matter or content. PCK represents the unique nature of teachers' knowledge of content and pedagogy. Shulman 1986 as cited in De Miranda 2008), describes PCK as the knowledge that comprises of three knowledge bases which come together to inform teacher practice, namely, subject matter knowledge, pedagogical knowledge and knowledge of context.

This Theorist distinguished between content as it is studied and learned in disciplinary settings and pedagogical knowledge needed for teaching a subject. A central contribution of the work of Shulman and his colleagues was to reframe the study of teacher knowledge in ways that included direct

attention to the role of content in teaching. This was a radical departure from research of the day, which focused almost exclusively on general aspects of teaching such as classroom management, time allocation, or planning.

Shulman (1985) points out that teachers should not treat subject matter knowledge and pedagogical knowledge as being mutually exclusive. He stipulates that teacher Education programs should strive at combining the two knowledge fields. This thus implies that to be effective in teaching ICT, teacher trainers ought to have a good mastery of the content (subject matter) to be taught, as well as a good knowledge of the teaching methods or strategies to use in teaching in order to meet up with the expected outcomes of lessons taught. This dynamic integration of knowledge of content, students, pedagogy, and educational contexts is PCK, which constitutes the unique professional knowledge of teachers. PCK plays an important role in the teaching learning process during classroom instructions since it has to do with teachers' competence in delivering lessons, and their mastery of the subject matter or content (Marzita 2014).

A full grasp of PCK may facilitate effective teaching of ICT by teacher trainers thus may enhance student teachers' academic achievement in ICT. Marzita (2014) points out that education needs more real and practical instruction. This Arthur adds that just as teachers have misconceptions of subject matter, so too teachers may teach wrong concepts to students; thus Shulman (1987) PCK theory can help reduce teachers' misconceptions. PCK involves blending of content and pedagogy in order to better understand how particular topics, problems or issues are organized, represented and adapted to both the diverse interests and levels of learners' abilities (Shulman 1987). This theorist adds that to be effective, teachers must be capable of transforming the knowledge to be taught to the students in a manner that will be easily understood. For actual teaching, teachers should not only skillfully demonstrate their knowledge, but should also be capable of guiding the students to understand and make meaning of the content (Hansen 1995). This thus shows the importance of PCK in the delivery of instruction in any classroom.

Shulman and Grossman (1988) divided knowledge into two components; substantive knowledge that has to do with key facts, concepts and principles and explanatory frameworks in a discipline, and the syntactic knowledge which deals with the rules of evidence and proof within a discipline. Shulman, cited in Marzita (2014), defines PCK as teachers' interpretations of subject matter knowledge in the contexts of facilitating the students' learning. Students can only respond and interact freely with their teachers in class during the teaching learning process if they are confident with their understanding of subject matter taught. Through the students' response, teachers can be able to identify their errors and misconceptions immediately. To be successful, teachers thus need to have a good mastery or understanding of the subject they teach. This thus implies that teacher trainers' understanding of subject matter or content of ICT may influence student teachers' learning of ICT.

Shulman (1986) states that the transformation of subject matter knowledge (SMK) is a significant focus in teacher education. In support of this view, other researchers and educators (Graeber 1999; Leinhardt, Putnam, Stein & Baxter, 1991) have equally stressed the need for teachers to alleviate their misconceptions about their subject matter. Lack of PCK negatively influences both the teachers' effective teaching and the learning process of students. In order to effectively carry out their duties of enhancing students' achievement, teachers should thus be free of misconceptions and errors. This can only be realized if the teachers are apt in their PCK. For "there is a close relationship with what a teacher knows, how she knows it and what she can do in the context of an instruction" (Marzita 2014:6). Shulman's (1986, 1987) theory thus has a bearing to this study because for ICT teacher trainers to be effective they must have a sound knowledge of content (subject matter) and a good knowledge of pedagogy. This is due to the fact that both the teachers' subject matter knowledge and pedagogical knowledge are crucial to good teaching and students' understanding (Reynolds, 1992).

### 2.1.2 Technological, Pedagogical and Content Knowledge Model (Koehler & Mishra 2006).

Technological Pedagogical Content Knowledge (TPACK) is a framework that facilitates an understanding of the kinds of knowledge needed by the teacher for effective pedagogical practice in a technology-enhanced learning environment. Koehler and Mishra (2006) added technology as a modeling to Lee Shruman's Pedagogical Content Knowledge (PCK) construct ( Archambault and

Crippen, 2009). This framework thus builds on Lee Shulman's (1986, 1987) construct of Pedagogical Content Knowledge (PCK) to include Technology Knowledge (TK). Koehler and Mishra described this framework for teacher knowledge for technological integration called Technological Pedagogical and Content Knowledge (TPACK). Koehler and Mishra (2006) believe that the development of TPACK by teachers is critical to effective teaching with technology. The TPACK framework for teacher knowledge is thus a complex interaction of three bodies of knowledge, namely content, Pedagogy and Technology. These three bodies of knowledge interact both theoretically and in practice to produce the kind of flexible knowledge needed to successfully integrate technology use into teaching.

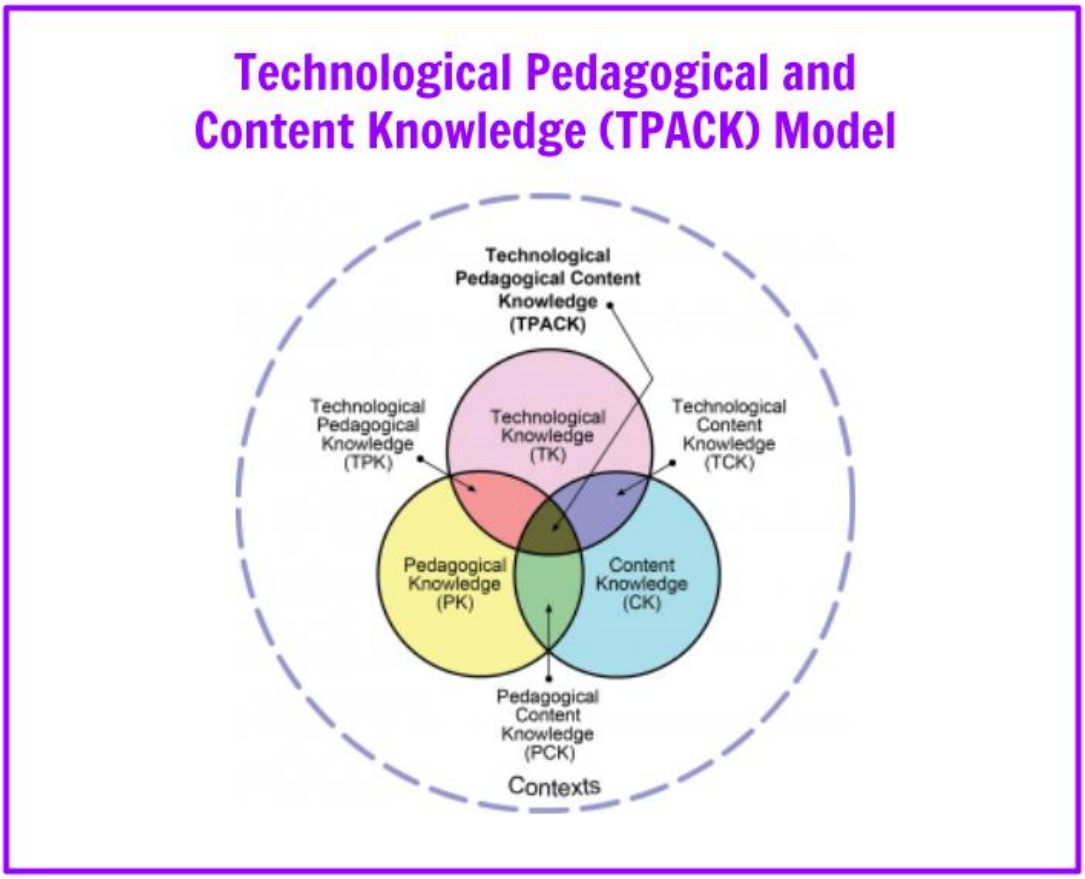


**FIG 1:** Technological Pedagogical and Content Knowledge (TPACK) Model Venn diagram. (Source: Koehler & Mishra 2009:63)

The TPACK Model represented in Figure 1 above is a useful model for educators as it helps them to be able to use digital tools and strategies to support teaching and learning. Mishra and Koehler (2006) designed this model around the idea that content (what a teacher teaches) and Pedagogy (how he teaches it) ought to serve the basis for any technology that he plans to use in his classroom to enhance learning. The circles in the TPACK diagram above represent Content knowledge (CK), Pedagogical knowledge (PK) and Technological Knowledge (TK). The areas where the three kinds of knowledge overlap are explained by Mishra and Koehler 2006 as follows:

Pedagogical Content Knowledge (PCK) is the knowledge that teachers have about their content (subject matter) and the knowledge that they have about how to teach that specific content. This specialized knowledge facilitates teachers' use of the most effective methods for teaching specific content. Technological Content Knowledge (TCK) refers to the set of skills which teachers acquire to help them identify the best technologies they can use so as to support their students as they learn content. Technological Pedagogic Knowledge (TPK) refers to the kind of skills developed by teachers, which helps them to identify the best technology to support a particular pedagogical approach. For example teachers may assign students to work in collaborative groups if they need to share tools like computers; or communicate what they have learned in a multimodal presentation using power point.

## 2.2 REVIEW OF RELATED LITERATURE

Contrarily to the views of James Colemann 1966, cited in Whitehurst (2002), that differences in teachers did not matter, recent studies have shown that the teacher is the single most important school related factor in Student achievement. Teacher content or subject knowledge is widely believed to have an influence on teacher effectiveness and may consequently affect student teachers' achievement. Available evidences from researches reveal that teachers' intellectual resources significantly affects students' learning experiences ( Odumosu, Olusesan & Abel (2016). Researches findings also show that students record the most gains when assigned effective teachers in terms of content knowledge (Ogar, 2006). Such findings have led many researchers to assert that the lack of content knowledge by teachers hugely contributes to the performance gap which exists among students. The primary purpose of teaching at all levels of education is to bring about a fundamental change in the behavior of the learner (Tebabal & Kahssay, 2011). In order to achieve this, it is necessary that Teacher trainers who teach ICT should have the knowledge and a high level of understanding of ICT concepts. Many studies equally support the notion that teachers who taught the subjects that they had previously studied in depth are particularly more effective that those who taught subjects that they had not studied previously (Olisama, Odumosu & Egbo 2011). It is based on this finding that Odumosu & Olisama (2018) conclude that there is a high correlation between students' content knowledge and students' performance in Mathematics in general and algebra in particular.

Ishola & Udofi (2017, cited in Odumosa & Olisama 2018), report that a number of research findings show that students' academic performance is more heavily influenced by the teacher quality with regard to content knowledge and pedagogic knowledge than by the students' priors academic records or school a student attends.

Subject matter knowledge by teachers of any subject is important in teaching as evidenced by the findings of Odumosu and Olisama (2018). They carried out a study to investigate the effects of teachers' content knowledge on students' achievement in algebra. The sample of this study comprised of 421 senior secondary school students drawn from 12 senior secondary schools in Lagos using random sampling technique; and 12 teachers selected using purposive and proportional sampling techniques. The research instruments used in collecting data for this study comprised of teachers' content knowledge tests in algebra, an observational schedule of teachers' pedagogy knowledge and students' achievement test in algebra. Data collected was analyzed by use of covariance (ANOVA). Findings obtained from this study revealed that there is a significant effect of mathematic teachers' content knowledge on students' academic achievement in algebra.

Bonney, Amoah, Micah, Ahiamenyo, and Lemaire (2015) carried out a study to investigate the relationship between teachers' quality and students' academic performance in Sekondi Takaradi Metropolitan Assembly (STMA). The study targeted junior high school teachers and pupils in the Metropolis. They used the descriptive Survey design to conduct the study on five randomly selected educational circuits in the metropolis. The stratified and systematic sampling techniques were used to sample the 500 participants used in the study. The instrument used for data collection was the questionnaire and data collected was analyzed using Pearson Moment Correlation, ANOVA, Means, Percentages and standard deviations. The findings of this study showed that there was a positive but low relationship between teachers' knowledge in subject matter and pupils' performance in the 2012 Basic Education Certificate Examination ( BECE) r=0.109*. These findings thus imply that the higher the teachers content knowledge in a subject area, the higher the pupils, performance.

Wenglinsky (2000) conducted a study to find out the relationship between indicators of teacher effectiveness and the performance of 8$^{th}$ graders. He examined approximately 15,000 scores obtained by 8$^{th}$ grade students in Mathematics and Science. The findings revealed that students whose teachers had college majors or minors in either Mathematics or Science scored 39% higher than those whose teachers lacked such preparation. Similarly, Monk (1994), as cited in Darling Hammonds (2000) using data collected from 2,829 students in a longitudinal survey study of American youths; found out that teachers' subject matter preparation, as measured by coursework in the subject area field, is positively related to student achievement in Mathematics and science. This thus implies that teacher education background is crucial to the students' performance in a given subject area.

Askew et al (1997) carried out informal 'concept mapping' interviews with teachers in order to find out how their subject knowledge affected their effectiveness. They found out that the connectionist teachers, who were the most effective, had a wider knowledge of practical and formal methods of representation and of students' mental strategies than transmission or discovery-oriented teachers.

Mandeville and Liu (1997) studied the effect of teacher certification based 0n teachers' 'subject matter knowledge on US seventh grade students' mathematics achievement by matching 33 schools in which teachers had secondary mathematics certification with schools where this was not the case. They found that students from schools with higher levels of teacher certification performed better on thinking skills than their peers in lower level certification schools, but that there was no significant difference in their performance based on their knowledge and competence in mathematics.

Similarly, in Darling-Hammond's (2000) study of US State policies; teacher preparation and certification based on teacher knowledge were the strongest predictors of relative achievement compared to other states, even after controlling for student poverty and number of students with English as their second language. Darling-Hammond (2000) reports that not all studies have shown that teacher subject knowledge affects achievement, however, he adds that a number of American studies on the relationship between teachers' scores on the National Teacher Examinations and the performance of their students have found little or no effect.

Though the evidence that makes a difference is mixed, research shows that teachers, education coursework has a positive effect on students, achievement. For example, a study conducted by Ferguson and Womack (1993), on the teacher education program at Arkansas Texas, sought to determine the extent to which education and subject matter coursework predicted the teaching performance of student teachers completing the program. Findings revealed that coursework in teacher education makes a difference in teaching performance. Education coursework was thus seen as a more powerful predictor of teacher effectiveness than measures of expertise in content area subjects.

In a study of over 2,800 students using data from the Longitudinal Study of American Youth, Monk (1994) found a positive relationship between teachers' subject knowledge as measured by courses taken and student achievement. This suggests that a threshold effect may be operating, in that a minimal level of subject knowledge is necessary for teachers to be effective, but that beyond a certain point a law of diminishing returns may operate, which may thus explain the mixed findings in other studies.

## 3. METHODOLOGY

The cross-sectional survey research design was used in this study. Geographically, the study was conducted in Fako and Meme divisions of the South West Region of Cameroon. The population of this study comprised of 20 ICT teachers and 900 student teachers in all teacher training colleges in the South West Region of Cameroon for the 2017/2018 academic year. (Statistics obtained from the South West Regional Delegation for Secondary Education; 2017/2018 academic year. A sample of 254 student teachers and 10 ICT teacher trainers were used to appraise the issue under investigation. The purposive sampling, simple random sampling and proportional stratified sampling techniques were used to select the sample. The purposive sampling technique was used to select the divisions of the South West Region used in the study (Fako and Meme), the government teacher training colleges, the student teachers of level three (final year students) and the 10 teacher trainers of ICT in the three Government Teacher Training Colleges used in this study. Meanwhile, the simple random sampling technique was employed to select the level three student teachers that actually comprised the sample studied. The proportionate stratified sampling technique was used to determine both the number of student teachers, as well as the number of male and female student teachers to constitute the sample from each of the teacher training colleges in the two divisions of study. The instruments used to collect data for this study comprised of observation checklists, interview guides (used to collect data from ICT teachers), and two separate sets of questionnaire (one set addressed to ICT teachers and the other to student teachers who comprised the sample of study).

Two data analysis approaches were used for the study that is the qualitative and quantitative method. The quantitative approach was used in analyzing the data from the closed ended items meanwhile the qualitative approach was used in analyzing the data from the open ended questions.

## 4. FINDINGS

**Table 1: Student teachers' perception of teacher trainers' knowledge of ICT content**

| Statements | Stretched | | | Collapsed | | | |
|---|---|---|---|---|---|---|---|
| | Strongly agree | Agree | Disagree | Strongly disagree | Neutral | Agree | Disagree |
| My teacher always plans lesson content well prior to teaching. | 120 (47.2%) | 118 (46.5%) | 10 (3.9%) | 1 (0.4%) | 5 (2.0%) | 238 (93.7%) | 11 (4.3%) |
| My teacher has a sound knowledge of all the ICT concepts which he has taught us. | 51 (20.1%) | 63 (24.8%) | 112 (44.1%) | 27 (10.6%) | 1 (0.4%) | 114 (44.9%) | 139 (54.7%) |
| My teacher can conveniently teach all the topics on ICT in the current syllabus for TTCs | 64 (25.2%) | 70 (27.5%) | 47 (18.5%) | 57 (22.4%) | 16 (6.3%) | 134 (52.7%) | 104 (40.9%) |
| My teacher has a sound knowledge on the manipulation and use of ICT tools like the computer. | 77 (30.3%) | 82 (32.3%) | 34 (13.4%) | 56 (22.0%) | 5 (2.0%) | 159 (62.6%) | 90 (35.4%) |
| My teacher has a sound knowledge of computer programs like Microsoft word, excel and power point. | 98 (38.6%) | 56 (22.0%) | 35 (13.8%) | 57 (22.4%) | 8 (3.1%) | 154 (60.6%) | 92 (36.2%) |
| My teacher guides students to apply knowledge of concepts learnt in class to real life situation. | 78 (30.7%) | 114 (44.9%) | 47 (18.5%) | 9 (3.5%) | 6 (2.4%) | 192 (75.6%) | 56 (22.0%) |
| My teacher often presents concepts systematically (from known to unknown) | 68 (26.8%) | 144 (56.7%) | 24 (9.4%) | 6 (2.4%) | 12 (4.7%) | 212 (83.5%) | 30 (11.8%) |
| Multiple response set | 488 (31.7%) | 503 (32.7%) | 285 (18.5%) | 207 (13.4%) | 53 (3.5%) | 991 (64.5%) | 492 (32.0%) |

n=254

The findings with regard to teacher trainers' ICT content knowledge as presented on table 1 above, show that 64.5% of the student teachers agreed that their teachers have adequate knowledge on ICT content, 32.0% of them disagreed and (3.5%) were neutral. To be more specific, 114(44.9%) of the student teachers agreed that their teachers have a sound knowledge of all the ICT concepts which are taught to them, 159(62.6%) perceived their teachers as having a sound knowledge on the manipulation and use of ICT tools like the computer, while 154(60.6%) agreed that their teachers have a sound knowledge of computer programs like Microsoft Word, Excel and Power Point. Furthermore, 134(52.7%) of the student teachers agreed that their teachers can conveniently teach all the topics on ICT in the current syllabus for Teacher Training Colleges (TTCs).

The table (2) that follows compares the student teachers' perceptions of the level of their ICT teachers' content knowledge with respect to the different TTCs, gender and course of study of the respondents.

**Table 2: Comparing student teachers' perception of primary teacher trainers' knowledge of ICT content by demographic factors**

| Demographic information | Categories | Have adequate knowledge of ICT content | | | Total based on response | Statistical test |
|---|---|---|---|---|---|---|
| | | Agree | Disagree | Neutral | | |
| Name of college | GTTC Buea | 422(66.6%) | 101(29.4%) | 22(4.0%) | 545 | $\chi2=3.14$ P=0.207 |
| | GTTC Limbe | 210(63.9%) | 89(42.6%) | 11(3.5%) | 310 | |
| | GTTC Kumba | 221(55.3%) | 191(44.0%) | 3(0.7%) | 415 | |
| Gender | Male | 129(66.2%) | 102(32.1%) | 4(1.7%) | 235 | $\chi2=0.04$ P=0.837 |
| | Female | 774(69.6%) | 129(27.3%) | 32(3.1%) | 1035 | |
| Course | 1 year | 707(68.0%) | 234(29.0%) | 29(3.0%) | 970 | $\chi2=2.44$ P=0.294 |
| | 2 years | 30(56.7%) | 41(38.0%) | 4(5.3%) | 75 | |
| | 3 years | 146(67.1%) | 76(31.6%) | 3(1.3%) | 225 | |

From table 2 above, it can be observed that student teachers' perception of their teacher trainers' knowledge on ICT content did not significantly differ between the three teacher training colleges, gender, and the student teachers' course of study (P>0.05). This therefore implies that irrespective of the student teachers' gender, course of study and school, they all share almost the same perception about their teacher's knowledge of ICT content.

Table 3 which follow presents findings from the teacher trainers' self evaluation with regard to their ICT content knowledge.

**Table 3: Teacher trainers' perception of their knowledge of ICT content**

| Statements | Stretched | | | Collapsed | | |
|---|---|---|---|---|---|---|
| | Strongly agree | Agree | Disagree | Strongly disagree | Agree | Disagree |
| I have a sound knowledge of all the ICT concepts which I teach my students. | 2 (20.0%) | 3 (30.0%) | 3 (30.0%) | 2 (20.0%) | 5 (50.0%) | 5 (50.0%) |
| I can conveniently teach all the Topics outlined for ICT in the current Syllabus for Teacher Training Colleges | 1 (10.0%) | 4 (40.0%) | 5 (50.0%) | 0 (0.0%) | 5 (50.0%) | 5 (50.0%) |
| I have a sound knowledge on the manipulation and use of modern ICT tools like the computer. | 2 (20.0%) | 5 (50.0%) | 3 (30.0%) | 0 (0.0%) | 7 (70.0%) | 3 (30.0%) |
| I have a sound knowledge of computer programs like Microsoft word, excel and power point. | 1 (10.0%) | 5 (50.0%) | 2 (20.0%) | 2 (20.0%) | 6 (60.0%) | 4 (40.0%) |
| I provide my students the opportunity to apply knowledge of concepts learnt in class to real life situations. | 0 (0.0%) | 6 (60.0%) | 0 (0.0%) | 4 (40.0%) | 6 (60.0%) | 4 (40.0%) |
| I present concepts to my students chronologically (from concrete to abstract) | 3 (30.0%) | 6 (60.0%) | 0 (0.0%) | 1 (10.0%) | 9 (90.0%) | 1 (10.0%) |
| Multiple response set | 9 (15.0%) | 29 (48.3%) | 13 (21.7%) | 9 (15.0%) | 38 (63.0%) | 22 (37.0%) |

n=10

Findings with regard to the teacher trainers' perception of their ICT content knowledge as presented on table 3 above reveal that a majority of the teacher trainers agreed that they have adequate knowledge on ICT content. However, the percentage of teacher trainers (63.0%) who perceived themselves as having adequate knowledge of ICT content was lower when compared with rating from the student teachers. To be more specific, a majority of the teacher trainers agreed that they have a sound knowledge on the manipulation and use of modern ICT tools like the computer 7(70.0%), and present concepts chronologically to their students (90.0%). Meanwhile, only 50.0% of them agreed that they have a sound knowledge of all the ICT concepts which they teach to their students, and can conveniently teach all the topics outlined for ICT in the current Syllabus for GTTC. Also, just 60.0% of them agreed that they provide their student teachers opportunity to apply knowledge of concepts learnt in class to real life situations.60% of them equally agreed that they have a sound knowledge of computer programs like Microsoft word, excel and power point.

**Table 4: An observation check list assessing primary teacher trainers' knowledge of ICT content**

| Check list items | Always | Sometimes | Never | Total number of observations made |
|---|---|---|---|---|
| Teacher presents concepts systematically (from concrete to abstract) | 7 | 3 | 0 | 10 |
| Teacher has a sound knowledge of computer programs like Microsoft word, excel and power point. | 0 | 4 | 6 | 10 |
| Teacher has a sound knowledge on the manipulation and use of ICT tools like the computer. | 0 | 4 | 6 | 10 |
| Teacher has a good mastery of the subject matter and presents lessons fluently. | 0 | 6 | 4 | 10 |
| **Overall remark** | Adequate | Average | Inadequate | 40 |
| | 7(17.5%) | 17(42.5%) | 16(40.0%) | |

From the observation conducted on the 10 primary teacher trainers, findings revealed that, only 17.5% of the teacher trainers observed had adequate mastery of ICT content, 42.5% of them had average mastery ICT content, while up to 40.0% were rated as having inadequate knowledge. These findings further throw more light on the fact that many teacher trainers lack a mastery of ICT content which could be detrimental to the effective teaching of ICT and consequently may negatively affect student teachers' achievement in ICT.

Figure 1 that follows presents how the research respondents perceive the level of ICT teacher trainers' ICT content knowledge and their level of knowledge as recorded on the observation check list.

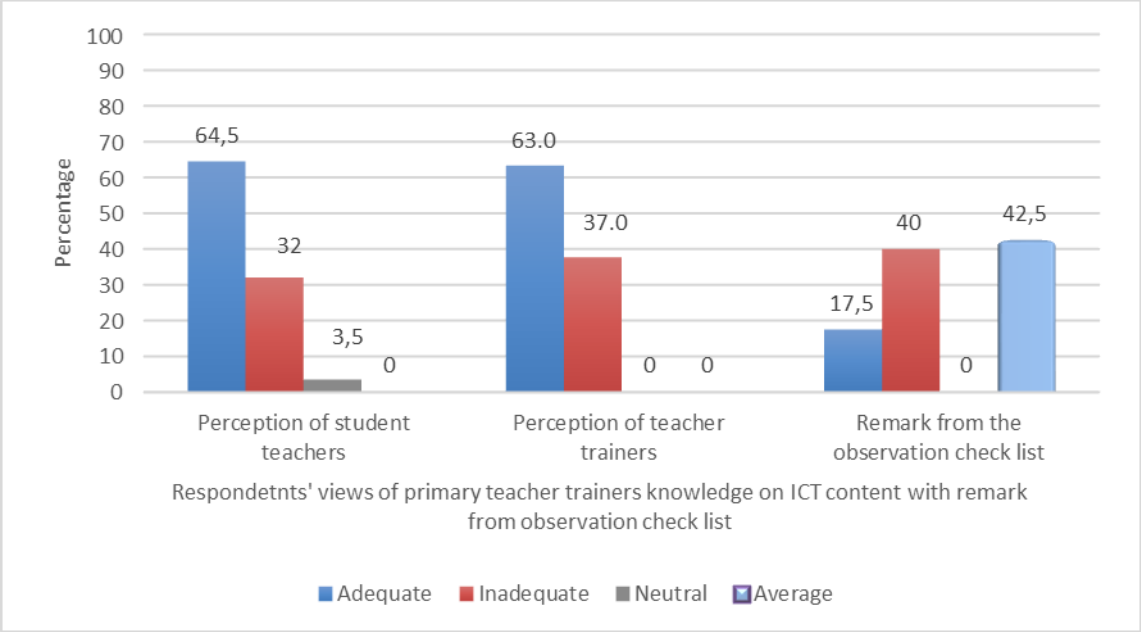


**Figure 1: Primary teacher trainers' ICT content knowledge**

Findings presented on figure 1 above, reveal that showed that the proportion of teacher trainers who perceived themselves as having adequate knowledge on ICT content (63.0%), was almost the same when compared with the perception of the student teachers (64.5%). These findings were however, far different from the results obtained from the observation check list wherein just 17.5% of primary teacher trainers were observed to have adequate knowledge of ICT content , 42.5% of them rated as having average knowledge and 40% as having inadequate knowledge of ICT content. However, there was a very slim disparity in terms of the percentages with regard to how student teachers, teacher trainers and the researcher rated the adequacy of teacher trainers ICT content knowledge.

As can be seen on table 5 below, there was some variation in the teacher trainers' perceptions about the level of their ICT content knowledge with regard to some key demographic factors.

**Table 5: Comparing teacher trainers' knowledge of ICT content as perceived by the teacher trainers themselves by key demographic factors**

| Demographic information | Categories | Have adequate knowledge of ICT content | | Total based on response |
|---|---|---|---|---|
| | | Agree | Disagree | |
| Highest academic qualification | First degree | 24(53.3%) | 21(46.7%) | 45 |
| | Master's degree | 5(100.0%) | 0(0.0%) | 5 |
| Longevity in the teaching profession | 0-5 years | 17(48.6%) | 18(51.4%) | 35 |
| | 6-10 years | 7(70.0%) | 3(30.0%) | 10 |
| | 16 years and above | 5(100.0%) | 0(0.0%) | 5 |
| Number of years in teaching ICT | 0-2 year | 9(36.0%) | 16(64.0%) | 25 |
| | 3-5 years | 15(75.0%) | 2(25.0%) | 20 |
| | 6-8 years | 5(100.0%) | 0(0.0%) | 5 |
| Have been taught ICT in the university | Yes | 8(80.0%) | 2(20.0%) | 10 |
| | No | 21(52.5%) | 19(47.5%) | 40 |

When teacher trainers' knowledge of ICT content as perceived by the teacher trainers themselves was compared based on their highest academic qualification, longevity in the teaching profession,

number of years in teaching ICT and whether or not they were taught ICT in the university, there was a wide gap in their responses. For instance, more teacher trainers with a Master's degree as highest academic qualification were perceived as having adequate knowledge on ICT content than their colleagues with first degree as highest academic qualification. With regards to longevity in teaching, teacher trainers who have taught for 6-10 years and 16 years and above were seen to have more knowledge on ICT content than their colleagues who have taught for less than 6 years. Furthermore, teacher trainers who have been teaching ICT for 3-5years and 6-8 years were rated as having more adequate knowledge on ICT content than their colleagues who have been teaching ICT for only 0-2 years. Furthermore, more teacher trainers who admitted that they have been taught ICT in the University were perceived as having adequate knowledge on ICT content than their peers who were not taught ICT in the University.

**Verification of Research Hypothesis: There is no significant relationship between primary teacher trainers' knowledge of ICT content and student teachers' examination scores in ICT.**

**Table 6: Relationship between primary teacher trainers' knowledge of ICT content and student teachers' examination score in ICT**

| | Test statistics | Primary teacher trainers' knowledge of ICT content | Student teachers' examination score in ICT |
|---|---|---|---|
| **Spearman's rho** | R-value | 1.000 | .416** |
| | P-value | | .000 |
| | N | 254 | 254 |

**. Correlation is significant at the 0.01 level (2-tailed).

Statistically, there was a significant, positive and relatively strong correlation between primary teacher trainer's knowledge of ICT content and student teachers' examination scores in ICT (R=0.416**, P=0.000>0.05). The positive sign of the correlation implies that student teachers are more likely to perform better or score higher in ICT examination if the primary teacher trainers have adequate knowledge of ICT content. Therefore, the hypothesis stated above was rejected, meaning there exists a significant and positive relationship between primary teacher trainers' knowledge of ICT content and student teachers' examination score in ICT.

## 5. DISCUSSIONS AND IMPLICATIONS

In summary, the finding from this study is that, there is a significant and positive relationship between teacher trainers' ICT content knowledge and student teachers' academic achievement in ICT. This thus implies that, student teachers are more likely to perform better or score higher marks in ICT examinations if their ICT teachers have adequate knowledge of ICT content.

This finding is in line with the positive relationship that exists between teachers' knowledge of content and students' achievement as portrayed in the theory of Pedagogic Content Knowledge (PCK) by Schulman (1987). Similarly, Yusof & Zakaria (2015) support the view of Schulman (1987) by stating that, teachers need to have a good command of subject matter knowledge so as to be able to enhance students' achievement in the classroom. This finding equally ties with the view of Anthony & Walshaw (2009) that in order for teachers to be effective, they must acquire and be able to demonstrate command of content or subject matter to be taught.

This finding however contrasts the research findings of James Coleman in 1960, cited in Archer (1999, p.3) that "Socio-economic status largely determines student achievement… and what schools do does not matter much, because at the end, poor kids learn very little and rich kids learn a lot". Contrarily, the finding obtained in this study show that schools do matter, and teachers' mastery of subject matter plays a crucial role in determining student teachers' academic performance in ICT.

Findings from the demographic data collected in this study reveal that all the teacher trainers (100%), studied specialized in the Sciences of Education at the various higher teacher training institutions which they attended and none of the them acknowledged having done ICT as a specialty at the teacher training college. Moreover, a majority of the teacher trainers who teach ICT (80%) said

they were neither taught ICT at the university level nor had ever received any formal training in ICT. This thus implies that most of the teacher trainers who teach ICT lack the basic ICT content knowledge required to be able to effectively teach this discipline hence are incompetent.

This finding equally confirms the view of Fong-Yee and Normore (2013) that teachers who hold college majors or minors in the subject area that they are teaching, positively impact students' learning in those subject areas. Teachers' professional knowledge and skills could be developed through professional development and in-service training programs so as to achieve successful academic outcome by students (King and Newmann, 2000). However, data collected from teacher trainers through interviews show that very little or no provision is made for in-service training of teacher trainers who teach ICT. This thus implies that the teacher trainers in the field who did not do any course work on ICT while at higher teacher training colleges and at the University level are equally not provided with the opportunity of acquiring ICT knowledge through in-service training.

From this study, it was equally realized that the percentage of teacher trainers who perceived themselves as having adequate knowledge of ICT content (63.0%) was slightly less than the perception of the student teachers (64.5%). These findings were however quite contrasting with findings recorded on the observation check list wherein just 17.5% of teacher trainers were observed to have adequate knowledge of ICT content. This disparity could have resulted from the inability of the teacher trainers and student teachers to properly evaluate themselves or evaluate their teachers respectively.

The lack of ICT content knowledge by the teacher trainers probably greatly accounted to just the 52.35% pass in ICT obtained by student teachers in ICT at the 2018 South West Regional mock CAPIEMP for the three teacher training colleges studied. This is because teacher trainers in ICT just like those teaching other disciplines need to have an adequate knowledge of subject matter in order to be able to teach effectively; as well as enhance student teachers' academic achievement in their different disciplines. In line with this assertion, Walshaw (2012) points out that teachers with limited subject matter knowledge tend to focus on a narrow conceptual field rather than forging wider connections between the facts, concepts, and teaching of Mathematics; hence are not beneficial to students' achievement.

The findings from the demographic data obtained equally revealed that the student teachers' perception of the level of their teachers' ICT content knowledge did not significantly differ between the various teacher training colleges, as well as in terms of their gender and the student teachers' course of study ($p>0.05$). This thus implies that the student teachers had almost the same perceptions about the level of their ICT teachers' content knowledge irrespective of their gender and the course of study into which they were enrolled.

Results obtained from an interview with ICT teacher trainers equally revealed the fact that all the teacher trainers studied acknowledged the fact that they are not quite comfortable with teaching ICT. The reason which they advanced for this is because they have never been taught ICT in school; but were assigned to teach this discipline while on the field. In addition to this, they said no provision is equally made for them to acquire the knowledge they require to be able to teach this discipline through in-service training. They thus resort to reading textbooks and carrying out research so as to teach the students the little they can grasp.

Most of the teacher trainers equally acknowledged the fact that there are some topics in the ICT syllabus for Teacher training colleges that they did not master at all hence could not teach them to students. Some of such topics which most of the teacher trainers acknowledged they could not teach included computer soft ware. This thus accounts for the fact that in response to the item of the questionnaire that requested student teachers to list areas which they would suggest their teachers to teach so as to enhance their performance in ICT; most of the student teachers suggested that their teachers should teach Microsoft words, Microsoft excel, Power point, and how to use the internet.

Based on the fact that the teacher trainers evaluated themselves as not being apt in terms of ICT content knowledge, most of them suggested that in order to improve on the teaching of ICT thus enhancing student teachers' performance, ICT specialized teachers should be assigned to teach ICT. In addition to this, they highlighted the need for teachers to be given the opportunity to undergo in-service training through participation in seminars and refresher courses on ICT so as to acquire the knowledge

of ICT content and skills which they require to be effective in teaching ICT especially given the fact that ICT is evolving hence teachers need to continue updating their knowledge with time.

### 5.1 Recommendations

Findings obtained from this piece of work reveal that teacher Trainers' content knowledge in ICT is scanty. There is thus the urgent need for professional programs to be organized to help teacher trainers understand ICT and provide them with the competencies of integrating ICT in the teaching learning process. Workshops, Seminars and Conferences should thus be organized from time to time to enrich and update the knowledge of Teacher Trainers in ICTs. Furthermore, teacher trainers should be encouraged and motivated by the Cameroonian Government. MINESEC should develop policy that mandates the teaching of ICT in teacher training Colleges to qualified ICT specialized teacher trainers so as to ensure that ICT is taught with competence, ingenuity, ability and resourcefulness to bring out the best from student teachers in terms of academic performance. The Government should also ensure that qualified teachers with ICT content knowledge and skills are recruited so as to enhance student teachers 'academic achievement in ICT.

## 6. CONCLUSION

Based on the findings of this study, it is imperative to state that the ICT content knowledge of teacher trainers is a strong indicator of student teachers' academic achievement in ICT. This is because student teachers' achievements at ICT examinations were found to be influenced to a great extent by their teachers' ICT content Knowledge. This thus implies that student teachers are likely to perform better in ICT if taught by teachers who properly master their subject matter and vice versa.

### 6.1 Limitations of the Study

The relatively small sample size of 10 ICT teacher trainers and 268 student teachers drawn from just three teacher training colleges in two divisions of the south west Region was used. This made it difficult to determine whether or not the sample was accurately representative of a larger population.

All the ICT teacher trainers were informed before the researcher observed them in a classroom setting. Consequently, all of them had a reason to prepare thoroughly for the lesson. This made it difficult to judge whether their lessons accurately represented their typical teaching approaches. Similarly, the ICT teachers were equally informed before the interview. Consequently, the participants may have felt obligated to provide positive feedback during the interviews.

The close ended items on both the teacher trainers' and students' questionnaires were in-exhaustive due to the need to make the instrument short and appealing to the respondents. Consequently, other important indicators of teacher effectiveness were not considered for the study. This lack of indebt investigation about teacher effectiveness further served as a shortcoming to the study.

However, in spite of the limitations pointed above, the researcher made some efforts to over to overcome them to a great extent. It is thus the assertion of this researcher that the study has been able to make pertinent and reliable findings for generalizations.

## 7. REFERENCE

Adediwura, A., & Tayo, B. (2007). Perception of Teachers' Knowledge, Attitude and TeachinG Skills as Predictor of Academic Performance in Nigerian Secondary schools. *Journal of Educational Research and Review, 2*(7). 165-171.

Aina, L.O. (2013). Information, knowledge and the gate keepers. The One Hundred and Thirty-Second Inaugural Lecture delivered at the University of Ilorin, Nigeria.

Archambault, L., and Crippen, K. Examining TPACK among K-12 online distance education in the United States. *Contemporary Issues in Technology and Teacher Education, 9*(1), 71-88.

Anthony, G. and Walshaw, M. (2009). Characteristics of Effective teaching of Mathematics: A view from the west. *Journal of Mathematics and Education.2*(2) 147-164.

Archer , J. (1999). Sandars 101. *Education Week,* 18(34), 22-28. Retrieved on 16, 2016 from Academic Search Elite: http://www.epnet,com/academic/asearchelite.asp.

Askew, M., Rhodes, V., Brown, M., William, D. and Johnson, D. (1997) *Effective Teachers of Numeracy: Report of a Study Carried Out for the Teacher Training Agency,* London: King's College London, School of Education.

Bangbade, J.O. (2004). Effects of subject matter knowledge in the teaching and learning of Biology and Physics. *Teaching and Teacher Education:* 109-102.

Ball, D.L., and Bass, H. (2000). Interweaving content and pedagogy in teaching and learning to teach: Knowing and using Mathematics. In J, Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning.* Westport, CT: Ablex Publishing.

Bonney, E. A., Amoah, D.F., Micah, S.A.,Ahiamenyo, C., Lemaire, M.B. (2015). The Relationship between the Quality of Teachers and Pupils' Academic Performance in STMA Junior High Schools of the Western Region of Ghana. *Journal of Education and Practice 6*(24). 139-150.

Darling-Hammond, L. (2000) 'Teacher quality and student achievement: a review of state policy evidence':*Education Policy Analysis Archives,* **8** (1): http://epaa.asu.edu/epaa/v8nl/.

De Miranda, M.A. (2008). Pedagogical Content Knowledge and Technological Teacher Education: Issues for thought. *Journal of the Japanese Society of Technology Education.50*(1). 17-26

Feiman-Nemser, S. 92001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. Teachers' college records, 1013-1055.

Fennema, E. and Loef-Franke, M. (1992) 'Teachers' knowledge and its impact', in D.A.Grouws (ed.) *Handbook of Research on Mathematics Teaching and learning*, New York: Macmillan.

Ferguson, P., & Womach, S.T. (1993). The impact of subject matter and Education Coursework on teaching performance. *Journal of Teacher Education , 44* (1), 55-63.

Fong-Yee, D. and Normore H. A. (2013). *The Impact of Quality Teachers on Student Achievement.* Florida: Florida International University.

Glossary of Education Reform (2016): *Content Knowledge*.https//www.edglossasry.org. Retrieved on 20/03/19.

Graeber, A. (1999). Forms of knowing mathematics: what a pre-service teacher should learn. *Educational studies in mathematics.* 38(1-3), 189-204.

Haji, S., Moluayonge G. E., and Park, I. (2017). Teachers' use of Information and technology in Education: Cameroon Secondary School perspectives. *Turkish online Journal of Educational Technology. 16*(3).

Hansen, D. (1995). *The call to teach*. Chicago: Teachers' college press.

Hattie, J. (2003). Teachers make a difference: What is the Reseach Evidence? ACER Research Repository. https://researcg,acer.edu.au. Retrieved on 20/03/2019.

Hawley, W. (1992). *The Theory and practice of alternative certification: implication for the improvement of teaching.* Peabody journal of Teacher Education. 67(3), 3-34.

Ihola, A.A. and Udofia I.G.R. (2017). Effect of Demographic Factors and Teachers' Mastery of Instructional Designs as Predictors of Pupils' Achievements in Mathematics. *Journal of Educational Research and Development.* 15(1) 10-24.

King, M.B. & Newmann, F.M.(2000). Will teacher learning advance school goals? *Phi Delta Kappan, 81* (8), 576-580.

Koehler, M. and Mishra, P. (2009). What is Technological Content Knowledge (TPACK)? *Comtemporaryissues in technology and teacher education.* 9(1), 60-70.

Koehler, M., Mishra, P. & Cain, W. (2013). What is Technological Content Knowledge (TPACK)? *Journal of Education.* 193(3),13-19.

Leinhardt, G., Putnam, R,T., Stein, M.K., & Baxter, J. (1991). Where subject knowledge matters. *Advances in research on teaching,* 2, 87-113.

Mandeville, G.K. and Liu, Q. (1997) 'The effect of teacher certification and task level on Mathematics achievement', *Teaching and Teacher Education,* **13** (4):397–407.

Marzita, P. (2014). Effective Teaching: Pedagogical Content Knowledge.

Mishra, P., & Koehler M. J (2006). Technological Pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers' college record.* 108 (6), 1017-1054.

Mishra, P., & Koehler, M.J. (2007). Technological pedagogical content knowledge (TPCK): Confronting the wicket problems of teaching with technology. In C. Crawford (Eds.),

*Proceedings of Society for Information Technology and Teacher Education International Conference 2007* (pp2214-2226) Chesapeake, VA: Association for the Advancement of Computing in Education.

Mishra, P., & Koehler, M.J. (2009). Too Cool for School? No way! Using the TPACK framework: You can Have Your Hot Tools and Teach with Them, Too. *Learning and Leading with Technology. 36*(7). 14-18.

Monk, D.H. (1994) 'Subject matter preparation of secondary Mathematics and Science teachers and student achievement', *Economics of Education Review*, **13** (2):125–145.

National Research Council (2000). *How people learn: Brain, mind, experience and school.* Washington, DC: National Academy Press.

Odumuso, M., Olusesan, E. G. and Abel (2016). Promoting the Effective Teaching and Learning of Mathematics Using Cooperative Learning method. A book of Reading in honour of Mr. Emmanuel Adetunji Oloyede, 31-43.

Odumuso, M.O and Olisama, O.V. (2018). Teachers' Content and Pedagogical Knowledge on Students' Achievement in Algebra. *International journal of Education and Research.* 6(3). 83-94.

Ogar, M. N. (2006). Instructional Media, Learner, Teacher and classroom Factors as Correlates of Secondary School students' learning outcomes in English Language. Unpublished Ph.D Thesis, University of Ibadan.

Olisama, V.O., Odumosu, M.O. and Egho, E.O. (2011). The use of internet for teaching effectiveness in Mathematics: Benefits and Challenges. *A journal of Educational Research and Development (JERD)* 6(1) 243-248.

Onyejekwe, A. (2006). Educational Technology in Curriculum Instructional Program. Onitcha: West and Solomon Publishing Co Ltd.

Pfundt, L., & Duit, R. (2000). *Students' alternative frameworks and science education* (5th ed.). Kiel, Germany: University of Kiel.

Shulman, L. & Grossman, P. (1988). *The interim teacher casebook.* San Francisco, CA: Far West Laboratory for Educationa Research and Development.

Shulman, L. S. (1986).Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

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

Shulman, L.S (1987). Knowledge and teaching. *Harvard Educational Review,*57 (1), 1-21.

Telewa (2008).*Implementing English Curriculum: Final Report of a Serminar held in New Delhi.*

U.S. Department of Education, Office of Elementary and and Secondary Education. (2002). *No Child Left Behind Act of 2001*. Washington, DC:Author.

UNESCO (1998). World Education Report: Teachers and Teaching in a changing World.

UNESCO (2002). Report on Information And Communication Technologies in Teacher Education.

UNESCO-UIS, (2015). *Information and Communication Technology (ICT) in Education in sub-Saharan Africa: A comparative analysis of basic e-readiness in schools.*

Walshaw, M. (2012). Teacher Knowledge as Fundamental to effective teaching practice. *Journal of Mathematics Teacher Education. 15*(3).

Wenglinsky, H. (2002). *How schools matter: the link between teacher classroom practices and studentacademic performance.* Education policy Analysis Achives, 10(12). 10 (12).

Yusof, Y.M. and Zakaria, E, (2010). Investigating secondary mathematics students'teachers' pedagogic content knowledge: a case study, *journal of Education and Sociology*, 32-39.

**Zambrut Journal, Link Access;**
https://zambrut.com
https://zambrut.com/communication-technology/