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The Teacher Trainers' Perceptions of the Challenges in Achieving Technological Pedagogical Content Knowledge for Teacher Education

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ABSTRACT: The study examined the challenges in implementation of the Technological Pedagogical Content Knowledge (TPCK) as a basis for 21st century learning and skills acquisition. The TPCK advocates for adequate balance of content knowledge with pedagogy and technology. The study sampled one hundred and twenty (120) teacher trainers whose status was senior lecturers and above in three Colleges of Education in Oyo State, Nigeria to determine the problems of achieving TPCK in teacher education. An open ended questionnaire which contained fifteen (15) statements on 4-point Likert scale was used as the only instrument. This allowed the teacher trainers to freely express their opinions on the issues related to the implementation of TPCK in the teacher education in Nigeria. The responses of the sampled teacher trainers were analysed using simple percentage. The finding indicated that inadequacy in teacher preparation, teachers' knowledge of application of technology, inadequate technological facilities, mode of recruitment of teacher trainers, lack of teacher motivation and irregular in-service training for the teacher trainers plague the implementation of TPCK in Nigeria teacher education system. The study recommends adequate knowledge and application of technological pedagogical content knowledge in teacher preparation, recruitment of teacher trainers, teacher motivation through prompt payment salary, adequate provision of technological facilities and regular in-service training. The study also suggested learning strategies that could be employed in teacher education to foster digital literacy, critical thinking, problem solving and collaboration Keywords: Teacher education, pedagogical content knowledge, technological pedagogical content knowledge, 21st century learning and skills.

I. INTRODUCTION

The 21st century education is aimed at preparing students for active learning, success in workforce and to be contributing members of the society (Adeoye, 2014, Adeoye 2016). In order to achieve these core aims of education, theory of constructivist approach to learning should be basis for instruction. This approach is student-centered which sees students as active constructors of knowledge and teachers as facilitators but not the custodian of knowledge. Education is not an act of knowing but a way of constructing knowledge from learning environment. Learning is discovery; knowledge should be meaningfully acquired by students. Memorization and regurgitation of facts should be discouraged. These, among other things are what the 21st century learning is set to accomplish in education.

Twenty first century learning is an approach to teaching that relates contents to skills which make learner more active in the classroom than in the traditional learning. Twenty first century learning emphasizes collaboration, digital literacy, critical thinking and problem solving as the core competencies that educational institutions need to teach for student to succeed in work, life and the society. Teacher has enormous tasks to perform in achieving the 21st century learning goals. Teacher must have adequate knowledge of the subject matter, the effective instructional learning strategies and ways to implement the strategies in order to achieve the core aims of 21st century learning.

Misdhra and Koettler (2006) identified three types of knowledge that teacher must possess. These are content, pedagogy and technology. The content knowledge is the specific and in-depth understanding of concepts in a subject matter. This involves the macroscopic, microscopic and representational knowledge (Adeoye, 2011; Adeoye and Ajeyalemi, 2016). The pedagogical knowledge is the knowledge that relate to teaching and learning process. It involves the knowledge of different theories about learning, teaching approaches and their classroom implementations, assessment, evaluation, management and others. Pedagogical content knowledge stresses good knowledge of topics in one's subject areas / discipline and the most useful forms of representing and formulating the knowledge (analogies, illustrations, examples, explanations and demonstrations) that make it meaningful and comprehensive to student. However, technological knowledge is the knowledge of digital innovations and application to teaching and learning. Mishra and Koettler (2006) identified relationships among the knowledge components (content, pedagogy and technology) and as represented in Fig 1.

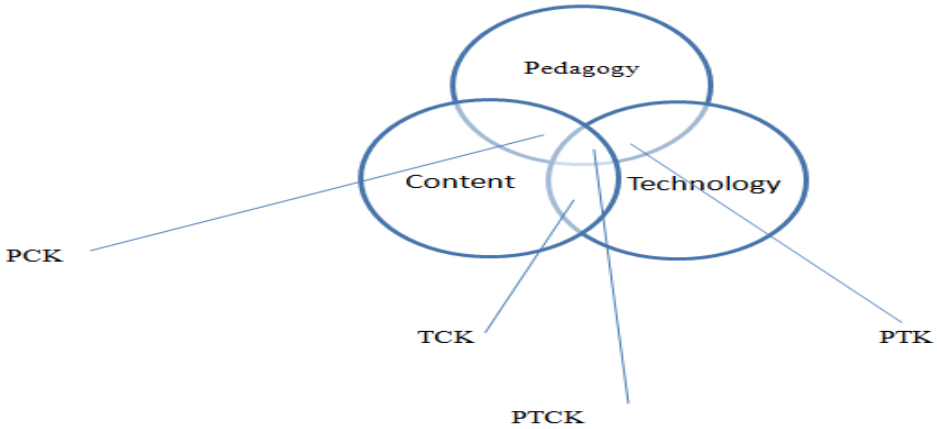

Fig 1: Relationships among Knowledge Components

Source: Midhra and Koettler (2006:1025)

PCK: Pedagogical Content Knowledge

TCK: Technological Content Knowledge

PTK: Pedagogical Technological Knowledge

TPCK: Technological Pedagogical Content Knowledge

Four types of interrelated knowledge emerged from the knowledge components. These are pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPCK). This intersect of the three components of learning is referred to as technological pedagogical content knowledge (TPCK) and intersect between content and pedagogy is known as pedagogical content knowledge (PCK). Shulman (1986), the proponent of pedagogical content knowledge (PCK) defined the concept as an amalgamation of content and pedagogical knowledge. PCK is the understanding that teacher has on how to assist students to meaningfully comprehend specific topics in a subject using appropriate learning theories and instructional strategies. This includes knowledge of how particular topics, problems and issues can be organized, represented and adapted to the diverse interests and abilities of students and then presented for instruction (Shulman, 1987; Magnusson, Krajack and Borke, 1999 and Mishra and Koettler, 2006).

However, the PCK teacher needs to know not just the subject matter, content arrangement, pedagogical knowledge and generic form of knowledge in learning (teaching strategies, classroom management, implementation and evaluation) but also the ways in which the subject matter and teaching strategies change with the application of technology. The TPCK is the basis for good teaching to foster critical thinking, meaningful understanding of concepts in any subject and development of digital skills.

II. STATEMENT OF PROBLEM

The globalization and rise in technologies in the 21st century have revolutionized the teaching and learning methods. In addition to this, 90 percent of jobs require digital skills for their effective performance. Therefore, students should be educated towards digital literacy (European Commission, 2017).

Teacher related factors such as teacher's knowledge of subject matter, organization of learning experiences, digital knowledge and competencies in appropriate and effective learning strategies implementation have strong influence on student's understanding of concepts and academic achievement. Quality of good teacher is determined by the performance of his students. In Nigeria, the spate in poor academic achievement of senior secondary school students in West African Examination Council (WAEC) is very discouraging. Reports of the analysis of Nigeria students in WAEC have shown that 31 percent of the registered students in WAEC passed with five credits including English and mathematics in 2014. In the year 2015, 38.68 percent had credit pass in five subjects while for 2016 and 2017, the percent passes were 52.92 and 59.22, respectively (Orijeogu, 2018). The rapid increased in the pass rate for 2016 and 2017 was as a result of the WAEC training program organized for senior secondary school teachers in 2016. The observed poor performance of the students in examinations is majorly based on the didactic method of instruction often employed, which centered on lecture and content demonstration has negative effect on student's knowledge and social competencies (Dimkpa, 2015 and Adeoye,

2016). This is seen as vicious cycle in which in-service teachers teach as they were taught. This study examined the teacher trainers' perception of the challenges in achieving technological pedagogical content knowledge for teacher education in 21st century learning.

III. METHODOLOGY

Survey research design was employed to determine the challenges in implementing technological pedagogical content knowledge in teacher education. Questionnaire was used to finding out teacher trainers responses on issues like teacher preparation, technology, mode of recruitment, in-service training and teacher motivation in teacher education. The questionnaire is in two sections. Section A is a close ended type that contains information about the respondent while section B is an open ended questionnaire which contained fifteen (15) statements on the issues in teacher education. The items were structured using Likert Scale of strongly disagree, disagree, agree and strongly agree with scores of 1, 2, 3 and 4 respectively. The questionnaire also had the part where the respondents are to make comments on each of the issues raised. In essence, the questionnaire was both structured and unstructured. The instrument was validated by two teacher trainers and the instrument was adjured to be valid for the study. The instrument was then administered to ten teacher trainers to determine the instrument reliability. Alpha Cronbach reliability was used to analyse their responses. The instrument had a positive correlation value of 0.89.

One hundred and twenty (120) teacher trainers who had attained the rank of Senior Lecturer and above were sampled from three public Colleges of Education in Oyo State, Nigeria. The responses of the sampled teachers to the questionnaire were analysed using frequency count and percentage.

3.1 Results

The results obtained from the close structured questionnaire are as presented.

S/N	Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	Prospective teachers are adequately trained in subject area and pedagogical knowledge as based on the curricula.	2 (2%)	3 (3%)	36 (30%)	79 (66%)
2.	The quality of the field experience prior to certification is inadequate.	7 (6%)	13 (11%)	48 (40%)	52 (43%)
3.	Teaching practice exercise is not adequate based on duration, supervision and teaching skills	8 (8%)	11 (9%)	51 (43%)	50(42%)
4.	Teacher trainers are recruited into various fields of teaching based on qualification as specified in Nigeria Certificate in Education minimum standard.	2 (2%)	15(13%)	31(26%)	72(60%)
5.	Selective screening of teacher trainers into teaching profession is majorly based on subject matter not on pedagogical knowledge and teaching skills.	4 (3%)	3 (3%)	31 (26%)	82 (67%)
6.	Job vacancy in my college is sometimes not publicly advertised. The vacancies are occupied by political appointees.	3(3%)	5(4%)	39 (33%)	73(61%)
7.	In-service training for teacher trainers are organised by my college quarterly in every year.	52(43%)	45(38%)	21(18%)	2(2%)
8.	I attend local/ national/international conference/workshop **twice** in a year to keep abreast in my field and teaching profession.	62 (52%)	30 (25%)	23 (19%)	5(4%)
9.	Sponsorship to conferences, seminars and workshops by my College Management is unbiased and adequate.	72 (60%)	31 (26%)	8 (7%)	9 (8%)
10.	Teaching is basically by lecture method because technology materials and equipment are not adequately in the college.	8(7%)	11(9%)	45 (38%)	56 (47%)
11.	Epileptic power supply hinders the use of information technology in my college if when technology materials are available	61 (51%)	34 (28%)	12 (10%)	13 (11%)
12.	Teacher trainers' knowledge on technology	62 (52%)	28 (23%)	12	18 (15%)

	applications in education is inadequate.			(10%)	
13.	I have no job satisfaction in teaching profession because I am not regularly paid for my service.	27 (23%)	32 (27%)	25 (21%)	36 (30%)
14.	There is no adequate facilities in the college to motivate me for teaching	19 (16%)	22 (18%)	37 (31%)	42 (35%)
15.	Teaching profession is not dignified in my country and that sometimes discourages me.	13 (11%)	17 (14%)	47 (39%)	43 (36%)

The results indicated that issues related to adequate teacher preparation, technological facilities, learning strategies, mode of students and teacher recruitment, in-service training and teacher motivation plagued adequate implementation of TPCK in teacher education.

IV. DISCUSSION OF RESULT

The discussion of the results are based on both the teacher trainers' responses to closed and opening questionnaires on the issues bothering on implementation of Technological Pedagogical Content Knowledge.

The respondents indicated that prospective teachers were adequately trained in the areas of subject matter and pedagogical knowledge. Ninety five percent (95 %) of the respondents agreed to this statement. Eight four percent (84 %) of the respondents observed that the field experience of the prospective teachers prior to certification was inadequate due to inadequate teaching practice experience based on prospective teachers teaching skills, duration of the teaching practice and ineffective supervision by the teacher trainers.

On the mode of recruitment of the teacher trainers, eight four percent (84 %) of the respondents agreed that mode of recruitment of the teacher trainers in various disciplines was adequate and was based on required qualifications as stipulated in the Nigeria Certificate of Education minimum standard. However, ninety four percent (94 %) of the respondents agreed that selection the teacher trainers during screening exercise was majorly based on subject matter neither was it teacher teaching skills nor on pedagogical knowledge. It was also observed by the respondents (93 %) that vacancy positions were filled by political appointees.

Lack of regular in-service training for teacher trainers to keep abreast with new methods of learning hinders the effective use of technological materials in classroom. Eighty one percent (81 %) of the respondents disagreed that in-service trainings were organized quarterly per year in their institutions. Twenty three (23 %) of the respondents attend local, national or international conference / workshop twice a year while 77 % degreed to this statement. The respondents, fourteen percent (14 %) indicated that the sponsorship received from College Management of their institution was unbiased and adequate while eight six percent (86 %) perceived the sponsorship to be biased and inadequate.

The teacher trainers, indicated non availability or inadequacy in technology materials and equipment make some of teachers (87 %) to result to the use of predominant lecture method in the classroom. The epileptic power supply hinders the use of technology in teaching even when technological facilities are available. Seventy nine percent (79 %) of the respondents were in agreement with this statement. Also, many of the respondents (75 %) indicated that inadequate application of technology knowledge in education negatively influences the use of technologies in teaching.

Furthermore, in Nigeria, the teaching profession is not dignified as perceived by the respondents (75 %) as other professions and this discourages the teacher trainers to put in their best in teaching. Inadequate facilities as perceived by sixty five percent (65 %) of the respondents and irregular payment of salary (51 %) hinder teacher motivation to teaching profession. However, the percent of the respondents to the issue of inadequate facilities and irregular payment of salary as motivating factor in teaching was low. This may be because two Colleges of Education among the four colleges of education sampled are federal institutions. The federal institutions enjoy regular payment of salary and adequate facilities than the state owned institutions.

4.0 Implications of the Study

This is discussed on the following headings:

4.1 Issues with Teacher Preparation

The teacher trainers are professionally trained and certified at the Colleges of Education and Faculty of Education in the Universities in Nigeria. Several issues emerged from the training of teacher to teach either at junior secondary school or senior secondary school. Some of these challenges which may not be limited to Nigeria alone, are balancing content with pedagogies, incorporating information technology into teaching practices.

In the professional training institutions in Nigeria, more than 80 percent of the time of the students are used in learning subject matter they are preparing to teach and on educational courses such as sociology, psychology, philosophy, history, evaluation and measurement, uses of English and basic mathematics as observed by the

writer. Less than 20 percent of their time is devoted to teaching practice and modern methods of teaching. This issue was also identified by Baumert and Kunter (2013) and Sutanbek (2015). Beyond the relevance of the content and pedagogical, is solid knowledge of technology and its applications to teaching and learning (Wilson, Floden and Ferrini-Mundy, 2002 and Olfos, Goldrine and Estrella, 2014). The priority in the teacher preparation is basically on intellectual development above professionalism. The didactic method of preparation reflects in the poor academic performance of the students in both internal and external examinations. There are should be adequate balance of pedagogical and content knowledge.

4.2 Issue with Technology: The use of technology in teaching is greatly hampered in the training of prospective teachers as result of lack of facilities both human and physical resources, to engage them in technological based learning. Most of the knowledge learnt on applications of technology to teaching and learning are basically theoretical in nature. There is need to balance the cognitive (content) knowledge in discipline and technology with practical applications to teaching and learning. It is also difficult for the teacher trainers to keep abreast with various new innovations in teaching and learning as result of limited access to internet, epileptic power supply and well-equipped technological laboratories for teaching and learning.

4.3 Issue with Mode of Recruitment: Recruitment of the teacher trainers is based on academic qualifications with little or no emphasizes on the teaching competencies of the teacher. Prospective teacher should be made to display their academic competencies in teaching when they are being interviewed for teaching appointment. Both cognitive knowledge and teaching competencies must be married before picking any candidate for teaching appointment.

4.4 Issue with In-service Training for Teacher Trainers: Teacher trainers need to keep abreast with the dynamism of the technologies and pedagogies in teaching and learning. This can be done through seminar, workshop and conference attendances. This opportunity is only enjoyed by very few teachers in Nigeria.

4.5 Issue with Teacher Motivation: Teacher motivation is importance to success in classroom because motivation energies, directs and sustains positive behavior of the teacher to teaching. Motivation inspires the teacher to do their best in teaching and learning process. A motivated teacher will in turn motive his students to learning. One of the ways to motivate teacher is regular payment of salary. The motivational incentive that teachers receive is the salary to the service they render. In Nigeria, many workers in state government have unpaid arrears of salaries most especially in tertiary institutions. There has been incessant workers' strike in many states of the federation. The moral and commitment of workers to work is dangling.

4.6 Learning Strategies for Technological Pedagogical Knowledge Development for 21st Century Learning

To achieve the goals of 21st century learning, student is an active participant in teaching and learning process. Problem-based, discovery, think pair and blended learning strategies are hereby recommended not only to foster achievement of 21st century learning but to prepare the prospective teachers to attain technological pedagogical content knowledge. The learning strategies when adequately employed in the classroom foster deep understanding of concepts, knowledge retention and social skills (collaboration and communication) among. The learning strategies are discussed.

4.6.1 Problem-based Learning Strategies

Problem-based learning is student-centered learning approach which involves student active participation to solve real-world problems. Problem-based learning strategy combines theoretical knowledge with practical knowledge. Students work collaboratively to solve a given problem. The problem may be quantitative or qualitative in nature. Students work in a group of mixed ability and ask questions on the problem: what do we know? What do we need to know? and how do we find out? The strategy involves student gather information, worked collaboratively to find solution to the problem and report the solution.

The learning strategy promote self-learning and interaction among students. Higher order thinking is encouraged and memorization of facts is de-emphasized. The problem-based learning prepares students to enter workforce than traditional method. Communication and interpersonal skills are developed. The approach motivated students to learn because the learning is relevant to the real world. However, problem-based learning is time constraint. Inadequate resources, student preparation and motivation may hinder effective use of problem-based learning (Abdelkarim, Schween and Ford, 2018)

4.6.2 Inquiry Learning Strategy

Inquiry learning is active, process oriented and self-directed learning which occurs in problem solving situation. It is a method of instruction through which student interact with learning environment by exploration and manipulation of objects in the environment. It is a way by individual student or group of students find out things for themselves by asking questions. Guided inquiry is recommended for teaching in basic or secondary schools. In this approach like problem-based learning, teacher is a facilitator of learning. Inquiry learning strategy when properly employed in the classroom motivates students to learn and makes learning of concept more meaningful than expository method. Knowledge retention is enhanced because inquiry is self-directing, self-investigating and concept is real to students. Inquiry strategy fosters skills acquisition (Adeoye, 2016 and Kistian, Armanto and Sudrajat, 2017).

4.6.3 Think-Pair-Share (SPS) Learning Strategy

In a think-pair-share learning strategy, a question or problem is presented to student to think on, answer and response to and then tell it to a partner. The teacher then calls some of the students to share their responses with the whole class. Think-pair-share gives all the students a chance to think and speak about question \ problem instead of just one or two students dominating the discussion. The strategy gives students the opportunity to formulate their thoughts and ideas which increases the quality of their responses and keeping them actively engaged (Sunita, 2014). In think-pair-share learning strategy, three distinguishable steps are involved. These are think, pair and share.

Think: students independently think and form ideas about the question that has been asked or problem presented.
Pair: Students are grouped in pairs to discuss their thought. This step allows the students to articulate their ideas using the prior knowledge and vocabulary to communicate with each other. It will also allow the students to practice their speaking and listening skills as they learn to respect multiple perspectives
Share: Students share their responses with the entire class. The students become more comfortable and willing to share with the whole class after sharing the response with the pair.
Benefits of think-pair-share learning strategy are:

- Critical thinking is retained after a lesson.
- Opportunity to discuss and reflect on the topic / lesson.
- Enhance students' oral communication skills.
- Building on the ideas of other.
- Teacher can assess students understanding.

4.6.4 Blended Learning Strategy

Blended learning strategy is the integration of digital tools, techniques and materials with the physical classroom traditions. Blended learning can be approached in various ways but it should be self-paced, teacher directed online or technological components and projects application learning are their characteristics. Three major models of blended learning are supplemental, replacement and emporium models. Blended learning can be implemented in classroom by flipping and blended with videos, power point, play games or have some practices as homework and discussion beyond school day and space through virtual wall (Poth, 2016). Blended learning has been surveyed to have positive involvement and motivation to learning on students (Shand, Farrelly and Costa, 2016). Classroom should be made flexible to accommodate different learning styles in blended learning. The use of technology promotes retention of information, make learning to be fun, class seat time is reduced and self-performance assessments are promoted in blended learning. Blended learning is cost effective because learning is meaningfully enhanced. It also encourages collaboration among students and teacher / instructor.
In using these strategies in the classroom, teacher adequate knowledge of contents, contents arrangement and availability of the learning materials are needed to engage students in any of the strategy to foster the goals of 21st century learning.

V. CONCLUSION AND RECOMMENDATION

For any country to achieve the 21st century learning goals that stress active participation of learners in learning, critical thinking, social skills of collaboration, leadership, communication, digital literacy and to foster success in work force in future among others, problem-solving, inquiry, think-pair-share and blended learning strategies would of great values for teaching. The learning strategies would also be effective in improving teacher's quality.
Quality of teachers affect the standard of education of any nation and education in turn has effect on manpower development of the nation. It is imperative to overhaul teacher education in Nigeria to achieve the goals of 21st century learning. It is recommended that prospective teachers should be adequately prepared in teaching skills, in knowledge of the subject they are prepared to teach (discipline) and in knowledge of technology and its application to teaching and learning, that is technological pedagogical content knowledge.
Adequate resources must be put in place for effective integration of the three knowledge components in learning. Huge amount of money should be allocated to teacher training in Colleges of Education as it is done for education at the Nigeria Universities.
Recruitment of the teachers should be based on adequate knowledge of content and effective applications of technological pedagogical in impacting meaningful knowledge to students.
In-service training should be constantly organized and attendance opportunity should be given to all teachers to keep abreast with technological, pedagogical and disciplinary change.
Teachers' salary should be promptly paid and motivating incentives should be given to most proficiency teachers in teacher education yearly to boost their commitment to teaching profession.

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