

The Significance of Quantitative Data on the Uptake of Modern Technologies in Classroom Learning in Teacher Education

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Abstract: *The article examines the significance of quantitative data on the uptake of modern technologies in teacher education as tools for teaching, learning and research that is dynamic in the 21st century workforce skills. The main objective was to assess the effectiveness of modern technologies in classroom learning in teacher education institutions in Gaborone. The researcher employed quantitative approach, guided by research objectives. The study was driven by theoretical constructs of Bransford who developed anchored instructional theory that falls under-social constructionism paradigm, and Mishra & Koehler TPACK framework (Technological, Pedagogical and Content Knowledge). The researcher used questionnaires as instruments for collection of raw data from lecturers and teacher trainees. In turn, the collected data were analyzed using SPSS version 20. Simple random sampling was used to select the participants. The study established that the effectiveness of modern technologies on teacher training has not reached the level of satisfaction in teacher education institutions in Gaborone. The study findings report a correlation between modern technologies in classroom learning in teacher education institutions and the teacher trainees' performance and skills. In the final analysis, the study recommends that further studies on the subject. This will contribute towards the bridging of the digital divide in the 21st century.*

Key Words: *Modern Technologies, Teacher Education Institutions (TEI's), Quantitative data, Classroom learning and 21st century workforce skills.*

1. INTRODUCTION:

Today, a significant body of research has made it clear that many teachers have been slow to transform the way they teach despite the influx of the 21st century technology into their classrooms (Herold, 2015). Most surprisingly, many students are more interested, confident and fluent in the use of dominant technologies of the 21st century than adults duly charged to teach them (Prensky, 2003). Despite government's effort in training instructors at teacher training institutions to become conversant with 21st century technologies, some trained members of staff seem to be failing to incorporate skills of these technologies, which they have been exposed to while executing their professional classroom obligations. It has been noted that despite teachers' being trained on simple and basic technology like the use of projector in classroom, most instructors hardly use PowerPoint presentation during lectures. This called for the need to probe into the reasons that contribute to the instructors' inability to incorporate the technologies into education and/or classroom learning despite receiving good training in modern technologies in the 21st century.

In Uganda, during the past two decades, the government has spent millions of Uganda shilling in an effort to incorporate the 21st century technologies into education. This is in order to meet the required information technology (IT) skills for purposes of technological advancement for its graduates, for instance, teachers (Newby et al., 2012; Save the Children, 2019). According to Save the Children Report (2019), in Uganda, the teacher training institutions have introduced lecturers to modern technologies such as interactive smart board, projectors, Digital Electronic Books (eBooks), simulation technologies, podcasting, students' response system, digital video conferencing, lecture capture apps and other technologies.

In Botswana, the information communication technology (ICT) policy was adopted in 2004 known as 'Maitlamo', which came out with the national ICT Policy framework that was revised in 2007. Among others, the policy objective was to "create an enabling environment, universal service and access to information and communication facilities to make Botswana regional hub". On a related perspective, the country's 2016 Vision, which was approved in 1997 articulates as one of its pillars: "towards an informed and educated nation". Although the government is concerned about ICT adaptation, there are challenges that are encountered, which include considerable differences in terms of urban and rural access to ICT services, high cost of computers and absence of electricity in some rural areas.

1.1. Objectives of the Study:

The investigation was guided by the following objectives, namely, to:

- i) Assess the effectiveness of modern technologies in classroom learning in teacher training
- ii) Evaluate the relationship between modern technologies in classroom learning and enhancing teacher trainees' performance skills
- iii) Analyze the marketability of the highly technologically equipped teacher trainee graduates in both public and private education sectors

1.2 Rationale of the study

The primary aim of the study was to probe into the reasons that contribute to the lecturers' inability to uptake the incorporation of modern technologies into education in order to achieve the desired learning and skills required for the 21st century workforce skills in teacher education.

1.3 Hypotheses

Decision rule was determined by data patterns and p-value of chi-square test of independence calculated at 95% confidence interval using SPSS. The research considered H_0 hypotheses based on objectives as follows:

H_0 : There is no relationship between effective teacher trainings on the modern technologies in education and the application of such technologies in classroom learning.

H_0 : There is no relationship between modern technologies in classroom learning and the teacher trainee's performance skills.

H_0 : There is no significant relationship between uptake of modern technologies in classroom learning in teacher training institutions and marketability of such graduates.

2. LITERATURE REVIEW:

Currently, incorporating modern technologies in classroom learning is very useful to education because the concept is applicable to all aspects of education at all levels (Barrette, 2006). The uptake of modern technologies is a wise application of non-human resources whence providing appropriate solution to educational problems (Barrette, 2006; Baule, 2007). According to Carr (2012), uptake of modern technologies in the United States of America is effectively being achieved through provision of better training in technology to teachers who are at the center of success of uptake. This is in line with a study which was done at Pennsylvania State University (USA), which looked at blending technology into education and it can be effectively done (Krupar, 2017). Krupar (2017) found that the effectiveness of training in information technology related to education by teachers, determines success of uptake of modern technologies in classroom learning in Afghanistan and Uganda.

Educationists have been probing the relationship between 21st century modern technologies in classroom learning in enhancing teacher trainee's performance skills. For instance, in an Australian study on education technology on teachers' performance, it was revealed that the more teachers' use technologies in teaching, the higher the performance achieved (Smith & Duncan, 2015). In Japan, a cross-sectional study conducted established that use of technologies in education enhances high performance among teachers (Kohei, 2014). However, in the African setting, the relationship between the uses of modern technologies in promoting teacher training performance skills has not been well explored. This is reflected in the study by Hannessy et al., (2010) in East African countries where a review of ICT in education indicated that literature was silent on the relationship between modern technologies in classroom learning especially on enhancement of teacher trainee's performance skills.

Uptake of modern technologies in classroom learning prepares individuals by helping them acquire a deeper understanding and mastery of learning resources such as messages, people, materials, devices, techniques and settings; processes for analysing and devising solutions to those problems through research, theory, design, production, evaluation, utilization; the process involved in organisation and personnel management (Banister & Vannatta, 2006). This gives confidence to the hiring organizations, companies and departments regarding the quality of graduates. Research has found in United Kingdom that graduates who are conversant with ICT are more marketable in both public and private sectors than those graduates with low level of ICT knowledge (Campbell, 2016). Another study in Germany indicated that teachers who have ICT knowledge are five times more employable than the teachers in the same field who have no knowledge of ICT in their resume (Klopper, 2014).

In a 2011 study by the World Bank about ICT use in Sub Saharan Africa, it was revealed that fresh graduates with ICT knowledge are more employable than old graduates with work experience but without knowledge of ICT. In Uganda, the introduction of information communication technology as outlined in the educational ICT Policy (2006)

came with its implication to teacher training in Uganda which included: ICT tools and gadgets being availed to all students during the classroom, delivery of in-service teacher training so as to be more of 21st century technology in education oriented, sensitize students to develop positive attitude towards the e-technology, need to review teacher education institutions (TEI's) curriculum to include ICT areas, and lastly continuous staff trainings/CPD's a key to achieving modern technology skills. However, the policy did not indicate that when the learners are conversant with the 21st century knowledge in ICT, they become more employable in both public and private sectors. Guma, (2013) stressed that in Uganda, teachers attend to ICT trainings without acknowledging the role of ICT in their profession or career for instance future job opportunities. Guma (2013) further argued that human resource managers when recruiting teachers, do not emphasize the significance of technology in the job advertisement. This is contrary to the tradition in developed countries like Japan, Britain, United States of America and Canada whereby teacher graduates who are highly knowledgeable in the use or uptake of modern technologies in classroom learning are prioritized in recruitment process (Martin, 2013; McConnell, 2016, James, 2018).

In Botswana, the Government put in place a policy on ICT in 2004 and it was revised in 2007. The policy emphasized creating an enabling environment, universal service and access to information and communication facilities to make Botswana the regional hub. The government's effort on working to improve the level of investment of educational ICT equipment, Software as well as broadband connectivity of schools, refurbishment of computers and training of teachers and administrators on e-learning came with implication to teacher education. However, the policy did not reflect on the aspect of marketability among graduates, and on workforce skills required in relation to modern technologies in classroom learning in the 21st century.

3.1 Theoretical Framework

The study was based on the theoretical constructs of Bransford who developed anchored instructional theory and Mishra & Koehler (2006) TPACK framework (Technological, Pedagogical and Content Knowledge) developed to integrate technology in education and how to structure the classrooms to provide the best educational experiences for students, while incorporating technology. Bransford anchored instructional theory falls under social-constructionism paradigm. The theory was originally influenced by the work of John Dewey and Charles Gragg of Vanderbilt University (The Cognition and Technology Group at Vanderbilt, 1990). The theory suggests that instructional activities should encourage exploration by the student and encourage hands-on activities on interactive learning opportunities (Ouyang & Stanley, 2014). This type of instructional activities form the focus and intention of technology based instruction. Mishra & Koehler TPACK framework was developed in 2006 to integrate technology in education and how to structure the classrooms to provide the best educational experiences for students while incorporating technology. The framework explains the set of knowledge that teachers need to teach their students a subject, teach effectively and use technology. In a nutshell, Mishra & Koehler (2006) suggest that the framework should guide curriculum development and teacher education as well.

3. METHODOLOGY:

The researcher used the quantitative approach guided by research objectives. The approach was considered appropriate because it minimizes bias and maximizes the reliability of the research (Kothari, 2004, p.33). The researcher used simple random sampling technique to select three (3) institutions for the quantitative data, and used blindfold techniques to avoid bias. Three institutions of higher learning with teacher training were selected for the study in Gaborone out of six institutions. Lecturers and teacher trainees (students) were selected using simple random sampling technique because they were many and there was a need to offer an equal opportunity to all and eliminate biased data. This study quantitatively engaged 111 teacher trainees and 9 lecturers to respond to the questionnaire and these were randomly selected from each institution. Thirty-seven teacher trainees and three lecturers were randomly selected from each institution. Prior to data collection, the researcher sought a research permit from the Ministry of Tertiary Education, Science, Research and Technology, Botswana. The instruments were first pilot-tested in one institution, which was not part of the targeted sample. This was done to ensure clarity, validity and reliability of data collection instruments.

The data were collected using questionnaires and coded into the statistical Package for Social Sciences (SPSS) Version 20.0. Both descriptive and inferential statistics were displayed, and presentation of percentages, means, standard deviations and frequencies was done. This was done by tallying responses, computing percentages of variations in response as well as describing and interpreting the data in line with the study objectives through the use of SPSS. Finally, the study hypothesis was tested using ANOVA where alpha value was at 0.05 level of significance for statistical inferences. Ethical issues were taken into consideration to protect the participants.

4. Analysis of Data and Interpretation:

The statistical analysis that was used in analysing the data is One-way Analysis of Variance (ANOVA). The main data were subjected to ANOVA in order to test the study hypotheses.

Hypothesis 1: H₀: There is no relationship between effective teacher trainings on the modern technologies in education and the application of such technologies in classroom learning.

Analysis of Variance (ANOVA)					
Table 4.1 ANOVA for determination of the relationship between effective teacher training on the modern technologies in education and the application of such technologies in classroom learning					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1268.310	3	422.770	1.822	.014
Within Groups	19720.571	85	232.007		
Total	20988.881	88			

The Analysis of Variance was carried out to establish the effectiveness of Teacher Trainings on the Modern Technologies in Classroom Learning for both lecturers and teacher trainees. The results in table 4.1 shows that $df = 3$; $F(3, 85) = 1.822$; $p\text{-value} = .014$ i.e. $p < .05$; therefore we reject the null hypothesis. This means there is a relationship between effective teacher training on the modern technologies in education and the application of such technologies in classroom learning.

Interpretation

The study has rejected the null hypothesis upon one-way ANOVA’s establishment that $p\text{-value} = .014$ i.e. $p < .05$; this therefore, means that there is a relationship between effective teacher training on the modern technologies in education and the application of such technologies in classroom learning. This has further been observed in Honesty Significant Difference (HSD) that carried multiple comparisons of the items that both lecturers and teacher trainees indicated on how they contribute to the relationship between effective teacher trainings on the modern technologies in education and the application of such technologies in classroom learning. The study established that lecturers fail to incorporate modern technologies in their teaching due to lack of training on such technologies, teacher training institutions fail to provide lecturers with modern technologies to be used in classroom learning and also the government underfunds the incorporation of ICT into classroom efforts. HSD multiple comparison has further revealed that most teachers have no ICT skills, hence it is difficult for them to use modern technologies in classroom learning. Also, teacher trainees are not interested in modern technologies being used during classroom learning.

Hypothesis 2: H₀: There is no relationship between modern technologies in classroom learning and the teacher trainee’s performance skills.

Analysis of Variance (ANOVA)					
Table 4.2 ANOVA for Evaluation of the Relationship between Modern Technologies in Classroom Learning in Enhancing Teacher Trainee’s Performance Skills					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1268.310	3	422.770	1.397	.015
Within Groups	19720.571	85	232.007		
Total	20988.881	88			

As depicted in Table 4.2 on evaluation of the relationship between modern technologies in classroom learning and the teacher trainees’ performance skills, the result of the one-way ANOVA indicates that there were statistically significant differences between group means as determined by one-way ANOVA ($F(3,85) = 1.397, p = .015$); therefore, we reject the null hypothesis. This means that there is a relationship between modern technologies in classroom learning and the teacher trainee’s performance skills.

Interpretation

The study has rejected the null hypothesis upon one-way ANOVA’s establishment on evaluation of the relationship between modern technologies in classroom learning and the teacher trainee’s performance skills. The result of the one-way ANOVA indicates that there were statistically significant differences between group means as

determined by one-way ANOVA ($F(3,85) = 1.397, p = .015$). This means that there is a relationship between modern technologies in classroom learning and the teacher trainee's performance skills. Both lecturers and teacher trainees confirmed this through HSD findings on variables that tested the hypothesis. The study has established that some lecturers use different modern technologies when delivering lectures, some lecturers have never trained in any modern technology and this results in their failure to incorporate ICT into their teaching. Teacher trainees have indicated that when lecturers use modern technologies in classroom learning, learners are motivated and equipped in using the same upon graduation. Graduates who have been exposed to modern technologies during classroom learning perform better at work as they are well exposed to modern technologies. Being conversant with modern technologies in education makes teachers perform highly in their careers. Teachers with modern ICT skills deliver better than teachers who rely on traditional methods of teaching. Finally, 21st century work performance skills are measured in terms of how teachers can incorporate modern technologies in classroom learning. It can be concluded that there is a relationship between modern technologies in classroom learning and the teacher trainee's performance skills.

Hypothesis 3: H₀: There is no significant relationship between uptake of modern technologies in classroom learning in teacher training institutions and marketability of such graduates.

Analysis of Variance (ANOVA)					
Table 4.3 ANOVA for Analysis of the Marketability of the Highly Technologically Equipped Teacher Trainee Graduates in both Public and Private Education Sectors					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1268.310	4	345.392	1.480	.012
Within Groups	19720.571	84	232.420		
Total	20988.881	88			

The Analysis of Variance was carried out to establish the effectiveness of teacher training on the Modern Technologies in Classroom Learning and table 4.3 shows that $df = 4; F(4, 84) = 1.480; p\text{-value} = .012$ i.e. $p > .05$; therefore we reject the null hypothesis. This means that there is a statistically significant relationship between uptake of modern technologies in classroom learning in teacher training institutions and marketability of such graduates.

Interpretation

The study has rejected the null hypothesis upon one-way ANOVA's establishment that $p\text{-value} = .012$ i.e. $p > .05$; this therefore, means that there is a statistically significant relationship between uptake of modern technologies in classroom learning in teacher training institutions and marketability of such graduates. Multiple comparisons of the items testing the hypothesis have shown that employers in both public and private sectors require teacher trainee graduates who are conversant with modern technologies. Teacher trainee graduates with good exposure to modern technologies are more marketable than teachers who do not know how to use a projector in a classroom. A teacher's CV that indicates his/her ability in using modern technologies in classroom learning attracts recruiters than a CV which is silent on use of modern technologies in classroom learning. Teacher trainee graduates who have skills in modern technologies face employers or recruiters with confidence hence always selected for the job, and also both private and public institutions require teacher trainee graduates with modern technology skills. This leads to the conclusion that there is a high marketability for technologically equipped teacher trainee graduates in both public and private education sectors.

5. DISCUSSION:

This study investigated the significance of quantitative data on uptake of modern technologies in classroom learning in teacher training institutions in Gaborone, Botswana. It aimed specifically to assess the effectiveness of modern technologies on classroom learning; to evaluate the relationship between modern technologies in classroom learning in enhancing teacher trainee's performance skills; to analyse the marketability of the highly technologically equipped teacher trainee graduates in both public and private education sectors; and to establish the barriers that impede uptake of modern technologies in classroom learning successfully in teacher training institutions in Gaborone, Botswana.

Firstly, the study has found that there is a relationship between effectiveness of modern technologies on classroom teaching and teacher training. This is in agreement with the findings of Salinas and Crossetti (2018) who stated that uptake of modern technologies in classroom has been growing tremendously over the years and that many societies are striving to advance in their educational technologies. This study has, therefore, established that lecturers at teacher education institutions are critical players in the relationship between effective teacher training on the modern technologies in education and the application of such technologies in classroom learning such as: failure of lecturers to incorporate modern technologies in their teaching due to lack of training in such technologies; teacher training institutions' failure to provide lecturers with modern technologies to be used in classroom learning and also the government's failure to fund adequately the incorporation of ICT into classroom efforts. These factors have also been noted by Singh (2011) who highlighted that for success of effective uptake of modern technologies; lecturers, teacher training institutions and governments have to come together in advancing the agenda. This study has further revealed that most teachers have no ICT skills hence difficult for them to use modern technologies in classroom learning and also teacher trainees are not interested in modern technologies being used during classroom learning. ChanLin (2007) argued that there is not enough training offered to lecturers and if any it is then not what the lecturers need to know. This is contrary to what principals and education officer indicated that lecturers in Gaborone teacher training institutions are all well trained. This study established that the effectiveness of teacher training on the modern technologies in classroom learning has not reached the level of absolute satisfaction in teacher education institutions (TEI's) in Gaborone.

Secondly, the study has found that there are statistically significant differences between group means as determined by one-way ANOVA ($F(3,85) = 1.397, p = .015$). This means that there is a relationship between modern technologies in classroom learning and the teacher trainee's performance skills. Both lecturers and teacher trainees confirmed that some lecturers use different modern technologies when delivering lectures; some lecturers have never trained in any modern technology and this results in their failure to incorporate ICT into their teaching. Newby et al (2012) echoed that a similar challenge was observed by Hannessy et al (2010) in East Africa that despite teachers attending to too many trainings on ICT both national and international ones, their use of modern technologies in classroom learning is very limited. The current study has further established that when lecturers use modern technologies in classroom learning, learners are motivated and equipped in using the same upon graduation. Graduates who have been exposed to modern technologies perform better at work as they are well exposed to modern technologies. Being conversant with modern technologies in education makes teachers perform better in their careers. Teachers with modern ICT skills deliver better than teachers who rely on traditional methods of teaching and finally 21st century work performance skills are measured in terms of how teachers can incorporate modern technologies in classroom learning. This is in line with what Smith & Duncan (2015) observed in Australia that the more teachers' use technologies in teaching, the higher the performance achieved. This has led to the conclusion that there is a relationship between modern technologies in classroom learning and the teacher trainee's performance skills.

Thirdly, the study has found that there is a statistically significant relationship between uptake of modern technologies in teacher training institutions and marketability of such graduates. This is in agreement with a cross-sectional study that was conducted in Japan and established that the use of technologies in education enhances high performance among teachers (Kohei, 2014). Banister & Vannatta (2006) further indicated that uptake of modern technologies in classroom learning stands for a wise application of the available human and non-human resources for providing appropriate solution to the educational problems and to improve the processes and products of education. The current study has found that employers in both public and private sectors require teacher trainee graduates who are conversant with modern technologies. Teacher trainee graduates with good exposure to modern technologies are more marketable than teachers who do not know how to use a projector; a teacher's CV that indicates his/her ability to use modern technologies in classroom learning is more attractive to recruiters than a CV which is silent on the use of modern technologies in classroom learning; teacher trainee graduates who have skills in modern technologies face employers or recruiters with confidence hence always picked for the job and also both private and public institutions require teacher trainee graduates with modern technology skills capability. Another study in Germany indicated that teachers who have ICT knowledge are five times more employable than the teachers in the same field who have no knowledge of ICT in their resume (Klopper, 2014). Finally, the study has found that there is a high marketability for well technologically equipped teacher trainee graduates in both public and private education sectors.

6. CONCLUSION:

This study investigated the progress of uptake of modern technologies in classroom learning in teacher training institutions in Gaborone, Botswana. It aimed specifically to assess the effectiveness of modern technologies in classroom learning in teacher training; to evaluate the relationship between modern technologies in classroom learning and enhancing teacher trainee's performance skills, and to confirm or disconfirm the marketability and employability of the technologically equipped teacher trainee graduates in both public and private education sector. The study has established that the effectiveness of modern technologies in classroom learning has not reached the level of absolute satisfaction in

teacher education institutions in Gaborone. Secondly, the study has found that there is a relationship between modern technologies in classroom learning in teacher training institutions and the teacher trainee's performance skills. Thirdly, the current study has established that there is a high marketability for well technologically equipped teacher trainee graduates in both public and private education sector.

7. RECOMMENDATIONS:

Based on the findings of the study, the researcher recommends that: the Ministry of Higher Education, Science, Research and Technology should ensure that lecturers in both public and private institutions of higher learning compulsorily train teacher trainees on the use of modern technologies in the classroom learning; the lecturers and instructors should be trained periodically through workshops and other vital programmes to update their knowledge on use of modern technologies and to remain productive and relevant to the dynamics in 21st century education landscape; the government and the directors of the privately owned institutions should equip the classroom and computer laboratories with modern technology facilities to facilitate classroom learning and that; the 'curriculum reviewers' and 'curriculum implementers' should accommodate the integration of the modern technologies in teacher education curriculum to meet the demands of the 21st century workforce skills in teacher education.

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