Integration of ICT in Curriculum - A Case Study of Botswana Junior Secondary Schools

Peggy Siamisang, Rajiv Kumar(✉), Sreekumar Narayanan, and Neelamegam Chandirakasan

Botho University, Gaborone, Botswana
psiamisang@gmail.com, dhiman.rajiv@gmail.com, {sreekumar.narayanan, neelamegam.chandirakasan}@bothouniversity.ac.bw

Abstract. Information and Communication Technology (ICT) has been growing so fast for the past 20 years in most of sectors, but still a lot of done in the education sector. Teachers are still relying on the old traditional way of teaching methods. Botswana are still far behind in benefiting from ICT usage in classroom. This study reviews various technology adoption frameworks such as Technology Pedagogy and Content knowledge, Teacher Development model, and Conceptual framework. This study assess the ICT infrastructure found in Botswana public junior secondary schools, assess teachers' skills, knowledge, confidence, and the perception on the integration of ICT in teaching and learning. A quantitative research design is used to collect data from teachers in Botswana Junior Secondary Schools. The major findings show that integration of ICT in Botswana Junior secondary schools is very low or not yet started. This has been influenced by factors such as lack of skill, lack of confidence in the use of technology by teachers, and lack ICT equipment in schools. The study recommends that schools should be equipped with education ICT supporting infrastructure, and teachers should be trained on the pedagogy of ICT in teaching. Furthermore, the curriculum should be designed in such a way that it includes ICT integration in subject areas.

Keywords: ICT · Content knowledge · Pedagogy · TPCK · TDM

1 Introduction

1.1 Background Information

Botswana is one of the countries in the world with fast growing economy. The country is putting more emphases on integrating ICT in education sector to ensure that all ministries are equipped with computer infrastructures. Policies and strategies are put in place e.g. Education and Training Strategic Sector Plan (ETSSP), Nteletsa project, Maitlamo, Thuto Net and other sectors such as Botswana Fibre Network Ltd (Bofinet), Botswana Communication Regulatory Authority (BOCRA) are playing a major role in the country by partnering with the government to ensure that ICT literacy is realized. Botswana is spending millions of Pulas' in order to improve the education system and currently there are more than 215 Junior Secondary Schools in Botswana.

A. K. Luhach et al. (Eds.): ICAICR 2018, CCIS 956, pp. 175–192, 2019.
https://doi.org/10.1007/978-981-13-3143-5_16

In 2002, Botswana made it a point that all secondary schools are equipped with computer infrastructures and internet connectivity, to ensure students learns basic computer skills. The introduction of ICT in education was made possible through national ICT policy called Maitlamo National ICT policies (2004) which is in line with the United Nations to provide a road map to socio economic, cultural, and political transformation through the use of ICT. Maitlamo's aim is to provide communication network of high international standard to ensure that ICT industry grows and to provide the ICT training to the teacher. The Revised National Policy on Education (2004) came up with the policy framework for the education system in Botswana called Education Training Strategic Sector Plan (ETSSP) which was formed in order to transform education from pre-primary to tertiary school, which is a five-year strategy for (2015–2020).

1.2 Problem Statement

ICT has the potential to improve students' performance in schools but it is a challenge to integrate ICT in teaching and learning in schools. Currently ICT is offered as a subject to enhance students' computer basic skills. But, most subjects are still relying on traditional methods to teach the content.

1.3 The Goal of the Study

The aim of the study is to investigate various factors that influence the use of ICT in Botswana public Junior Secondary Schools.

1.4 The Significance of the Study

The research is useful to identify the importance of ICT in school education; curriculum designers. Maitlamo National ICT policy designed a framework that addressed four stages (emerging, applying, infusion and transformation) teacher development in relation to ICT usage in classroom and to ensure that the strategy is implemented and monitored.

1.5 Research Objectives

The following research objectives are:

- To assess the skill and knowledge that teachers can integrate technology in a teaching and learning.
- To identify ICT equipment available to support teacher in delivering the content of the subject.
- To assess the level of ICT application.
- To assess the perception of teachers in the use of technology in their subject expertise.
- To investigate the influence of gender on the use technology in delivering the content of the subject.
- To investigate the influence of qualification on ICT integration in teaching and learning.

1.6 Research Questions

The following research questions are:

- What are the skills and knowledge that teachers possess in the use of computer aided instructional tools in junior secondary schools?
- What are the ICT tools available to support delivering of the content of the subject matter?
- To what extend are ICT facilities used to support teaching and learning?
- What are teachers' views on the use of technology in their subject areas?
- Does gender influence the intention to use computer aided instructional tools?
- Does qualification influence the intention to use computer aided instructional tools?

1.7 Scope of the Study

The survey focused on Junior Secondary School teachers in Botswana who are employed by Ministry of Education Skills and Development for Basic Education. The study is useful for the effective use of computer aided instructional tools in a classroom environment.

2 Literature Review

2.1 The Importance of ICT in *Schools*

The computer aided instructional tools can support teachers to ensure that students stay focused throughout the lesson. Students can learn by doing, they can also receive feedback and continuously, refine their understanding and build new knowledge and provide self-paced learning. Computer assistant instructional packages can be developed in order to assist and inspire teachers to prepare for subject areas [3]. They carried research on e-reader project in rural Tanzania which addressed lack of books in rural schools and found that students showed a lot of improvement in reading skills when e-reader was introduced, both the teacher and student were motivated and engaged in learning.

Botswana Inter-Governmental Information for All Programme (IFAP) established in 2001 as successor to the General Information Programme (PGI) [1] and International Informatics Programme (IIP) under UNESCO conducted the desktop survey on ICT in education at all levels primary, Junior and secondary schools and tertiary education. The committee followed a framework by the UNESCO-UIS (2009) when analyzing the effective use of the ICT in Botswana schools. The Botswana IFAP literacy report (2016) indicated that ICT policies relevant to ICT are available but they focus on availability of computers and internet connectivity in school but lacking in integrating ICT in curriculum [1]. The report also revealed that computer awareness course is offered at Junior Secondary School, which is not compulsory to some schools and also not examinable.

The IFAP policy framework has recommended that the Ministry of Skill and Education development (MOESD) should develop an ICT pedagogy framework in

education, provide schools with high speed internet connection, integrate ICT in other subjects, identify teachers skills and qualification in ICT and train teachers to boost their confidence on the use of ICT in schools, increase computer-based learning resources that are of high quality in schools and establish a centre for excellence for ICT that will support research and the ICT pedagogy in education [1]. They investigated the "ICT usage and perceptions of public primary school teachers, Gaborone" in Botswana. The survey indicated that ICT can add value to teaching and learning, even though there are some challenges which hinder the integration of ICT in education [3, 4].

The use of ICT in classrooms does not mean that traditional method will be faced out technology is introduced to support the teaching methods and to make learning more interactive. Researchers have proposed various models that could help in adopting integrating ICT in classroom environment for any subject. This study reviews various models which were proposed for adoption of technology in classroom.

3 Technology Integration Models

To adopt technology in classroom, various models have been used;

- Technology Pedagogy and Content Knowledge (TPCK)
- Teacher Development model (TDM)
- Conceptual framework

3.1 The Implication of Technology Pedagogy and Content Knowledge (TPCK)

Teachers' knowledge has been focusing on the content and the pedagogy (how to teach) with model called Pedagogy Content Knowledge (PCK) for effective teaching and learning in classroom. A teacher should must familiar with Content Knowledge (CK) and various approaches e.g. lesson plan, assessment, and alternative methods: recap of the previous knowledge by students or strategies on how to deliver the content of Pedagogy Knowledge (PK). This approach has been adopted by Botswana education system: there are training institutes for teachers in Botswana, which provide teachers with the content and pedagogy.

Due to the increase usage of technology, this model was later developed by introducing Technology knowledge; the 21st generation could benefit a lot from technology if it can be integration in education [6].

3.1.1 TPCK (Technology Pedagogy and Content Knowledge)

According to Mishra et al. [6], the ability to connect Technology Knowledge (TK), Content Knowledge (CK) and Pedagogy Knowledge (PK) together, Technology Knowledge (TK) refers to understanding the computer hardware and software, the internet and use the hardware and software in a classroom environment [6]. The aim of technology is to support teachers in delivering the content of the subject in such a

manner that will be easily understood by learners. In this situation, technology will be used as a pedagogy tool. "The Content Knowledge (CK) is the knowledge about the subject to be learned, Pedagogy Knowledge (PK) refers to knowledge about processes, strategies and methods to be used in delivering a subject". The Pedagogical Content Knowledge (PCK) that can be used to address an objective for a specific method. PCK covers teaching strategies, lesson plan, assessment and curriculum (Fig. 1).

Fig. 1. TPCK model

3.1.2 Technology Content Knowledge (TCK)

Different technologies are available, the teacher need to understand the impact of technology in their subjects. They need to know how the introduction of technology is going to change, support or enhance the subject.

3.1.3 Technological Pedagogical Knowledge (TPK)

Technology Pedagogy Knowledge (TPK) is vital because teachers are the drivers of the lesson that they need to develop a skill that can reconfigure the technology to suit the pedagogy approach. This requires teachers' creativity, being able to customize the tools in such way that will suit the strategies.

3.2 Teacher Development Model (TDM)

Teacher Development model (TDM) addressed four steps (emerging, applying, infusing and transforming) that can be adopted in order to integrate technology in teaching processes. *Emerging Stage* is the initial stage of the model to ensure that computers and other tools are in place. Teachers familiarize themselves with the ICT tools and develop the ICT literacy skill. The *Applying stage* is where the teacher decides what, where, when and how-to ICT tools will contribute to subject objective and choose the appropriate tool. The *infusion stage* enables teachers to infuse technology in all aspect of learning. At this stage teachers are more creative, active, and plan for the lesson with technology. The *transformation stage* where the whole school is transformed. Teaching is transformed from teacher centered to learner centered and new uses of technology are discovered (Fig. 2).

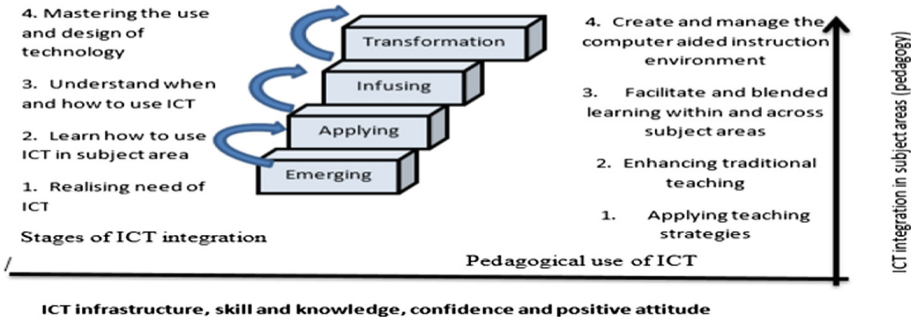

Fig. 2. Teacher development model

3.3 The Conceptual Framework

The conceptual framework is shown as in Table 1.

Table 1. Conceptual framework

Variables	Enabling factors
ICT infrastructure	-Presence of ICT correct and enough infrastructure (hardware and software) -Internet connectivity
Teacher and learner's ICT skill	-Teachers and learners need necessary ICT training -Understand when, where, and how to use the tools
Technical and financial support	-Without technical support, integration will lead to failure -The infrastructure will continuously need to repaired funds required for technical support)
Perception of teachers, school management towards ICT integration	-Positive attitude and perception about integration of ICT supporting the content of the subject matter -Teachers and learners need confidence in using the ICT tools -School management should be willing to fund the technical support

4 The Research Framework

The study has been based on the TPACK and the Teacher Development Model. The models were chosen because they cover all the aspects that are necessary when using computer aided instructional tools in delivering the content of the subject.

4.1 The Framework for Map/Processes to use ICT to Support Teaching Methods Using TDM Model and TPCK Framework

Adoption of Computer aided instructional tools stages; the first thing is to ensure that ICT tools are available. The next step will provide training to teachers how to use the tools in the subject by integrating ICT in lesson plans to enhance the traditional teaching. We need to understand when and how to use ICT for pedagogical transformation through specializing in the use/design of ICT e.g. creating learning multimedia software, interactive tools and gaming etc.

4.2 Implication of TPCK and the TDM Models for ICT Integration in Teaching and Learning

Implementation of the TPCK and TDM Model is shown in Table 2.

Table 2. Implementation of the TPCK and TDM model

TPCK	TDM	Subject content and professional competencies	ICT competency that can be learned by teachers
Mastering learning through ICT	Transforming	Developed professional skills	Creation of interactive tools and gaming; creation of 3D animation in education
Facilitating student learning with or through ICT	Infusing	Designing ICT enabled lessons	Specific learning tools; web quests
ICT integrated in the subject teaching	Applying	Integrating ICT in lesson plans	Multimedia tools: graphic design of educational media
Teachers learning about ICT	Infusing	Enhance traditional teaching management using ICT	Productivity tools and internet: email

4.3 TPCK in a Classroom

Firstly, a teacher must know about the content knowledge (CK). Secondly, the pedagogy knowledge how the student learns the content. Thirdly, the technology knowledge (TK), teacher need to understand a wide range of tools available and knowledge about the tools. Technology Pedagogy Knowledge (TPK), is useful to select the technology tools for a specific subject. TCK is the understanding of the relationship between content and tools, the ability to modify and manipulate content with the tools and PCK is how to teach what you are teaching to specific students [6].

Technology Pedagogy and Content Knowledge (TPCK) is used to connect pedagogy, content and technology knowledge. Computer awareness subject was introduced in Botswana Junior Secondary schools in order to equip learners and teachers with technological skill on the use of computers e.g. Microsoft word, PowerPoint, graphics, excel such that students are familiar with technology, it is going to be easy for teachers to use technology to support learning in their subject areas.

Table 3. How ICT is offered to classes in schools

	Responses	Percentage
ICT is taught as a subject	Yes 52	98%
	No 1	2%
I choose to incorporate ICT in my subject	Yes 16	30%
	No 37	70%
ICT is integrated in my subject area (syllabus)	Yes 30	57%
	No 23	43%

5 Research Methodology

The study uses the survey method to investigate the objectives of research work that is based on the quantitative research design.

5.1 Instrumentation and Sampling

The research methods consist of self-administered and online questionnaire, the first section covered background information (age, sex, years in service and subject taught by the teacher and training in ICT and indicate how ICT is offered in their schools), the second part is response category which assess the available technical resources. the third section was about teacher's skill and knowledge on ICT forth part will look at teacher's ICT application looking at how often do they use technology the last section included teacher's perception in integrating of ICT in subject areas. The survey is distributed to the participants at Makhubu J S S teaching staff. To increase the number of participant, an online questionnaire sends to specific teachers through various media. The questionnaire has taken from three researchers, which are "on teacher's attitude" about "the level ICT usage" on Malaysian Online journal of Educational technology (MOJET) and Teacher questionnaire on the use of ICT (2015)-Agrupamento de Escolas de Atouguia da Baleia – Portugal [6].

5.2 Data Collection Procedure

The researcher started by consulting schools to ask for permission to do research. Then the researcher asked for permission from relevant authorities Once granted the researcher sent the letter to Makhubu J S S and specific individuals who are teachers. The Cochran formula used to determine the sample size.

$$\text{The Cochran formula :} \qquad \mathrm{n} = \frac{N}{1 + \mathrm{N}(\delta)^2} \tag{1}$$

Where, *n* is the sample size, N is Target population and δ is the Significance level". 5% significance level is used to select number of teachers.

Data is collected using simple random sampling. All the names of teachers in Makhubu Secondary school is collected. The researcher randomly selects the list, 38 teachers from a total of 42 staff members from Makhubu secondary school.

5.3 Data Analysis Process

The application provides a summary sheet for all the responses analyzed in different formats like pie charts, tables and bar charts. This study follows a descriptive statistic where by numerical counts, percentages, tables, measure of central tendency (mode) and measure of variability is used to analyses the data.

5.4 Questionnaire Return Rate

The questionnaire was administered to sample size of 66 teachers, of which 80% were filled.

6 Findings

6.1 Background of Teachers

6.1.1 Gender

The participants were asked to state their gender. The study shows that 42% males compared to 58% females (Fig. 3).

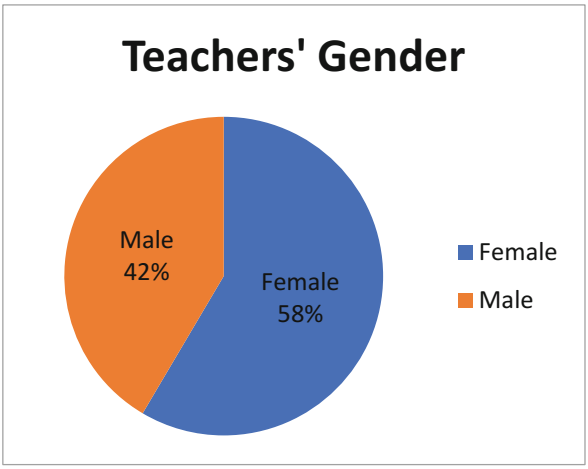

Fig. 3. Gender for the participants

6.1.2 Ages

The study involved teachers of varies ages ranges with most teachers interviewed being at 36–45 years, followed by age between 26 and 35, then 45 and above. The least were 18–25 years and above (Fig. 4).

6.1.3 Number of Years of Teaching

The study also wanted to find out work experience for the participants, the majority were having working experience which is between 6 and 10, followed by 11–15 years and 16–20 years by 24.5%, 1–5 years and lastly 1–5 years and those 21 at 5.7% (Fig. 5).

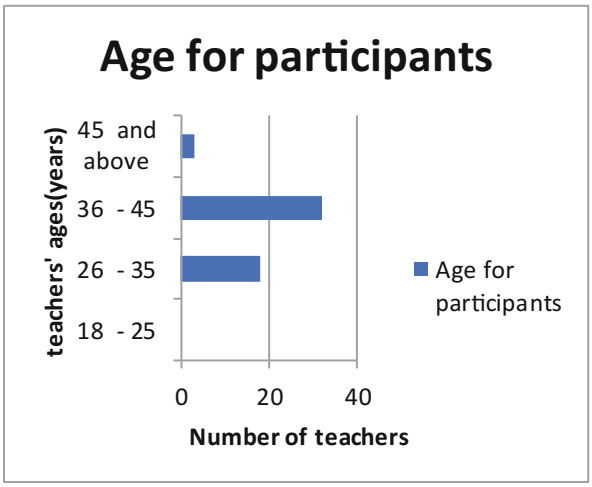

Fig. 4. Ages of the participants

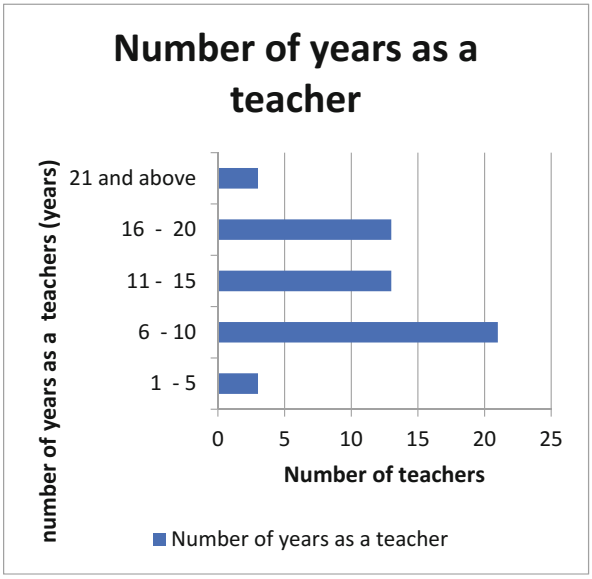

Fig. 5. Number of years as teachers

6.1.4 Qualification

The modal qualification from the participants' responses is Diploma with 50% followed by Degree with 48% and others by 2% (Fig. 6).

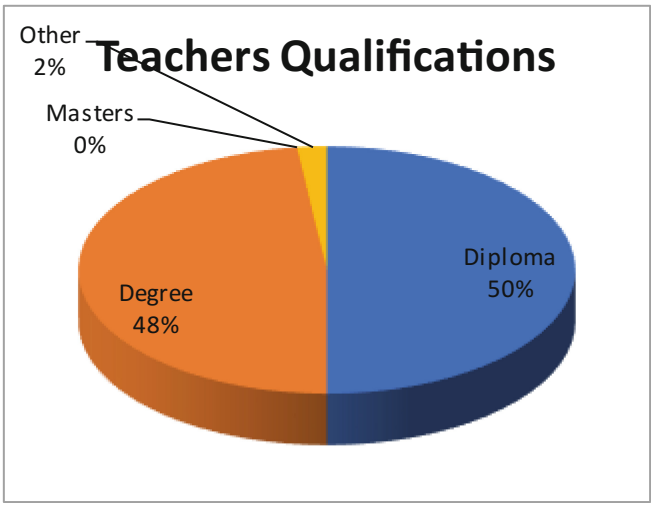

Fig. 6. Qualifications of participants

6.1.5 Training on the Pedagogical use of ICT in Supporting Content Delivery

According to the pie chart the majority of teachers have not been trained on the pedagogy use of computer aided instructional tools, this was shown by 94% rate of No's followed by 6% of Yes (Fig. 7).

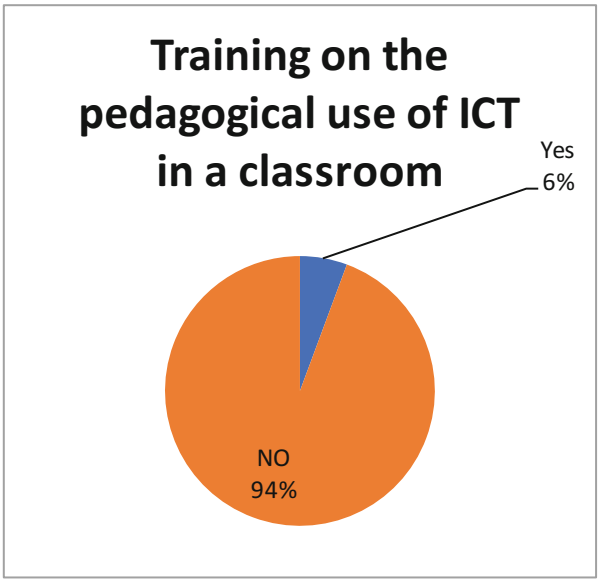

Fig. 7. Training on pedagogical use of ICT

6.1.6 How is ICT Taught to Classes in your School?

The findings reveal that 98% of responses indicated that ICT is taught as a subject, 70% of teachers indicated that they have not chosen to integrate ICT in their subject and 57% shows that ICT is integrated in their curriculum (Table 4).

Table 4. Gender influence on ICT integration

	Yes	No	Total
Female	6	25	31
Male	10	12	22
Total	16	37	53

6.2 Cross Tabulation

6.2.1 The Influence of Gender on the use of Computer Aided Instructional Tools

The value of the test statistics

$$x^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E} (\text{Cochran formula}) \tag{2}$$

Where

x^2 = Pearson cumulative test statistics, chi square value
i = is the ith position in the contingency table
O_i = observed frequency
E_i = expected frequency
N = is the number of cells in the table

Many statistics rely on a concept called the degrees of freedom (df). It is based on the number of variables involved in a calculation. For Chi square, the degrees of freedom are:

$$\text{Df} = (\#\ \text{rows} - 1) * (\#\ \text{columns} - 1) \tag{3}$$

For Chi square test, the tables are based on the level of risk, with common thresholds of 10%, 5%, 2.5%, 1% and 0.1% and each risk level has a critical value associated with it". The level of risk for this study is 5% (Table 5).

Table 5. Gender intention to use ICT

	Yes	No	Total
Female	E: 9.36 O: 6 Df: 1.21	E: 21.64 \O: 25 Df: 0.52	31 31
Male	E: 6.64 O: 10 Df: 1.70	E: 15.36 O: 12 Df: 0.74	22 22
Total	16	37	53

Expected value for yes' (E) = (Total Yes * Total female)/Total Table
Observed value (O) = observed frequency from the Table 3.

A low value for chi square means there is high correlation between the set of data, if the expected and observed value are equal it means there is no difference.

$$\text{Cochran Formula} \quad x^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E} = 1.21 + 0.52 + 1.70 + 0.74 = 4.17 \tag{4}$$

After adding all the differences, the total Chi square value was 4.17.
For this analysis, the degrees of freedom (df) will be:

$$\begin{aligned} \text{Df} &= (\#\ \text{rows} - 1) * (\#\ \text{columns} - 1) \\ &= (2-1) * (2-1) = 1 \\ &\text{Total Chi square} = 4.17 \end{aligned} \tag{5}$$

According to Cochran formula, the calculated Chi square 4.17 is greater than the tabulated Chi square value of 3.84 at 5% significant level with 1 degree of freedom. The chi square value (4.17) lies between 3.841 and 5.142 of the chi square distribution table of with 1 degree of freedom and the corresponding probability is between 0.05 and 0.02 of probability levels. The p value is of $0.04 < 0.05$. Because calculated value exceeds the critical value, the difference is significant. Therefore, it means the male use of ICT is significant compared to female counter part.

6.2.2 The Influence of Qualification on Intend to use ICT in Subject Areas

The study found out teacher's responses towards behavior to choose ICT in teaching and learning (Table 6).

$$x^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E} = 4.2 + 1.82 + 4.36 + 1.89 = 12.27 \tag{6}$$

After adding all the differences, the total Chi square value was 12.27
In this case, the Degrees of freedom will be:

$$\begin{aligned} \text{Df} &= (\#\text{r} - 1) * (\#\text{c} - 1) : \\ &= (2-1) * (2-1) = 1 \end{aligned}$$

r represents rows and c represent columns.

The Chi square statistics ($x^2 = 12.27$), at a level risk of (0.05) and degrees of freedom (df = 1). The calculated value is more than the critical value; therefore, the difference is statistically significant. The p-value of 0.00046 is less 0.05. According to the study 52% of degree holders shown that they integrate ICT in their subject area because they chose to do so as compared to only 8% of the Diploma holders.

6.3 Infrastructure

This question was designed to identify the type of technical and instructional support available to teachers to use in schools. The findings as indicated by the Table 7 shows that learners have computers and computers are connected to the internet as this was indicted by the high percentages rate in the table (98% and 100%), followed by projection system by 77%, digital audio.

Table 6. The critical value of qualification influence

	Yes	**No**	Total
Degree, Honors Degree,	Observed 14 Expected 8.15 Df: 4.2	Observed 13 Expected 18.85 Df: 1.82	27 27
Diploma	Observed 2 Expected 7.85 Df: 4.36	Observed 24 Expected 18.15 Df: 1.89	26 26 13.02
Total	16	37	53

6.4 Teachers ICT Usage

Findings provided in Table 7 about teacher's skill and knowledge on ICT equipment shows that most teachers have a less skill in using most of the ICT facilities available in their schools. The responses rate increases towards the left side of the table (the sometimes, rarely and never) which indicate that teachers rarely use the hardware and software available (Table 8).

6.5 Teachers Skill and Knowledge

The findings show that the participant lacked skill and knowledge in using the hardware and software as indicated by Table 10. The purpose of the question was to identify the level in which teachers use this technology to support teaching in class. What most teachers are conversant with is using word processing document as it was at 81%, followed by the use of emails to communicate. Other computer instructions teachers showed that they have little knowledge in using tools as the sum of none and little were more than half of the total of the participants.

6.6 Teachers Perception

The last question was designed to assess teachers' perception on the integration ICT in subject areas. Teachers were asked to indicate how they feel about the use of technology in order to support the old traditional style of teaching. Table 11 illustrates the

Table 7. Availability of ICT equipment (hardware and software)

Infrastructure availability	Responses	Percentage
Computers for learners	Yes 52	Yes 98%
	No 1	No 2%
Interactive white boards	Yes 49	Yes 8%
	No 4	No 92%
Video conferencing systems	Yes 48	Yes 91%
	No 5	No 9%
Audio equipment	Yes 21	Yes 40%
	No 32	No 60%
Digital photo camera	Yes 37	Yes 70%
	No 16	No 30%
Digital video camera	Yes 35	Yes 66%
	No 18	No 34%
Projection system	Yes 41	Yes 77%
	No 12	No 23%
Educational software for my subject	Yes 3	Yes 6%
	No 50	No 94%
Internet connectivity	Yes 53	Yes 100%
	No 0	No 0%
Online prescribed textbooks for my subject	Yes 51	Yes 96%
	No 2	No 4%
Website for the school	Yes 3	Yes 6%
	No 50	No 94%

Table 8. The extend in which the participants use the ICT equipment (hardware and software)

Items	Never	Rarely	Sometimes	Often	All time	Never	Rarely	Sometimes	Often	All time
	Frequency					Percentage (%)				
Browse/search the internet to collect information to prepare lessons		7	1			7	2	0		
Browse/search the internet to collect resources to be used during lessons	3	3	2			5	5	2		
Use applications to prepare presentation for lessons	3	1	4			3	1	6		
Create your own digital material for students	0					5		5		
Use ICT to prepare exercises and tasks for students	1	1	5			7	3			
Use ICT to provide feedback and/or assess students' learning	1	1	5			0	1	8		
Evaluate digital learning resources in the subject you teach	1					7	3			
Download/upload/browse material from learning platform	2		1			0	1	1		
Look for online professional development opportunities	2	1				2	1	3	1	3
Prepare lesson plans using computer applications like word processing	5					9				

results that shows how to use computer aided instructional tools in supporting my subject (81%), Use of Technology tools can increase the interest of students toward learning (79%), Use of technologies can improve the quality of education (74%), ICT supported teaching can make learning more effective (70%), Use of computer aided instructional tools is very important (70%), Using instructional technologies can make teachers more productive (66%) and Students can easily understand concepts if ICT is integrated in the curriculum (62%) (Table 9).

Table 9. The participants' knowledge on the hardware and software

Item	None	Alittle	Somewhat	Alot
	Frequency and percentage (%)			
Capture and edit digital photos movies or other images	42	6	1	4
	79%	11%	2%	8%
Use email to communicate with others	9	8	6	30
	17%	15%	11%	57%
Produce a text using a word processing document	3	4	3	43
	6%	8%	6%	81%
Edit text online containing internet links and images	42	6	0	5
	79%	11%	0%	9%
Create database	38	9	2	4
	72%	17%	4%	8%
Use a spreadsheet (e.g. excel)	18	17	6	12
	34%	32%	11%	23%
Use spreadsheet to create graphs	18	19	4	12
	34%	36%	8%	23%
Create presentations with video or audio clips	37	5	6	5
	70%	9%	11%	9%
Download and install software on computer	19	20	7	7
	36%	38%	13%	13%
Participate in discussion forum on the internet	43	3	4	3
	81%	6%	8%	6%
Prepare material to use with an interactive whiteboard	46	4	1	2
	87%	8%	2%	4%
Download curriculum resources from the internet or learning platforms for student use	34	12	4	3
	64%	23%	8%	6%
Use students response systems (e.g. ActiVote, ActvExpression or other)	47	3	1	2
	89%	6%	2%	4%

Table 10. Teachers' perception on the use of computer aided instructional tools

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	Frequency and percentage (%)				
Use of ICT for instructional purposes is very important	1 2%	1 2%	2 23%	12 23%	37 70%
Use of technology tools can increase the interest of students toward learning	2 4%	2 4%	1 2%	6 11%	42 79%
ICT supported teaching can make learning more effective	1 2%	1 2%	2 4%	12 23%	37 70%
I would like to be trained on how to use computer aided instructional tools in supporting my subject	1 2%	2 4%	1 2%	7 13%	43 81%
Use of technologies can improve the quality of education	1 2%	5 9%		9 17%	38 72%
Students can easily understand concepts if ICT is integrated in the curriculum	1 2%	6 11%	4 8%	8 15%	34 64%
Using instructional technologies can make teachers more productive	2	5	1	10	35

Table 11. Comparative analysis between TPCK and TDM

TPCK	TDM	Status	ICT competency that can be learned by teachers
Mastering learning through ICT	Transformation Mastering the use and design of technology	Not there	Teachers cannot create interactive tools and gaming; creation of 3D animation in education
Facilitating student learning with or through ICT	Infusion Understand when and how to use ICT	Designing ICT enabled lessons is not yet enhanced. Teachers lack the skill	Teachers still rely on chalk and board, manila to draw charts
ICT integrated in the subject teaching	Applying Learn how to use ICT in subject area	No Integrating ICT in lesson plans	No multimedia tools: graphic design of educational media is being used
Teachers learning about ICT	Emerging Realising need of ICT	Schools are equipped with computers and slow internet connectivity. Little is being done to enhance traditional teaching management using ICT	Computers are there for computer awareness lesson not for other subject areas. The school set up does not have an ICT policy that can be give other subject areas opportunity to use the computer lab

7 Conclusion and Future Scope of the Study

Base on the data analysis, most of Botswana Junior Secondary schools are at the following stages of TPACK and TDM model as shown in Table 11.

The study assessed the training of pedagogy use of computer aided instructional tools and it is clear from the teachers' responses that more than 90% teachers have not received any training. So, it is necessary to teach teachers how to incorporate technology in their teaching subject areas. The study revealed that ICT is offered as a subject in school meaning that students are taught computer basics like word processing, spreadsheet, and paint leaving out teacher development. Teachers' professional development should focus on pedagogy, content and technology. Unfortunately, most of the Botswana training institutes for teachers do not focus on the pedagogy principles which facilitate the use of ICT in supporting the delivery of the subject content. For this, model need monitoring and evaluation for it to work.

Infrastructure is one of the key elements that need to be in place for effective integration of ICT teaching and learning. Using hardware and software such as emails; web sites; digital audio, digital video, computer conferencing, interactive boards, developed educational software and individual learning environment can enable a learner to learn any time anywhere and empower the learner. It is also clear that teachers see the benefits of using computer aided instructional tools to support their traditional method of teaching and they are willing to be trained.

In the future, we will cover the study over the large population. We have performed the research in the Botswana region, we are planning to conduct the research in the neighboring countries as well. We only focused on the junior secondary schools in Botswana, we would like to conduct the study in higher level also.

Acknowledgement. The authors are thankful to management of Botho University, Gaborone to provide their support. We also grateful to management of Makhubu Secondary Schools to conduct the research in their organization.

References

1. Botswana IFAP Report: ICT Literacy Policy-Botswana Paris, 9th Session (2016)
2. Maitlamo: Botswana's National ICT policy legislative framework and change report. Botswana Government, Final Report 2004 (2014)
3. Bhatt, J.M.: Integrating information and communication technology in teacher Education, Vol 6, India (2016)
4. Adomi, E.E., Kpangban, E.: Application of ICT in Nigerian secondary schools. Library Philosophy and Practice 2010, Abraka, Delta State University (2010)
5. Mishra, P., Koehler, M.J.: Technological pedagogy knowledge content knowledge: the framework for teachers knowledge. Teach. Coll. Rec. **108**(6), 1017–1054 (2006)
6. Albirini, A.: Teachers attitude towards information and communication technologies. The case of Syrian EFL teachers. Comput. Educ. **47**(4), 373–378 (2006)
7. Esleem, M.B.: Relationship of selected factors and the level of computer use for instructional purposes by technology education teachers in Ohio public schools. A statewide survey (2003)
8. http://math.hws.edu/javamath/ryan/ChiSquare.html. Accessed 04 June 2017