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Examining factors that influence teachers to adopt information and Communication Technology in rural secondary schools: an empirical study

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Abstract

Information and Communication Technology (ICT) has undoubtedly forms an important channel for improving student learning through continuous access to information and knowledge development. Evidence suggests that teachers in rural secondary schools are still unclear about how to use technology appropriately to facilitate particular approaches to educational practice. Quantitative research method and the modified *Unified Theory for Acceptance and Use of Technology* (UTAUT) model were used to investigate factors that influence teachers to adopt ICT in rural secondary schools. A closed questionnaire was used as a data collection instrument and the data was analysed using descriptive statistics techniques. The results show that opportunities such as ICT infrastructure, training policy, collaboration, ICT assessments and ability to communicate using ICT influence teachers' adoption of ICT and make teaching and learning effective. ICT assessments facilitate the recording of responses, provide necessary feedback, empower teachers and students and transform teaching and learning processes from being teacher-centered to student-centered. Furthermore, communication platforms and collaboration models if implemented might be particularly effective in generating increased participation and improve learning outcomes. The ICT training policy guide teachers in the adoption of ICT in the classroom. Evidently, it is essential to adequately develop teachers' ICT fluency and put in place appropriate ICT infrastructure and training policy to enhance teaching and learning practices in rural secondary schools.

Keywords Factors · ICT adoption · Rural secondary schools · Teacher

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1 Introduction

In many countries the adoption of ICT in classrooms has transformed learning routines and teachers' roles from deliverers of content to facilitators (Glasset and Schrum, 2009). However, there has been uneven adoption of ICT to support learners in rural secondary schools (African Union, 2015). Research show that teachers' lack of the necessary skills to use computers affect their response to learners' greater flexibility and autonomy to use ICT in classrooms (Fleischer, 2012; Maluleka, 2011; Ministry of Education and Sport (Uganda), 2011; Sung et al., 2015), there is a lack of technical support; rarity of ICT use and use of traditional instructional models (Greaves et al., 2010; Levin & Schrum, 2013); lack of access to ICT infrastructure, such as internet, WIFI and computers (Olugbenga & Adebayo, 2010), schools fail to provide effective ICT training to teachers (Gustafsson, 2019; Warschauer et al., 2014), there is a lack of documentation on how teachers are using ICT in rural secondary schools in South Africa (McKnight et al., 2016; Penuel and Yarnall, 2005), and a lack of support for computer activities and large class sizes discourage teachers to use ICT in the classroom (Baylor & Ritchie, 2002). Essentially, ICT adoption can be transformative and lead to the design of new and enabling learning environments (Department of Education and Science (DES), 2008; Huh & Reigeluth, 2018), enable learners to build their knowledge through communication, critical thinking and problem solving (Mathevula, 2014; Voogt & Roblin 2012), and help enhance the simplest tasks, such as the advancement of the traditional learning process (Raza et al., (2021**)**. Therefore, the importance of this study is to inform the factors that influence teachers to adopt ICT in rural secondary schools, by answering the following research question (RQ):

RQ: Are there any significant differences among teachers' perceptions of factors that influence them to adopt ICT in the classroom in rural secondary schools?

2 Defining ICT adoption

Rogers (2005) defines adoption as the decision of an individual to make use of an innovation as the best course of action available. This begins with knowledge, followed by the formation of attitude, and then the decision to adopt or reject. If the decision to adopt is chosen then implementation occurs (Basri et al., 2018). According to Sari & Mahmutoglu (2013) ICT adoption is gradual switching over to ICT to facilitate the educational processes. Basically, the adoption of ICT in schools bring change and a paradigm shift that would recommend student-centered approaches and empower teachers to support learners for lifelong learning (Report on STEM Education, 2016), pedagogy and instruction is enhanced (Huh & Reigeluth, 2018), teaching models, classroom organisation, teaching and learning processes and interaction mechanisms are also changed (Sangará and González- Sanmamed, 2016), and exploratory learning outside the classroom is enhanced (Liu et al., 2012).

3 The context of ICT adoption in rural secondary schools

The adoption of ICT in South African secondary school curriculum remains significantly under-developed (African Union, 2015; Mathevula, 2014). Generally, in these schools teacher-centred pedagogy and belief is associated with traditional methods of teaching where the focus is on knowledge reproduction (Lui, 2011), and teachers have little interaction with their learners as knowledge is imparted through "chalk and talk" mode (Naicker, 2010). There is limited use of ICTs in the development of higher-order thinking, creative and collaborative, independent-working skills and communication (DES, 2008; Eivers, Close, Shiel, Millar et al., 2010), and a lack of ICT professional development to equip teachers with the necessary ICT skills (SAPA, 2014). The contexts and experiences of teachers does not focus on how they teach with technology, enhance learning using ICT and accommodating individual and varied learning styles (Isaacs, 2015). These rural secondary schools experience a lack of ICT resources and infrastructure, access to the internet, lack of software and hardware, electronic content resources and electricity blackouts (Barakabitze et al., 2015; DBE, 2019), and they still use fixed study timetables (Hodges et al., 2020). Ideally, ICT provide access to advanced learning content and ignite cognitive processes that enhance learning (Glasset and Schrum (2009), provide timely feedback and personalized study/learning options (Zhou et al., 2020), supplement to traditional learning, to add an active component (Allcoat & von Mühlenen, 2018), and foster creativity, innovation and enterprise skills integral to a future economy (Prinsley and Johnston, 2015; Bebell & O'Dwyer 2010),

4 Theoretical framework

The theoretical perspective used in this study is the modified *Unified Theory for Acceptance and Use of Technology* (UTAUT) model which holds that the following constructs: Effort expectance; Performance expectance; Facilitating conditions; Social influence; Hedonic motivation and Habit, influence the behaviour intention of teachers to adopt ICT in the classroom (Vanketish et al., 2003). The Social influence (SI) constitutes the reflection of peers, instructors and friends' perceptions regarding ICT on the individual's behavioural intentions within a social environment (Venkatesh, et al. 2003). Venkatesh, et al. (2003), refer to Facilitating Conditions (FC) as the availability of adequate support and resources for the proper use of ICT. In the context of ICT environments, FC focuses on the accessibility of technical support and organizational structure to scaffold the adoption of ICT in the classroom (Ain et al., 2016), and includes training and the provision of the required infrastructure (Dečman, 2015). However, the lack of assistance and timely support due to limited availability of resources and information hinder the acceptance level of ICT among teachers. Basically, the FC provides training and support to justify performance expectations and teachers' adoption of ICT in the classroom. Through ICT training teachers keep their knowledge and skills up to-date (Australian National STEM School Education Strategy, 2015), promote active learning, engagement using interactive technology tools and motivation for better student outcomes (Blasco-Arcas et al., 2013), and

facilitate communication, collaboration and implementation of positive pedagogical attributes of ICT, including preparing, delivering lessons and assessing learners (Chi & Wylie, 2014; Cui, 2013).

5 Factors that influence ICT adoption in secondary schools

Basically, ICT environment transform classrooms from a teacher-directed model to learner-centered strategies (Michael, 2006; Prince, 2004), facilitate innovative learning methods and support learners individually (Lan et al., 2007; DES, 2008), the learning environment become hands-on, immersive and experimental (Darling-Hammond, Austin Orcutt and Rosso, 2001), learners have choice, responsibility and control in the learning process and are prompted towards multiple individualised strategies and pathways of learning (Mcknight et al., 2016), they learn independently and tackle complex problems, rather than learn passively (Chen, 2010), active learning is promoted through interactive technology tools and cognitive processes related to motivation, attention, and engagement are enhanced (Chi & Wylie, 2014; Koretsky & Magana, 2019), and allows students to ask questions, share applications, conduct presentations and manage group dynamics (Ahmed & Opoku, 2022).

Furthermore, ICT provides content that influences pedagogical orientation and learner performance (DES, 2008; Ministry of Education and Sports (Uganda), 2011), improves the knowledge retention rates of students by promoting multi-sensory learning (Obaydullah & Abdur Rahim, 2019), promotes sustained task orientation and advanced knowledge construction (Duffy & Jonassen, 2013; Schellens & Valcke, 2005), improves cognitive functions and students acquire meta-cognitive knowledge (Ouyang & Scharber, 2017), helps teachers to make sense of learners' knowledge and skills (Lubisi, 1999), and learners relate knowledge and skills to build answers, improve problem-solving skills, promote critical thinking and generate content to stimulate collective knowledge through creativity and community identity (Tsiotakis & Jimoyiannis, 2014),

Essentially, ICT is used for communicating information and presenting new ideas and innovations for learners to interact, retrieve, retain and analyse information for decision-making (Kaufman, 2014; Olelewe & Amaka, 2011), empower students to modify, store, search, identify, evaluate and harness information (Obaydullah & Abdur Rahim, 2019; Wheelers, 2010), help students retain information longer (Ayemoba, 2013), facilitate access to information, processing information and transmission of information of concepts taught (Kaufman, 2014), teachers and learners have the opportunity to share information collaboratively to resolve problems (Lan et al., 2007), facilitate communication with colleagues when seeking support (Mwapwele et al., 2019), and enhance real-time interaction between teachers and students and simulate the communication model of the traditional classroom (Talib et al., 2021).

Also, ICT makes it possible to foster technological collaboration to promote critical thinking, social interaction and learning as a partnership (Struyven et al., 2010; McComb and Vakili, 2005), develop the 21st century skills (problem-solving, creative and critical thinking) (Voogt & Roblin, 2012), learners share and co-develop

new, rich multi-media content that promotes greater engagement with particular content topics (DES, 2008; Fleischer 2012; Nkechi, 2019). Thus, collaborative contexts allow teachers to identify problems and possibilities and model activities in their own practice (DES, 2008), enable learners to learn from the experience of others and sharing ideas (Huh & Reigeluth, 2018), students sharpen their interpersonal skills and achieve academic success (Ouyang & Scharber, 2017), and enhance participation during teaching and learning processes (Becker & Riel, 2000; DES, 2008).

ICT facilitates assessment in real time to help learners develop logical, critical and creative thinking abilities (Ahmed & Opoku, 2022; STEM Education Reviews Group, 2016), allows teachers to interpret results, to design learner-specific, corrective interventions and provide direct instruction to meet learning objectives (Meyer & Gent, 2016), limit the amount of time spent preparing learner marks and allowing for greater grading consistency and transparency in reporting learner progress to both learners and parents (DES, 2008), prompt accountability to complete assignments (Meyer & Gent, 2016), facilitates teamwork in the resolution of tasks and assignments and give on-going, immediate and just-in-time corrective feedback to learners (Nkechi, 2019), and teachers have the opportunity to adjust instruction to meet learning needs (Grimes & Warschauer, 2010; Mcknight et al., 2016).

The availability of ICT infrastructure, resources and equipment in rural schools is a key component to the provision of quality education (Barakabitze et al., 2015; Mathevula, 2014). Nguyen et al., (2012) see ICT in learning as a learning resource and a solution to resource shortages to support and make possible effective teaching and learning. Essentially, ICT enable teachers to create their own materials and make learning more meaningful for learners (Reid, 2002), and students have the opportunity to develop deeper and more engaged understandings of topics (Mcknight et al., 2016). The sharing of learning resources through ICT has the potential to minimise costs, especially in under-resourced schools, by using digital devices, such as Personal Digital Assistant (PDA) and tablets to store textbooks, trial assessments and other instructional materials (Aina, 2013; Mdletshe, 2013), and it empowers teachers to become resource persons, facilitators and mediators during teaching and learning processes (Nguyen et al., 2012; Nkechi, 2019).

However, ICT in the classroom encounters obstacles when teachers have different levels of ICT knowledge for transfer to their teaching (Ostrowick, 2016). The training of teachers in the use of ICT in teaching and learning facilitate shared learning resources, shared learning spaces, collaboration and the move towards autonomous learning (Mikre, 2011), promotes the emergence of new skills, attitudes, pedagogical approaches and sufficient capacity amongst teachers (Adedoyin & Soykan, 2020; Maluleka, 2011), increases confidence and lifelong learning (Mikre, 2011), and bolster teachers' skill-set and ability to use digital devices (Dawodu & MacGregor-Odusanya, 2010; Ostrowick, 2016). Moreover, ICT adoption is enhanced when schools have an effective ICT training policy (Barakabitze et al., 2015), and that on-going training enhances readiness to use computers (Naicker, 2010; Finnish National Board of Education, 2014). Thus, ICT adoption inevitably requires teachers' higher competence in terms of ICT knowledge and skills (Adedoyin & Soykan 2020).

6 Methodology of research

Quantitative research and a random sampling technique were used to investigate factors that influence teachers to adopt ICT in the classrooms in rural secondary schools.

From twenty randomly selected schools, five teachers were randomly selected from each school. The respondents were between the ages of 24 to 60 and had 5 to 20 years of teaching experience. The gender ratio of participants was 42 females and 58 males.

The central, data collection instrument used in this study was a closed questionnaire. The questionnaire was convenient for collecting data from a large sample of teachers. It was straight forward, required little time to complete and was treated confidentially to safeguard anonymity. It provided a substantial amount of data that could be quantified, summarised and reported to all stakeholders (i.e., teachers, school principals, parents and the Department of Basic Education). Questions were closed-ended and required respondents to select a "Yes" or "No" response. The researcher administered the questionnaire to 100 teachers from 20 public schools and obtained a 100% response rate in completed questionnaires.

In order to guard against reliability the measuring instrument was piloted, revised and given to experts for final checking. The validity of the instrument was checked before administering it. The inclusiveness, content and relevancy of the questions to the subject under study were assessed. This helped to reveal any ambiguities and ensured both validity and reliability assisted the questionnaire to achieve the degree of precision necessary for respondents to understand exactly what was asked. Reliability and validity was, therefore, verified using content validity and construct validity.

Prior to the collection of data for this research, we applied for ethical clearance from the University of the Witwatersrand research committee (Protocol Number: H18/10/34) and permission from the Department of Basic Education as the data was collected from teachers. The identities of the participants were kept confidential and did not appear on the questionnaires used in the study.

The teachers received letters with information about the study and signed a consent form. In the letter information explaining how the questionnaires were to be completed was provided. The researcher informed the participants that the information they gave remained confidential.

The data was collected and analysed on the basis of the responses given by respondents using descriptive statistics techniques. Descriptive statistics that involved observed and expected frequencies derived from mathematical formulas were used to analyse and organise data. Inferential statistics (Observed Frequency (OF), *T*-value, level of significance-0.05, *P*-value) were used to discuss the results, as the research required the estimation of population characteristics from an available sample of subjects.

7 Results

RQ: *Are there any significant differences among teachers' perceptions of factors that influence them to adopt ICT in the classroom in rural schools*?

In order to find out the most significant factors that influence teachers to adopt ICT in the classroom, the frequencies of the participants' choices were calculated and the relationship between the observed and the expected frequencies was also counted. The tables below present the results of the study with reference to participants' responses towards the questionnaire items with some inferential analysis.

Table 1 summarises the Observed Frequencies (OF) of willingness to use ICT (16%), skills to use ICT (66%), support on use of ICT (12%), planning activities using ICT (52%), teaching using ICT (80%) and access to computers and internet (81%. It was found that teachers' ICT adoption had a significant influence on using ICT to plan activities and teaching. However, the participants lacked ICT skills and access to computers and internet connectivity. The computers and internet played a significant and positive role on student learning, but only related to teachers' adoption of ICT which was generally not equally distributed in these schools. Therefore, perceived ICT use through ICT adoption involves adjustments to teachers' ICT skills and access to computers and internet connectivity. Judging from the observed frequencies of the two concepts (planning activities and skills to use ICT), it is advisable that teachers are trained.

According to the findings in Table 2, there is no significant difference between observed frequencies and the expected frequencies concerning the participants' responses towards ICT adoption to connect learners with the subject matter

Table 1 Teachers' perceptions of their use of ICT in the classroom

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You are willing to use ICT in the classroom	84	48.8	16	51.17	188.66	5	11.09
You have the skills to use ICT in the classroom	34	48.8	66	51.17			
You support the use of ICT in the classroom	88	48.8	12	51,17			
You use ICT to plan activities	48	48.8	52	51,17			
You teach learners using ICT	20	48.8	80	51.17			
You have access to computers and internet	19	48.8	81	51.17			
Total	**293**		**307**				

188.66>11.09 Significance level = 0.05

O.F.: Observed Frequency; **E.F**.: Expected Frequency; **Sd**: Significant difference; $\boldsymbol{X^2}$: test of goodness of fit; **Df**: Degrees of freedom.

Table 2 Teachers' views on using ICT to connect learners with the subject matter.

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You use ICT to teach the subject matter and to meet diverse learners' needs	32	33.5	68	66.5	9.93	3	7.82
You integrate ICT with teaching methodologies	41	33.5	59	66.5			
You assist learners to connect subject matter using ICT	39	33.5	61	66.5			
You develop ICT instructions using accurate content	22	33.5	78	66.5			
Total	**124**		**266**				

9.93>7.82 Significance level = 0.05

(9.93 > 7.82; p > 0.05). Regarding using ICT to connect learners with the subject matter, the results showed that OF (68%) respondents did not use ICT to teach the subject matter and to meet diverse learner needs, and OF (59%) participants did not adopt ICT as a teaching methodology. In practical terms, OF (61%) participants did not assist learners to learn the subject matter using ICT, and OF (78%) teachers did not develop ICT instructions using accurate content; indicating that most of the teachers did not adopt ICT during teaching and learning. It can be inferred from the results that the observed frequencies of teaching the subject matter were affected by teachers' lack of ICT adoption in the classroom. These results showed that teachers' knowledge of ICT adoption is not highly contextualized to the pedagogies associated with the subject matter

According to the findings in Table 3, there is no significant difference between observed and expected frequencies concerning the participants' responses towards the use of collaboration during classroom instruction (2.42 < 5.99; p > 0.05). The results showed that OF (69%) participants did not foster collaboration to engage learners in group discussions and experiencing team work. The survey responses, OF (62%) participants were not currently engaging with peers during lesson planning and implementation using ICT and did not use collaboration models (OF-72%) through ICT. This means that teachers who participated in the survey were less frequently engaging in collaboration with peers and students to develop abilities, whereas they were less frequent in using collaborative models through ICT. Thus, their answers to the survey showed less frequent practices of collaboration in the area of ICT adoption in the classroom

The findings in Table 4 (*above*) shows that there are no significant differences between the categories observed (10.04 < 12.59; p > 0.05). The results indicated that, OF (66%) participants did not understand assessment of learners using ICT, OF(65%) participants and OF(64%) participants did not have knowledge to use and to do demonstrations of various assessment strategies and instruments to meet learner needs respectively, OF(58%) participants did not evaluate and communicate assessment results using computers, OF(74%) did not use ICT assessment results to modify instruction, OF(55%) teachers did not use ICT for recording and filling information in the classroom, and that OF(67%) respondents did not involve learners in ICT assessment. Hence as observed from the study, there is less evidence that teachers used ICT assessments to meet learner needs. Thus, their answers to the survey showed less frequent practices of ICT assessments in the area of ICT adoption. It can be inferred

Table 3 Teachers' perceptions on collaboration with peers and learners through ICT

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You foster collaboration using group discussion and team work experiences	31	32.3	69	67.67	2.42	2	5.99
You collaborate with others in lesson planning and implementation using ICT	38	32.3	62	67.67			
You use collaborative models through ICT	28	32.3	72	67.67			
Total	**97**		**203**				

2.42<5.99 Significance level = 0.05

Table 4 Teachers' views on assessment processes in using ICT

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You understand assessment of learners using ICT	34	35.86	66	64.14	10.04	6	12.59
You demonstrate knowledge of various strategies and instruments based on learner needs	35	35.86	65	64.14			
You use appropriate ICT assessment strategies and instruments based on learner needs	36	35.86	64	64.14			
You evaluate and communicate assessment results using computers	42	35.86	58	64.14			
You use ICT assessment results to modify instruction	26	35.86	74	64.14			
You use ICT for recording and filling information in the classroom	45	35.86	55	64.14			
You involve learners in ICT assessment	33	35.86	67	64.14			
Total	**251**		**449**				

10.04<12.59 Significance level = 0.05

from the results that the observed frequencies of ICT assessments were affected by teachers' lack of ICT adoption in the classroom. Due to the difficulties associated with ICT assessments, teachers were faced with the challenge of evaluating and communicating results and using assessment results to modifying instruction. ICT assessments, when used appropriately can empower teachers and students and promote the shift to learner-centered environment. Furthermore, ICT assessments can facilitate the recording of responses and used to provide the necessary feedback to students.

According to the findings in Table 5, there are no significant differences between the observed and expected frequencies concerning participants' responses on ICT training policy, training and availability of computer laboratory ($5.14 > 7.82$; $p > 0.05$). The results have shown that the relationship between ICT time-table (OF-75%) and ICT training policy (OF-73%) was found to be positively significant with teachers' ICT adoption. This means that ICT training policy, training (OF-66%) and the presence of a computer laboratory (OF-62%) have been found to have positive and significant relationship with teachers' ICT adoption. This means that the availability of the necessary ICT infrastructure influenced teachers' behaviour towards ICT adoption. It can then be argued that teachers were reluctant to embrace ICTs, because their crucial concern was a lack of computers and training. As observed from the study, there was less evidence that teachers used ICT time-table to meet learner needs. Thus, their answers to the survey showed less frequent practices of ICT time-table in the area of ICT adoption. As such, the lack of time negatively influenced the adoption of ICT in the classroom. Furthermore, the absence of the ICT training policy meant that there was no roadmap of actions to be pursued by schools in the use of ICT, such as training opportunities of teachers to develop their skills and understanding in ICT.

The findings in Table 6 shows no significance difference between observed and expected frequencies concerning participants' responses on communication using ICT ($28.9 > 11.05$; $p > 0.05$). The results revealed that, OF (85%) participants did not communicate with students using ICT, OF (82%) teachers did not employ ICT as a communication tool, OF (55%) participants were not utilizing ICT to communicate with colleagues, parents and the community, OF (74%) teachers had challenges in

Table 5 Teachers' views on ICT training policy and availability of infrastructure

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You have a computer laboratory at your school	38	31	62	69	5.14	3	7.82
Your school has an ICT training policy	27	31	73	69			
You receive ICT training at school	34	31	66	69			
The time-table allows the use of ICT	25	31	75	69			
Total	**124**		**276**				

5.14<7.82 Significance=0.05

Table 6 Teachers' perceptions of their level communication using ICT in the classroom

	YES		NO		X^2	Df	Sd
Variable/Category	**O.F**	**E.F**	**O.F**	**E.F**			
You communicate with students using ICT	15	26.83	85	73.17	28.9	5	11.05
You employ ICT as a communication tool	18	26.83	82	73.17			
You use ICT to communicate with colleagues, parents and the community	45	26.83	55	73.17			
You demonstrate to learners how to communicate using computers	26	26.83	74	73.17			
You have competence in ICT use in the classroom	31	26.83	69	73.17			
You use communication platforms to build knowledge of learners in ICT	26	26.83	74	73.17			
Total	**161**		**439**				

28.9>11.05 Significance level = 0.05

demonstrating to learners how to communicate appropriately using computers, and OF (69%) participants were not competent in adopting ICT in the classroom. The teachers seemed to not communicate information with students. Furthermore, their answers to the survey showed less frequent practices of communication in the area of ICT adoption. Judging from these behaviours, it is inferred that teachers did not spend a significant amount of time using communication platforms to build knowledge of learners using ICT.

8 Discussion

The purpose of the study was to answer the research question, "Are there any significant differences among teachers' perceptions of factors that influence them to adopt ICT in the classroom in rural secondary schools?

The results confirmed that very few teachers were not willing to use ICT and were not supporting the use of ICT in the classroom. In general, these results indicated that most teachers held a reasonably positive attitude towards ICT adoption in the classroom. The results however, showed that the majority of teachers were not skilled to teach learners using ICT. In addition, teachers' responses to the survey showed observed frequency in the area of not using ICT to plan activities in the class. These results showed a lack of ICT adoption in the classroom. As such, ICT learning environment was missing in this context to enhance planning activities on strategy for future learning tasks. One possible explanation for this discrepancy can be teachers' lack of knowledge and skills about ICT use and a lack of access to computers and the internet. In other words, teachers need to be supported in their master of knowledge and skills to allow them to implementing appropriate pedagogical activities (Sung et al., 2015). The use of ICT in practice offers new opportunities and capabilities that inevitably lead to changes in pedagogy (Maluleka, 2011), and for this reason there is high expectation of teachers to adopt ICT in their teaching practice.

It can be inferred from the results that teachers were not using ICT to teach the subject matter and to meet diverse learner needs, did not assist learners to connect subject matter using ICT, and did not develop ICT instructions using accurate con-

tent, indicating that most of the teachers did not adopt ICT in their classes. In this study, ICT integration with teaching methodologies was not particularly effective to increase student engagement with the subject matter and to improve learning outcomes. These responses reflected difficulties teachers experienced to adopt and apply ICT into pedagogies to deepen student engagement (Lui, 2011). Resultantly, it showed that teachers were not confident in adopting ICT in pedagogy and subject matter which tend to lead to poor learner outcomes (Ostrowick, 2016), and they might not have sufficient knowledge and understanding of how to teach the subject matter using ICT (Mikre, 2011).

Furthermore, the study viewed collaboration as a multidimensional concept which is necessary in the classroom (DES, 2008; Struyven et al., 2010). For analyzing survey responses, teachers were not currently engaging in collaboration with peers during lesson planning and implementation using ICT to develop their skills. The results showed that they did not foster collaboration to enhance group discussions and team work experiences, but some studies have emphasized its positive effects (Eivers et al., 2010; Mikre, 2011). It was found that, teachers did not use collaborative models through ICT. In these situations, collaboration models if implemented might be particularly effective in generating increased participation and improved learning outcomes (Becker & Riel, 2000; Huh & Reigeluth, 2018). It can be argued that teachers did not play a significant role to enhance the collaborative dimensions with peers because of lack of knowledge and skills in ICT. To solve this discrepancy in the teachers' lack of adoption of ICTs to foster collaboration with peers, one possible and fundamental solution could be training them sufficient knowledge about ICT processes, particularly collaboration models, as part of their professional development (Barakabitze et al., 2015). If teachers can develop their knowledge of ICT, it can be more manageable and efficient to utilise collaboration during teaching and learning processes (Australian National STEM School Education Strategy, 2015).

The results also indicated that teachers' lack of ICT adoption significantly impacted on ICT assessments within the classroom context. As observed from this study, evidence showed that teachers did not understand how to assess learners using ICT, did not have knowledge to use and do demonstrations of various assessment strategies and instruments to meet learner needs, did not evaluate and communicate assessment results using computers, did not use ICT assessment results to modify instruction, did not record and file information using ICT, and did not engage learners in ICT assessments. Basically, the teachers' responses reflected difficulties of using ICT assessments into pedagogies and learner involvement. One possible explanation for this discrepancy can be teachers' lack of sufficient knowledge and skills about assessing learners using ICT (STEM Education Reviews Group, 2016; Nkechi, 2019). As a result, they just focused on traditional learning methods (Greaves et al., 2010; Levin & Schrum, 2013). Moreover, teachers might acquire knowledge on using ICT assessments from training to resolve pedagogical problems and technological usage (Kaufman, 2014). Ideally, ICT assessments, when used appropriately can empower teachers and students and promote the shift to learner-centered environment. Ultimately, the ability to integrate ICT into assessment processes may change teachers' perceptions towards ICT adoption in the classroom.

This study postulated based on previous studies that communication is essential to convey information (Kaufman, 2014; Olelewe & Amaka, 2011), and to promote knowledge building (Schellens & Valcke, 2005). In other words, teachers needed to communicate with students, colleagues, parents and community when they experienced challenges. Arising from the findings, the teachers were not skilled to do demonstrations to learners on effective ways of communication using computers. In this study, it is highly probable that students did not receive balanced information from teachers as they experienced a lack of communication skills using ICT. Basically, communication platforms were ideal to enhance the learning environment (Huh & Reigeluth, 2018), but the results showed that teachers' practices of communication were not focused on ICT use in the classroom. One possible explanation for this discrepancy could be teachers' lack of knowledge and skills about available communication platforms. The communication platforms enable teachers to connect with students, peers and parents as classroom communities (DES, 2008; Mwapwele et al., 2019), enhance successful lifelong learning (Koster and Dengerink, 2008; Report on STEM Education, 2016), and create a learning environment characterized by positive flow of information and student achievement (Kaufman, 2014). As a result, the ability to communicate using ICT could influence teachers' adoption of ICT in the classroom.

From the proceeding findings, one can deduce that most schools did not have ICT training policy, and teachers did not receive training in ICT. As a result, they were not confident enough to adopt ICT in teaching and learning purposes and did not realize the value that ICT bring, issues that should be addressed in school training programs. To attain the highest level in teaching and learning implies that schools should put in place ICT training policy (Barakabitze et al., 2015). These findings are in consistent with those from previous studies about the positive effects of on-going training of teachers (Ayemoba, 2013; Dawodu & MacGregor-Odusanya, 2010; Ostrowick, 2016), and ICT training policy guided teachers in the adoption of ICT in the classroom. Therefore, providing support, developing and managing training environments enabled teachers to adopt ICT in their educational path.

Apart from the above, the results indicated that most schools did not have computer laboratories. From the results, investment in the ICT infrastructure and resources enabled teachers to be competent and effective in utilizing technology tools into pedagogy and content delivery. These results thus reinforce the recommendations of previous studies in ICT adoption, regarding the need for the provision of ICT infrastructure and resources (Venkatesh, et al. 2003; Aina 2012; Nguyen et al., 2012). This will empower teachers to become resource persons, facilitators and mediators during teaching and learning (Nguyen et al., 2012; Nkechi, 2019), and enhance the provision of quality education (Barakabitze et al., 2015; Mathevula, 2014).

9 Conclusions and implications of the study

The success of teaching and learning in secondary schools was impacted by the teachers' perceived lack of skills to adopt ICT in the classroom. This affected them to foster collaboration with peers and students, the ability to use communication plat-

forms and ICT assessments to deepen learner engagement with the subject matter. Essentially, ICT assessments could empower teachers and students and promote the shift to student-centered environment. Furthermore, ICT training policy was found to be essential and the lack of ICT infrastructure and resources affected teachers to adopt ICT in the classroom. The results highlight that the lack of on-going training of teachers affected ICT adoption in the classroom. Therefore, the findings of the study have implications for schools and DBE to train teachers to increase their ICT skills and putting in place appropriate ICT infrastructure to enhance ICT adoption in rural secondary schools.

10 Limitations and implications for future research

One of the limitations of this study to better assess its results and conclusion is that teachers in the survey were asked to provide responses on factors that influence them to adopt ICT in the classroom, which can contain self-report bias. Moreover, a survey was the only source of data in this study, therefore, it is advisable to have multiple of data to triangulate the findings in future research using case study methods.

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Declaration

Conflict of interest None.

Ethical clearance The researchers applied for ethical clearance from the University of the Witwatersrand Ethics Committee (PROTOCOL NUMBER-H18/10/34) and the Limpopo Department of Basic Education.

Undertaking/Declaration We undertake that the article has not been published or is being presented for publication elsewhere and there is no conflict of interest.

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