Using diffusion of innovation theory to understand factors impacting technology teachers

Department of Humanities, Faculty of Science, Tshwane University of Technology, Pretoria, South Africa

s.matips@gmail.com

Sylvia Ramaligela

Department of Humanities, Faculty of Education, University of Limpopo, Polokwane, South Africa

Sylvia.ramaligela@ul.ac.za

Moses Makgato

Department of Humanities, Faculty of Science, Tshwane University of Technology, Pretoria, South Africa

makgatom@tut.ac.za

Abstract

The aim of this study is to explore the factors influencing technology teachers' acceptance and usage of Information and Communication Technology (ICT) innovations. The acceptance of a new idea is not an overnight phenomenon, but does not happen simultaneously for all people in a social system. Users who innovate earlier have different characteristics than those who innovate later. Therefore, it is important for policy makers and facilitators to understand the characteristics of each segment that either support or hinder the introduction of an innovation. However, diffusion of these innovation initiatives remain a major challenge to realise the desirable outcome, particularly in teaching technology using ICTs for delivery of quality learning. This article sought to bring light in the way diffusion of innovation initiatives is being carried out in technology using ICT tools.

Keywords: Diffusion, ICT, Innovation, Subject, Teacher, Technology.

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Introduction

South Africa has for many years struggled to deliver an acceptable mathematics, science and technology education at primary and secondary schools (Gauteng Department of Education, 2010). Poor learner performance in South Africa has been attributed to different issues such as learners' social and economic circumstances, lack of learner support materials and related resources, overcrowding, and a lack of teacher and learner discipline and commitment, to mention but a few (Mahomed, 2004; Mapotse 2012). Some education stakeholders hold assumptions that learners perform better when their teachers have received quality education and training in the subjects they teach and at the levels/phases in which they are placed. Technology education (TE) therefore is a foreign concept to many teachers and a new learning area in school curriculum both nationally and internationally. The challenges that teachers face regarding the policy of technology are articulated in terms of interpretation, analysis and implementation of the policy (Mapotse 2012).

There has been a trend of technology studies conducted both nationally and internationally to address diverse issues around technology education in relation to strengthening subject knowledge and pedagogy of technology teachers. Erekson and Shumway (2006), De Vries (2007), Mettas and Constantinou (2007), Nkosi (2008), Middleton (2009), Somekh andZeichner (2013), Mapotse (2012), Potgieter (2012), Mapotse and Gumbo (2012a) and Khobidi, Chikasanda, Otrel-Cass, Williams and Jones (2013), have attempted to raise some aspects around pedagogy and content knowledge of technology education. However, little research has been conducted to strengthen the use of ICT in teaching technology as a subject.

Problem statement

The acceptance and application of technology innovations by technology teachers has been a serious drawback over the past decade; usage is very low despite the accessibility of ICT tools such as smartboards and laptops. The ideal situation would be when teachers have a positive attitude and the required skills to access ICT tools as well as high quality ICT usage skills for teaching and learning. Teachers need to be able to use ICT to perform a substantial part of their duties. The role of teachers is to promote the use of ICT in teaching and learning both inside and outside the classroom. If this situation is left unsupervised, a lack of positive attitudes and skills will result in learners being unable to navigate a complex digital landscape and being unable to fully participate in the economic, social and cultural life around them. It will also produce learners who lack knowledge in various areas that require intellectual analysis and critical thinking later in life.

Purpose of the study

The purpose of this study is to examine technology teachers' acceptance and usage of ICT innovations. Furthermore, to understand how technology teachers implement ICTS in their teaching, and to explain why technology teachers implement the content the manner they do?

Research question

The three components of Rogers' theory described above help us address the following research question:

To what extent do technology teachers' acceptance and usage of ICT innovations relate to the types of adopters?

Theoretical Framework

Rogers theory of Diffusion of Innovation helps with obtaining reasons and explanations behind the spread of a new ideas and technology. Some studies have included the theory into using active learning approaches decisions, produced, by teachers (Blumberg, 2016, Andrews, 2015). In the current study, three models from Rogers' theory that includes kinds of adopters, innovation-decision process, and characteristics, of innovations will be applied.

Adopters categorization according to the degree of innovation

Innovators are willing to try new ideas until their adventurousness becomes practically a passion. Innovators' interest in new ideas leads them out of a local peer group and into social relationships that are more multicultural than normal. Typically, innovators have significant financial resources and the ability to understand and apply complex technical knowledge. While others may consider the innovator rash or daring, it is risk-taking risk that is of preeminent value to this type of person. The innovator is also willing to accept the occasional setback when new ideas are unsuccessful (Rogers, 2003). Early adopters tend to be more integrated into the local social system than innovators. The early adopters are considered localities in contrast to the cosmopolitan innovators. People in the early adopters' category appear to have the highest level of opinion leadership in most social systems. They offer advice and information that other users are looking for about an innovation. Change agents are looking for early adopters to speed up the dissemination process. The early adopter is usually respected by his peers and has a reputation for using new ideas successfully and discreetly (Rogers, 2003). Members of the early majority category will adopt new ideas shortly before the average member of a social system. They often interact with their peers, but are not often found in leadership roles. As the link between very early adopters and late adopters, early majority adopters play an important role in the dissemination process. Their innovation decision-making time is relatively longer than that of innovators and early adopters, as they consider some time before fully adopting a new idea. Rarely leading, early majority adopters willingly follow innovation (Rogers, 2003). The late majority is a sceptical group that picks up new ideas right after the average member of a social system. They can be adopted out of economic necessity and in response to increasing social pressures. They are cautious about innovation and are reluctant to adopt it until most of the others in their social system do it first. An innovation must definitely have the weight of system standards behind it in order to convince the late majority. Even if they may be convinced of the benefits of the innovation, the pressure from colleagues to take over must be strong (Rogers, 2003).

Laggards are traditionalists and the last to embrace innovation. Having almost no opinion

leadership, stragglers are so localized that they are isolated compared to the other categories of adopter. You are fixated on the past and all decisions must be made with previous generations in mind. Individual laggards mainly interact with other traditionalists. An innovation that was eventually adopted by a latecomer can already become obsolete with newer ideas already used by innovators. Latecomers are likely to be suspicious of not only innovation, but innovators and change agents as well (Rogers, 2003).

Rogers innovation decision-making process

After creating a classification for the different types of users, Rogers also described the process of decision-making in response to an innovation. This innovation decision-making model comprises five successive stages: knowledge, persuasion, decision, implementation and confirmation. Knowledge is the stage when individuals become aware of an innovation and begin to understand how it works. In the persuasion stage, individuals shape their attitudes towards an innovation either positively or negatively.

After attitude is formed, a decision is made as to whether the innovation is accepted or rejected, the so-called decision stage. This is followed by the implementation stage; In this stage, individuals test the innovation. The last stage is the confirmation, in which the individual summarizes his thoughts and experiences with the innovation and finally confirms whether he would like to take over the innovation in the long term. Rogers defined this innovation decision-making process as a process of reducing uncertainty (Roges,2003). In other words, the less uncertainty people have, the more likely they are to adopt an innovation.

Rogers Five Qualities of Innovation

After all, the likelihood that a participant will successfully introduce an innovation depends on the characteristics of the innovation that are perceived by the potential users. The five attributes of innovations are relative advantage, compatibility, complexity, testability and observability. How individuals perceive the attributes of innovation affects their adoption rate. Relative advantage is the advantage that innovation has compared to other approaches that it outperforms. The compatibility shows how well the innovation can be in harmony with the existing beliefs and values of individuals. The greater the compatibility, the less uncertainty individuals will have. Complexity refers to the relative difficulty individuals have in understanding and leveraging innovation. As the level of difficulty increases, the likelihood of adoption will decrease. Testability is how easily an innovation can be tested. Observability is the extent to which results of implementing the innovation are visible to others. Rogers also discussed the relationships between testability and types of adopters. (Rogers,2003). Relative early adopters tend to place more emphasis on testability than late adopters, as most of them are the pioneers who tend to try things out. In this study, we applied this model to the two different innovative teaching strategies taught in two different professional development programs to examine how their distinctive features affect adoption decisions. In this study the model was applied to explore how technology acceptance impact adoption decisions.

Barriers affecting the continuous professional development of technology teachers

Numerous barriers exist that impact on the quality and success of Continuous Professional Development programmes (CPD). These barriers need to be considered in conjunction with teachers' levels of Technological Pedagogical Content Knowledge (TPCK) to ensure that what teachers learn during Continuous Professional Development interventions translates to their practice. Firstly, teachers engaging in Continuous Professional Development possess different ICT skills, goals, attitudes about their abilities and notions of themselves as ICT integrators (Morsink, Hagerman, Heintz, Boyer, Harris, Kereluik, & Siegler, 2011). As such, Continuous Professional Development cannot assume a one size-fits-all approach (Guerrero, 2010). Secondly, Morsink et al. (2011) allude to inconsistent models of CPD as a barrier towards teacher development and training in terms of effective ICT integration. This may be exacerbated by the fact that teachers often claim lack of time and access to ICTs as barriers to their participation in both formal and informal CPD (Bennison & Goos, 2010) and is evident in teachers' failure to develop their identities as fluent users of ICTs, even after engagement in CPD. Often CPD efforts are disconnected from classroom practice and the role of reflection is disregarded. Polly and

Hannafin (2011) advocate that reflection plays an important role in CPD, which should create opportunities for teachers to examine their own teaching praxis and should be integral to classroom activity and situated in teachers' work. Thus, sharing of ideas, peer coaching and collaborative problem solving are requisite to teachers' efforts to integrate ICTs into teaching (Galanouli, Murphy, & Gardner, 2004). Furthermore, developing expertise in ICT integration is a time-consuming, long-term process that requires commitment and ongoing effort from teachers (Morsink et al., 2011). CPD programmes should focus on the appropriate use of ICTs by allowing time for teachers to review, evaluate and explore the affordances of different technologies and mathematical software. Teachers need to develop an understanding of when to use ICT as a part of instruction (Crompton, 2011). Polly and Hannafin (2011) advocate that teachers should select the content and activities they want to focus on during CPD. When teachers perceive ownership, they are more likely to adopt and integrate the CPD pedagogies in their own teaching. Cassim (2010) suggests that teachers should design ICT-based lessons in collaboration with their colleagues by forming a community of practice. Knowledgeable teachers should also host informal ICT-mediated workshops to support less knowledgeable teachers. Therefore, the researchers advocate CPD programmes aimed at improving teachers' TPACK, which are grounded in the context in which ICT integration is applied (Ford & Botha, 2010) by taking cognisance of existing barriers to ICT integration, rather than isolated, once-off isolated professional development programmes.

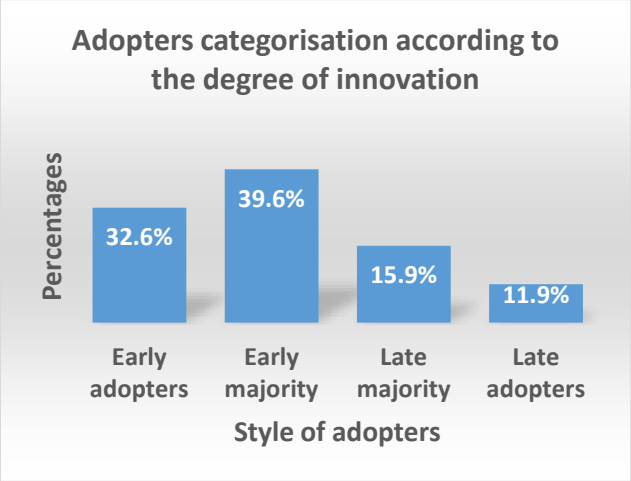
Methodology

The study employed quantitative research method. Quantitative research method is the systematic empirical investigation of observable phenomena via statistical, mathematical, or computational techniques (Lisa 2008). Polit and Hungler (1999) refer to the population as an aggregate or totality of all the objects, subjects or members that conform to a set of specifications. The population of this study comprised of educators in secondary schools in district 14. The records of the District Office (D14) show that the total number of secondary schools is 11 with 401 educators, where 173 (33%) are male educators and 228 (67%) are female educators. The study used purposive sampling in selecting the schools and the participants for inclusion in this study. Babbie (2010) defines purposive sampling as a form of nonprobability sampling in which units to be observed are selected on the basis of the researcher's judgment about which ones are the most useful or representative. Sampling is a technique used in eliciting data from the representative group from a larger population. The main reason for sampling is to collect specific data that will explore depth and understanding of the study (Neuman, 2011). The sample size in this case study consisted of forty educators. Data is defined as information obtained in a course of a study. (Polit and Hungler, 1999). The study collected the data in district 14 in South Africa by using structured questionnaire. The questionnaire was distributed to the respondents with teaching background. The complete filled-up questionnaires were gathered and collected for further data analysis to get the output and findings for the study. Data analysis is described as an activity, which involves the synthesis of data in order to come up with conclusions on a research problem (Walliman, 2005). The analysis includes both descriptive and inferential analysis. The researchers used descriptive analysis to analyse the frequency and percentage of the overall population in the demographic background. Besides, it is also used to determine the mean, standard deviation, frequency and percentage to identify the factors associated with the attitudes of educators in the integration of ICT.

Findings and discussion

Rogers' types of adopter model help frame the categories of participants in this study. In terms of the distribution of different adopters, early adopter and late majority were the dominant groups in the sample, while in Rogers' model, early and late majority are the two major types. Rogers' model applies to the whole population of potential adopters. However, in this study, we only have a sub-sample of the population all the study participants voluntarily chose to par take in answering the questionnaire; they wanted to make some changes in their current teaching to some extent, which is expecting to have fewer late majority. Non-adopters exist due to either improper teaching contexts or insufficient survey replies. The expectations indicated by participants also aligned with these results. This research question seeks to explore the acceptance and use of ICT in teaching technology.

In order to understand how they implement ICT in teaching and learning. The RQ1 used 9 sub-research questions, thus, SRQ1-SRQ9.



The distribution of adopters in this study (See in Figure 1) was shifted more towards early majority and early adopters as compared to the distribution expected by Rogers. (i.e. normal distribution cantered on Early and late majority). The number of those with early adopter traits (32.6%) whereas early majority rated (39.6%), while the number of late majority traits (15.9%) is relatively small. 11.9% of non-adopters were also observed. As each adopter type has unique features, it can be interesting to see whether the educators have the competencies and skills to effectively integrate ICT in their teaching and learning.

(SRQ1) Learners need to know how to use ICT for their own future.

When asked whether Learners need to know how to use ICT for their own future.S

84.61% of those with early majority traits expressed that learners need to know how to use ICTs for their own future. On the contrary, 15.39% were classified as late majority since they did not agree that learners need to know how to use ICTs for their own future. Whilst (2.56%) who were undecided about the implementation were classified as late adopters. As suggested by Rogers, (2003), the normal distribution cantered on Early and late majority. On the other hand, compatibility was major reason for early majority to support the perception that learners. Lastly The participants were classified as belonging to the knowledge stage, it's when individuals become aware of an innovation and begin to understand how it works.

(SRQ2) Knowing about ICT earns one the respect of others.

In this question, respondents were asked whether knowledge of ICT deserves the respect of others. 48.71% of those with early majority characteristics said knowledge of ICT does not earn the respect of others. On the contrary, 51.29 were classified as late majority because they agree that knowledge of ICT earns the respect of others. This finding agreed with Rogers (2003) that the participants felt under observability and observability is the extent to which results of implementing the innovation are visible to others the results also show that the knowledge about ICT is still in the initial knowledge stage of the innovation-decision process, and only the 'early adopters' in the teacher population adopt and continuously used this innovation. The participants

(SRQ3) ICT will improve our standard of living.

When asked if ICT will improve our standard of living. The response was that 24.99% of those with late majority characteristics said ICT will not improve our standard of living. On the contrary, 75.01% were classified as early adopters because they believe that ICT will improve our standard of living. This finding agreed with Rogers (2003) that relative advantage is the degree to which an innovation is perceived as better than the idea it is replacing. The participants were classified as belonging to the knowledge stage this is when individuals become aware of an innovation and begin to understand how it works.

(SRQ4) Using ICT would not hinder our generations learning their traditions.

In this question, respondents were asked whether using ICT would not impede our generations from learning their traditions. Their reply was as follows. (64.09%) of those with early adopters' characteristics said that using ICTs would not impede their generations from learning their traditions. Whilst 35.91% were categorized as late adopters because they feel that using ICT would hinder our generations from learning their traditions. The results show that participants believe that using ICT would not hinder our generations learning their traditions the participants were classified under

compatibility were tradition and habit also appeared to play an important role in hindering adoption of ICT. The participants were classified as belonging to the knowledge stage this is when individuals become aware of an innovation and begin to understand how it works.

(SRQ5) ICT's are proliferating too fast.

When asked whether ICT's are proliferating too fast. 58.96% of those with early adopters' characteristics said that ICTs are proliferating too fast. On contrary, 41.04% were classified as late adopters because they disagreed that ICTs are proliferating too rapid. The results show that compatibility was the main attributes in the spread of ICT which promoted participants to accept and use ICT in their teaching. The participants were classified as belonging to the knowledge stage, it's when individuals become aware of an innovation and begin to understand how it works

(SRQ6) People who are skilled in computers have privileges not to others.

Respondents were asked whether people with computer literacy had privileges, not over others. Their response was 51.27% of those with early adopters' characteristics said that people who are skilled in ICTs have privileges not to others. On contrary, 48.27% were classified as early adopters because they disagreed that people who are skilled in computers have privileges not to others. Whilst (5.12%) of those with late adopters' characteristics did not respond to the question. The results show that the relative advantage was the main attribute in that believe that people who are skilled in ICT have the privilege on others. Furthermore, participants were classified as belonging to the persuasion stage, were individuals shape their attitudes towards an innovation either positively or negatively.

(SRQ7) The increased proliferating of computers will make our lives easier.

The question was whether the increased proliferating of computers will make our lives easier. 66.09% of those with early majority' characteristics said that the rise of computers will make our lives easier. While 33.91% were classified as late majority because they did not believe that the increase in the use of computers will make our lives easier. Furthermore (7.69%) were classified as late adopters since they did not respond to the question. The results agree with Rogers, (2003) findings that compatibility shows how well the innovation can be in harmony with the existing beliefs and values of individuals. The participants where categorised as belonging to the implementation stage; at this stage, individuals test the innovation.

(SRQ8) Working with ICT does not demolish people's relationship with others.

When asked whether working with ICT does not destroy people's relationships with others. Their response was that 69.22% of those with early adopters' characteristics said that working with ICT does not demolish people's relationship with others. On contrary, 30.78% were classified as late adopters because they did not believe that working with ICT do demolish people's relationship with others. This finding agreed with Rogers (2003) that relative advantage is the degree to which an innovation is perceived as better than the idea it is replacing. The degree of relative advantage can be measured in terms of economic profitability, low cost, convenience, time and labour savings, and immediate reward. The participants where categorised as belonging to the persuasion stage, were individuals shape their attitudes towards an innovation either positively or negatively.

(SRQ9) ICT should be a priority in education.

The question was whether the ICT should be a priority in education**.** Their responded as follows 66.65% of those with early adopters' characteristics said that ICT should be a priority in education. Whilst 33.35% were classified as late adopters because they did not believe that ICT should be a priority in education. This finding agreed with Rogers (2003) that relative advantage is the degree to which an innovation is perceived as better than the idea it is replacing. The degree of relative advantage can be measured in terms of economic profitability, low cost, convenience, time and labour savings, and immediate reward. On the other hand, on Rogers innovation decision-making process the participants were classified as being in the knowledge stage it's when individuals become aware of an innovation and begin to understand how it works.

Recommendations

The results of this study have important implications for professional development

facilitators. This study demonstrates that different types of adopters attend professional development programs. Characterizing and leveraging the type of adopters present in the group of participants can enhance the effectiveness of the program and increase adoption. For example, early adopters can help those teachers who hold concerns and hesitations toward adoptions like late majority. Moreover, the need for each group of adopters can be targeted during the professional development program.

Conclusion

This study focused on the technology teachers' acceptance and usage of technology innovations. The study drew the following conclusions:

Firstly, the majority of teachers lacked the necessary skills to facilitate the use of ICT in the classroom in teaching technology. One of the most significant roadblocks to successful ICT implementation in teaching technology is the lack of a critical mass of teachers who are comfortable with ICT and can thus provide support to those who have not yet mastered the tools. Secondly making ICT skills and knowledge mandatory for technology teachers can greatly boost their ICT skills and knowledge, and in general, technology teachers saw the adoption and use of ICT in schools as crucial because it may help them fulfil the different requirements of learners, organize their work, make teaching more effective, and plan lessons, and use ICT in teaching.

Limitations of the study

Small sample size is one issue that exists in the current study, which makes it harder to report any statistical significance within our findings. Nevertheless, few studies have looked at the characteristics of potential adopters through Rogers' Innovation Diffusion model to figure out the slow uptake of innovative instructions. This study relied on a questionnaire. Although questionnaire on teaching practices is a common and popular evaluation method, it may not be utterly accurate. Yet, if designed questionnaires can look through the lens from more than one perspective, it can still lead to the right direction. In this study some participants claimed to be aware of the strategy of teaching using ICT tools. However, the reasons they provided revealed that they had little knowledge about the importance of ICT in their teaching which confirm that they were actually at unawareness knowledge stage.

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