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Self-efficacy and Prior ICT experience: Effects of individual differences on science teachers' acceptance of digital videos in the Zimbabwean context.

Norman Karimazondo [a], Jérémy Castéra [b], Maria Impedovo [b], Edistio Martinez [a]

[a] Bindura University of Science Education, P. Bag 1020, Bindura, Zimbabwe

[b] Aix-Marseille Université, EA4671 ADEF, ENS de Lyon (Aix-Marseille, France)

Abstract

ICT is yet to penetrate Zimbabwean schools. However, several programs in 2009 and 2011 tried to promote the teaching and learning of science and mathematics in schools through new technologies. Based on the Technology Acceptance Model (TAM), the study aims to assess the effect of technology self-efficacy and prior ICT experience on Zimbabwean in-service science teachers' acceptance of digital videos in science education as an expectation of syllabuses. Quantitative analysis was done to gather data from sixty-three Zimbabwean in-service science teachers. The study has shown that both technology self-efficacy and prior ICT experience have a positive effect on the perceptions of the TAM. Several recommendations included teacher training are provided.

Keywords: Technology Acceptance Model, Zimbabwean in-service science teachers, acceptance of digital videos, Prior ICT experience, Technology self-efficacy.

INTRODUCTION

The rapid advancement in Information and Communication Technology (ICT) is revolutionising teaching and learning of science (Liu, Liao, & Pratt, 2009). In science education, ICT teaching activities include tutorial applications, simulations, modelling and use of multimedia for example digital videos and use of the internet to access information (Hogarth, Bennett, Lubben, & Robinson, 2006). This study focuses on digital videos which are part of eLearning multimedia components for teachers and students to access digital content in the Zimbabwean context.

Especially, the research was done regarding the trends of science education in Zimbabwe. A Zimbabwean publication by Kusure and Basira (2015) noted that there was a decline in enrolment of science students nationally, poor pass rates in science every year, and under-supply of appropriately qualified science teachers. Their study revealed that the Zimbabwean government has responded by rolling out eLearning programmes to promote science education. To date, more than eight hundred and sixty schools across the country had received eLearning equipment (Kusure & Basira, 2015). The same study highlighted that the use of interactive ICTs such as digital videos and other technological equipment has been found to reduce perceived difficulties in learning and increase motivation for learning science. Other benefits for using digital videos include enhancing student comprehension and remembering of content, and provides greater accommodation of diverse learning styles (Mitra et al. 2010).

Despite the outlined benefits, the impact of ICT in Zimbabwean schools is less than being expected because of the reality in the school and classroom practice. Some of the evidence suggests that they are problems in trying to promote eLearning. A survey of the schools in Mashonaland West Province in mid-2011 showed that most of the eLearning equipment was not being utilized (Musiyandaka, Ranga, & Kiwa, 2013). Paradoxically, one of the Zimbabwean science syllabus aims, is to promote the use of ICT as an aid to experiments and as a tool for interpretation of experimental and theoretical results (Chemistry - Advanced Level Syllabi - Zimbabwe Schools Examination Council, 2013). Although, the science syllabus demands the teachers to use digital videos in teaching science on the other hand it's quite new technology in Zimbabwe, teachers are likely to resist and threatened by its presence.

Researchers and other stakeholders in education expect science teachers to use digital videos in ways which are consistent with the belief that new technology will impact on teaching and learning of science. They must be aware that teachers are faced with many variables that interact with each other to facilitate the acceptance of computer related technology (Teo, 2009). This has raised some questions to what causes individual science teachers in Zimbabwe to accept new ICTs like digital videos in science education. Is it something inherent in the individual science teacher? Therefore, this study is concerned with the effect of individual differences on Zimbabwean science teachers' acceptance of digital videos in science education.

THEORETICAL FRAMEWORK

Technology Acceptance

Dillon (2001) defined acceptance as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support. Acceptance was chosen because the use of digital videos is considered new in Zimbabwe and the eLearning program is yet to be fully developed (Kusure & Basira 2015). The concept of acceptance is applied to in-service science teachers' who intend to use digital videos for the purpose of science education. Therefore, acceptance is examined through intention to use digital videos in science education based on the Technology Acceptance Model (TAM) (Teo, 2009).

Davis (1989) developed the technology acceptance model (TAM) based on the principles of Fishbein and Ajzen (1975) attitude paradigm from psychology. Since the TAM was developed, it has been used in the study of the acceptance of computers (Teo, 2009), information systems (Yang & Yoo, 2004) Microsoft PowerPoint (P. J.-H. Hu, Clark, & Ma, 2003) and videos games (Bourgonjon, Valcke, Soetaert, & Schellens, 2010). As shown in Figure 1, technology usage is determined by behavioural intention, which is in turn determined by attitude towards use and perceived usefulness (Carlos & Soares, 2011). Attitude towards use of technology was found to be partially mediating the effect of perceived ease of use and perceived usefulness on behavioural intention (Kim, Chun, & Song, 2009). In addition perceived ease of use has a direct influence on perceived usefulness not vice versa (Teo, Faruk Ursavas, & Bahçekapili, 2011). In other words, people will perceive a technological artefact to be more useful when it is easy to operate (Bourgonjon et al., 2010).

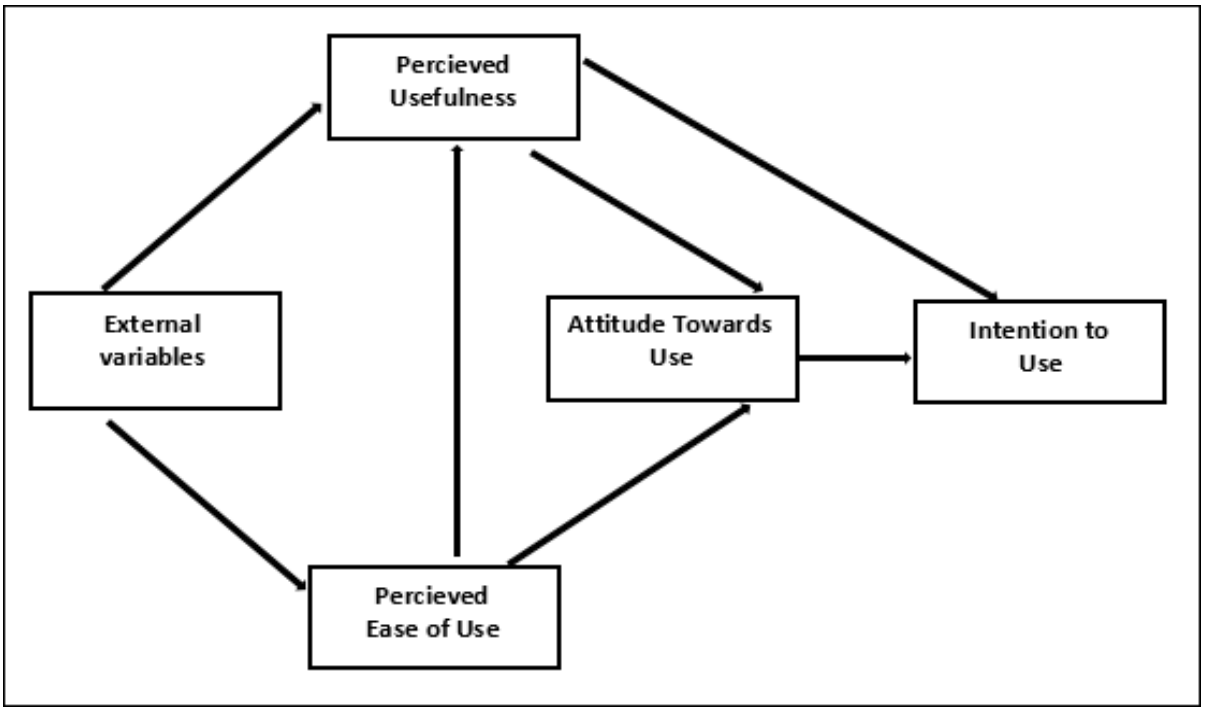

Figure 1. Technology Acceptance Model (adapted from Teo, 2009)

The original TAM and its extended forms has received empirical support as a powerful and parsimonious model across various technology settings and times (Kim, Chun, & Song, 2009; Teo, 2009). The main advantage of using TAM to examine technology acceptance is that it has a well-validated measurement inventory (Thong, Hong, & Tam, 2002). An extensive review of literature of previous TAM studies, revealed that specific names of the technologies were used to replace "the technology" in specific questionnaires and items were modified to make them relevant and fit the specific context of technology under study (Donkor, 2011). Therefore, in this study, TAM items were modified to fit the specific context of digital videos. In several TAM studies items for the constructs were measured using 5-point Likert scale (strongly disagree=l, strongly agree=5) (Yi, Wu, & Tung, 2005). Furthermore, items based on the TAM were adopted in this research because it possesses predictive validity in studies involving pre-service teachers who have similar professional pathway as in-service teachers (Teo, 2009).

Digital videos in education

A significant body of research has investigated how digital videos promote learning. Digital videos are a powerful tool that can motivate students, make abstract ideas concrete, enable deeper learning and retention of content (Cherrett, Wills, Price, Maynard, & Dror, 2009; Choi & Johnson, 2005; Mitra, Lewin- Jones, Barrett, & Williamson, 2010; Williams & Lutes, 2008) This is possible because digital videos materials have innovative features like sensory images, audio, text and dynamic features that can be used to make instruction more appealing to learners (Williams & Lutes, 2008). Other studies have considered teachers and students perceptions and attitudes towards videos (Boateng, Boateng, Awuah, Ansong, & Anderson, 2016; Marcus Grandson 2014) as prerequisites towards acceptance of digital videos in education. Students perceive digital videos as beneficial to their learning and have positive attitudes towards their educational use (Boateng et al., 2016).

However, there is less literature that actually examines factors that go beyond perception and attitude towards digital videos such as individual differences particularly among teachers. Digital videos are complex and much broader in context, as they involve enabling technology, distribution environments, target users and content (Hong, Thong, & Wai-Man Wong, 2002). Definitely, there is a reasonable assumption that perceptions are antecedent to acceptance of technology like digital videos. Contrastingly, it's often not always the case as some technologies have been developed without an adequate understanding of the targeted individual users (Holden & Rada, 2011). This is worth considering because poor acceptance of digital video by teachers reflect poorly implemented pedagogy or an over-estimation in their potential in education (Mitra et al., 2010). Therefore, this research calls for the investigation of the effect of individual differences on in-service science teachers' acceptance of digital videos in science education.

Acceptance of digital videos in science education

There is little research which exactly points out about acceptance of digital videos in science education or education in general. Very few studies, for instance, one study by Donkor (2011) assessed distance learners' acceptance of video based instructional materials for teaching practical skills in block-laying and concreting. Donkor (2011) seeks to determine whether levels of learner acceptance differ according to study centres. The results of the study revealed that learners of different study centres exhibited high and same level of acceptance of the video based instruction. However, the results have some limitations when it comes to studies involving individual differences and adults like teachers.

In-service science teachers' acceptance of technology

Among the key stakeholders in any effective use of ICT in science education are the in-service science teachers who are fulltime classroom practitioners. As part of their job requirements, in-service science teachers are expected to use technological tools and have to toggle between science pedagogy and technology in a seamless way (Teo et al., 2011). However, research evidence from some Zimbabwean studies such as the one by Musiyandaka et al., (2013), has shown that acceptance of ICT in secondary schools remains peripheral and minimal. In-service science teachers are a special target for this research because in a science classroom context it is up to the teachers to decide whether or not to use specific learning technological tools (Bourgonjon et al., 2010). Given that critical role in education, there is need to closely examine factors that influence their acceptance of new technology like digital videos (Teo, 2009).

Individual differences as external variables of the TAM

Davis (1989, 1993) suggested that future research should consider the role of additional variables and all of the later variables should come under the rubric of external variables. Perceived ease of use and perceived usefulness as constructs that are central to the TAM, are posited to fully mediate the effects of all other external variables on technology acceptance (Wang, Wang, Lin, & Tang, 2003). The TAM has been criticized for failing to explicitly consider a set of important constructs, specifically individual differences which is conceptualized to be an external variable. Several studies suggest that individual differences interacts with perceptions about ICT to influence intention to use ICT (Yi, Wu, & TUNG, 2005). This means that, the effects of individual differences on intention to use ICT would be shown indirectly via relationships with perceptions. Individual differences are what distinguish the in-service science teachers from one another and makes them unique individuals in regard to measurable traits such as age, gender, technology self-efficacy, prior ICT experience, education. In this study prior ICT experience and technology self-efficacy were selected as individual differences variables of the study.

In this study technology self-efficacy refers to the assessment of the in-service science teachers' ability and confidence to use digital videos together with related hardware like computers and projectors in science education (Aypay, Celik, Aypay, & Sever, 2012). The mechanism through which technology self-efficacy affects intention is unclear and there has been limited empirical research (Hong et al., 2002). According to Hong et al. (2002) technology self-efficacy has a direct effect on perceived ease of use, but not on perceived usefulness. Teo (2009a) argued that technology self-efficacy has a direct effect on perceived usefulness and perceived ease of use, although the effect size of the latter is smaller.

Prior ICT experience has served as a correlate to technology self-efficacy, perceived ease of use and usefulness (Hsioung, 2002). In this study prior ICT experience refers to the in-service science teachers' self-reported skill, exposure and familiarity to digital videos and other computer related technology (Thong, Hong, & Tam, 2002). A higher level of prior ICT experience greatly improves the teacher's technology self-efficacy and perceptions by increasing the teachers' ability to master challenge and to reduce any fears of using ICT in the classroom (Hsioung, 2002). Like any other external variable prior ICT experience is likely to have indirect effect on intention to use through technology self-efficacy and other mediating variables in the TAM.

Several studies have attempted to develop reliable and comprehensive instruments to measure individual differences such as technology self-efficacy and Prior ICT experience. The Computer Self-Efficacy Scale (CSE) (Compeau & Higgins, 1995) was developed to measure the respondents' confidence about their knowledge and skills in specific computer related technologies on Likert scales ranging from (1) strongly disagree to (5) strongly agree. Previous computer experience was measured by the period that the respondent has used a computer (Thong et al., 2002). Despite the fact that there are a lot of studies that have attempted to develop instruments for measuring individual differences very few of them had managed to link individual difference and technology acceptance. In this study previous computer experience and computer self-efficacy have been operationalised as prior ICT experience and technology self-efficacy respectively.

Aim of the study

This research sought to answer this question: What is the effect of external variables such as prior ICT experience and technology self-efficacy on in-service science teachers' acceptance of digital videos in science education?

H1. Technology self-efficacy and prior ICT experience have a positive effect on the perceived usefulness of digital videos in science education.

H2. Technology self-efficacy and prior ICT experience have a positive effect on the perceived ease of use of digital videos in science education.

H3. Prior ICT experience have a positive effect on technology self-efficacy about digital videos

METHODS

Participants

The research used a convenient sample of sixty-three Zimbabwean in-service science teachers of both gender categories. The sample consists of thirty-two females and thirty-one males aged between twenty-one and sixty-two. Participants who volunteered for the study were drawn from eleven secondary schools in Marondera District, Mashonaland East Province. To contact the participants in their schools the researchers sought permission from the regional authorities to carry out the research. After being granted the research permission the researchers visited the participants in their various schools.

Instrument

A questionnaire was designed to study the effect of prior ICT experience and technology self-efficacy on in-service science teachers' acceptance of digital videos in science education. The questionnaire consisted of twenty randomly mixed items addressing variables which include prior ICT experience, technology self-efficacy, perceived ease of use, and perceived usefulness as shown in table 1. Individual differences which are external to the TAM were measured with items on prior ICT experience, technology self-efficacy whereas items on perceived ease of use, and perceived usefulness were measuring perceptions which are internal to the TAM.

The items for the variables were adapted from previous studies of the TAM to ensure content validity and modified to meet the specific demands of the research project. Perceived ease of use and perceived usefulness was measured using items from prior research by Kim et al. (2009) whereas items about technology self-efficacy and prior ICT experience were adapted from research by Bourgonjon et al. (2010); Lamb et al. (2014). All items are based on a five point Likert scale, ranging from one (strongly disagree) to five (strongly agree). A pilot study was done with fifty pre-service science teachers at Bindura University of Science Education to assess the validity of the instrument. All items were found to be valid.

Table 1. Items related Prior ICT Experience (PICTE), Technology Self-efficacy (TSE), Perceived Ease of Use (PEU) and Perceived Usefulness (PU).

PICTE_3.	I rarely play digital videos in science lessons.
PICTE_ 9.	I have never used digital videos in science lessons.
PICTE_11.	I have played different types of digital videos in my science lessons.
PICTE_17.	I would describe myself as experienced in using computers, internet and projectors.
PICTE_20.	I often play digital videos in science lessons using a computer and projector.
TSE_5.	I would understand how to use videos in science lessons.
TSE_7.	I would navigate freely on internet for digital videos to use in a science lessons.
TSE_12.	I am confident that I would be able to use digital videos in science lessons.
TSE_14.	I would be competent on using digital videos in science lessons.
TSE_19.	I would overcome obstacles that occur when I use the digital videos in science lessons.
PEU_2.	Learning to use digital videos would be easy for me.
PEU_10.	I would find it easy to operate features of digital videos during science lessons.
PEU_15.	I would find it easy to get the digital videos to do what I want it to do.

PEU_16.	Interacting with digital videos during lessons would be easy for me.
PEU_18.	I would find the digital videos to be easy to use.
PE_1.	Using digital videos would improve my performance in teaching science.
PU_4.	I think digital videos would help my students to understand science.
PU_6.	Using digital videos would enhance effectiveness in my work.
PU_8.	I would find digital videos useful in my work.
PU_13.	Using digital videos would help me to explain abstract concepts in science.

Data collection

Data collection for the study was done in May 2016, over a time of two weeks. The researchers administered the questionnaire by visiting the respondents in their respective schools after seeking permission from the regional authorities. Research participants were invited to participate in the study and were provided with instructions for completing the task both in written and verbal form. According to the instructions in the written consent form, the participants were informed about the purpose of the study, confidentiality of their information, risks and benefits for participating in the study if they were available and their right to withdraw from the study at any time during and after the study. Participants took about ten to fifteen minutes to complete the questionnaires and the researchers had to collect them for data analysis.

RESULTS

In this section of the paper, results of the quantitative analysis are presented. The statistical results show the relationships among the study variables and the effects of the independent variables on dependent variables

Relationships among the study variables

The table 2 shows correlation (r) matrix of the relationship among the study variables. All the correlations are significant and positive. Strong positive correlations were found between technology self-efficacy and perceived ease of use (r = 0.73) and technology self-efficacy and perceived usefulness (r = 0.71). Moderate positive correlations were found between perceived ease of use and perceived usefulness (r = 0.54), prior ICT experience and perceived ease of use (r = 0.46) and prior ICT experience and technology self-efficacy (r = 0.38). Weak positive correlations were found between prior ICT experience and perceived usefulness (r = 0.32)

Table 2. Pearson correlation coefficients among the study variables

		PU	PEU	TSE	PICTE
PU	Pearson Correlation	1	.536**	.713**	.315**
	Sig. (1-tailed)		.000	.000	.006
	N	63	63	63	63
PEU	Pearson Correlation	.536**	1	.729**	.461**

	Sig. (1-tailed)	.000		.000	.000
	N	63	63	63	63
TSE	Pearson Correlation	.713**	.729**	1	.383**
	Sig. (1-tailed)	.000	.000		.001
	N	63	63	63	63
PICTE	Pearson Correlation	.315**	.461**	.383**	1
	Sig. (1-tailed)	.006	.000	.001	
	N	63	63	63	63

**. Correlation is significant at the 0.01 level (1-tailed).

b. Variables: PU (Perceived Usefulness), PEU (Perceived Ease of Use, TSE (Technology Self-Efficacy, PICTE (Prior ICT Experience).

Effects of the independent variables on dependent variables

Table 3 shows a multiple regression analysis in which perceived usefulness was set as a dependent variable and, prior ICT experience and technology self-efficacy as independent variables. The results of the multiple regression indicated that the independent variables explain 51 % of the total variance (R = 0.715, R Square = 0.511). Standardized regression coefficients (β) indicated the relative effect of the independent variables and they are as follows: technology self-efficacy (β = 0.694) and prior ICT experience (β = 0.049).

Table 3. Results of regression on Perceived Usefulness

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta (β)		
1	(Constant)	1.958	.343		5.714	.000
	TSE	.589	.083	.694	7.101	.000
	PICTE	.043	.085	.049	.500	.619

a. Dependent Variable: PU (Perceived Usefulness).

b. Predictors: (Constant), PICTE (Prior ICT Experience), TSE (Technology Self-Efficacy)

c. Model summary: R = 0.715, R Square = 0.511

Another multiple regression analysis was also conducted analysis in which perceived ease of use was set as a dependent variable and, prior ICT experience and technology self-efficacy as independent variables. Table 4 shows that the results of the multiple regression indicate that the independent variables explain 57% of the total variance (R

= 0.755, R Square = 0.570). Standardized regression coefficients (β) indicated the relative effect of the independent variables and they are as follows: technology self-efficacy (β = 0.648) and prior ICT experience (β = 0.212).

Table 1. Results of regression on Perceived Ease of Use

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta (β)		
1	(Constant)	.320	.402		.796	.429
	TSE	.688	.097	.648	7.071	.000
	PICTE	.232	.100	.212	2.317	.024

a. Dependent Variable: PEU (Perceived Ease of Use

b. Predictors: (Constant), PICTE (Prior ICT experience), TSE (Technology Self-Efficacy)

c. Model summary: R 0=.755, R Square = 0.570.

Lastly, a simple regression analysis was conducted in which technology self-efficacy was set as a dependent variable and prior ICT experience as an independent variable. Table 5 shows that the results of simple regression indicated that the independent variable explain 15% of the total variance (R = 0.383, R Square = 0.147). Standardized regression coefficients (β) indicated that the relative effect of the independent variable, prior ICT experience as (β = 0.383).

Table 2. Results of regression on Technology Self-Efficacy

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta (β)		
1	(Constant)	2.793	.390		7.163	.000
	PICTE	.394	.122	.383	3.242	.002

a. Dependent Variable: TSE (Technology Self-Efficacy)

b. Predictors: (Constant), PICTE (Prior ICT Experience)

c. Model summary: R = 0.383, R Square = 0.147.

DISCUSSION AND CONCLUSION

According Thong, Hong, & Tam (2002) the effects of external variables on intention to use are mediated by perceptions. Therefore this study was focused on investigating the effects of individual differences variables which

are external to the TAM on perceived ease of use and perceived usefulness. Figure 2 shows a proposed model which is based on the findings of this research.

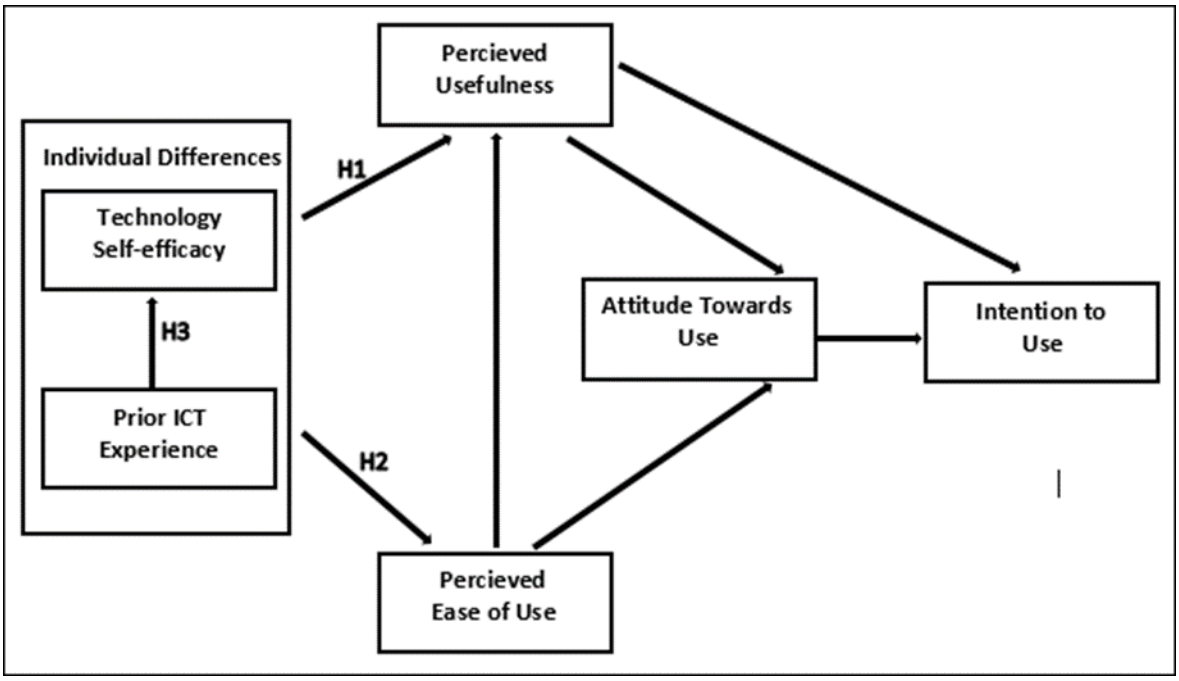

Figure 2. Proposed TAM based on research findings

Firstly, consistent with the hypothesis (H3, $\beta = 0.383$) of the study, prior ICT experience has a positive effect on technology self-efficacy about the use of digital videos in science education. The level of experience in using technology influences to a considerable extent, an individual's technology self-efficacy (Paraskeva, Bouta, & Papagianni, 2008). Moreover, the study had proved that prior ICT experience has a positive effect on ease of use (H2, $\beta = 0.212$). This is consistent with research by Bourgonjon et al. (2010) which have found that high level of prior ICT experience has a profound effect on ease of use ($b = 0.49$, $p < .001$). More ICT experience usually implies greater exposure to different types of applications and higher level of familiarity various ICTs which can help individual to learn how to use new technology like videos more easily (Thong et al., 2002). Therefore, higher level of ICT experience will lead to a higher level of perceived ease of use of digital videos in science education. In addition, prior ICT experience has a positive effect on perceived use of digital videos in science education (H1, $\beta = 0.05$). This is consistent with results of the research by Bourgonjon et al. (2010) which has also found that prior ICT experience has an effect on perceived usefulness ($b = 0.15$, $p < .001$.).

Consistent with hypothesis (H2, $\beta = 0.648$) of the study, technology self-efficacy has a positive effect on the ease of use of digital videos in science education. These results support prior research which has found that there is a direct relationship between technology self-efficacy and perceived ease of use (Hong et al., 2002; Thong et al., 2002). Users who have higher levels of confidence in using ICT in general are more likely to find the digital technology easy to use (Hong et al., 2002). Lastly, technology self-efficacy has a positive effect on perceived usefulness of digital videos in science education (H1, $\beta = 0.694$). In-service science teachers with a strong sense of technology self-efficacy will persist with their efforts and the result is that they are more likely to see digital videos being useful in their practice of teaching science (Teo, 2009)

In fact, this study contributes to the understanding of acceptance of digital videos in science education by demonstrating that Zimbabwean science teachers' individual differences have a positive effect on the perceptions of the TAM. All the effects of technology self-efficacy on perceptions are both strong and higher than that of prior ICT experience. Also, prior ICT experience has a positive effect towards technology self-efficacy in the use of digital videos in science education. Furthermore, the research has used quantitative analysis to study the acceptance of digital

videos in science education. This had provided an opportunity to explain the interaction and relationship among variables observed.

This study has several implications for science teachers and school administrators. Digital videos are not easy to use like emails, spreadsheets etc. for teachers with low levels of prior ICT experience and technology self-efficacy. They are little bit involving and a lot of effort is required to search, censor, edit and integrate them with other technologies. So there is need to enhance in-service science teachers with ICT background through training and staff development programs. Apart from this, the school administrators should provide access to a variety of technologies such as simulations, virtual labs, internet, iPads and computers to the in-service science teachers. This is meant to develop the in-service science teachers' technology self-efficacy, which is linked to prior ICT experience in the use of digital videos in science education (Paraskeva et al., 2008)

As for pre-service teachers, they should be provided with the ICT skills and experiences which are relevant to their future job as teachers whilst they are still students at universities and colleges. This study recommends that future teachers should be provided with a course for Educational Technology that will enable them to integrate technology as part of their instructional strategies. When pre-service science teachers have experienced the affordances of technology in their learning at college, they would expect technology integration to continue over and over time (Teo, 2009).

The study has some limitations because of the small sample size of sixty-three in-service science teachers. Therefore, it is limited on how to detect large differences between the measures of acceptance of digital videos in science education. Moreover, the use of perceptions rather than actual usage of digital videos in the study could have inflated the total variance explained by the study. This might give an overestimation of the study in terms of explaining the acceptance of digital videos in science education. Even though, perceived ease of use and perceived usefulness are constructs which have been reported to mediate all external variables to the TAM, there is a possibility that the effects may vary across different contexts and samples (Teo, 2009)

Future research could include an in-depth analysis on perceived usefulness of digital videos in science education. It has emerged that in the study prior ICT experience is limited in explaining the teachers' perception of the use of digital videos in science education despite teachers having different levels of prior ICT experience.

Author notes

Norman Karimazondo is a high school teacher in Zimbabwe. He did Bachelor of Science Education in Geography with Bindura University of Science Education, and postgraduate in Teacher Training Science and Technology with Odisee University College and Master of Research in Education and Training with Aix Marseille University. Currently, he is doing Master of Science Education in Geography with Bindura University of Science Education. His research interest is in the field of educational technology.

Please address correspondence regarding this article to Norman Karimazondo: Bindura University of Science Education, P. Bag 1020, Bindura Zimbabwe. E-mail address: nkarimazondo@gmail.com.

Dr. Jérémy Castéra is assistant professor at the Ecole Supérieure du Professorat et de l'Education at the University of Aix-Marseille in France. He obtained his PhD in 2010 from the University of Lyon in France. His research interest is in biology education and educational technologies.

Maria Antonietta Impedovo is a Teacher and Research Assistant in the School of Education at Aix-Marseille University in France. She has a PhD in Technological Education. Her research interests regard educational technology, teacher professional development and teacher identity.

Edistio Verdecia Martinez has a PhD in Pedagogical Sciences. Currently, he is working as an Associate Professor in the Computer Science Department at Bindura University of Science Education. His research interest are the application of artificial intelligence in education, programing language theory and soft computing

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