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Teachers' Adoption of Information and Communication Technology in Foundation Phase Teaching: A Study of Selected Schools in the Eastern Cape in South Africa

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ABSTRACT This paper aimed to evaluate the teachers' use of information and communication technology (ICT) as a means to improve teaching and learning of mathematics in disadvantaged contexts. Sixty teachers were selected from one district through convenience and stratified random sampling, and they responded to structured questionnaires. The predictors for teachers' integration of ICT comprised, possession of a computer record of word problems and exercises on a computer, regularly using the Internet to download word problems videos, transcriptions and exercise samples, and regularly using computer games to create enthusiasm among learners when tackling word problems. The analysis of data was done using both descriptive and inferential statistics. The results showed a lack of ICT resources in the selected schools and a shortage of teachers skilled in ICT use. The research contributed to technology acceptance model's (TAM) theoretical validity by recommending an integrative conceptual framework of system adoption.

INTRODUCTION

Today's kids live in the era of the Z generation (Reilly 2012). They are youngsters who were born after the data transformation, who are emerging and obtaining information and aptitudes in the time of quick mixed media and non-direct data, virtual reality situations, parallel biosphere and so on. Youngsters born in the 21st century generally consider ICT to be a basic piece of their living surroundings (Glusac et al. 2015).

A great part of the research on children and the Internet has concentrated on dangerous online encounters, for example, cyber bullying, introduction to explicit entertainment, and outsider methodologies, and studies have emphasised how concerned adults are about these online dangers and their inclination to belittle them (Byrne et al. 2014). Nevertheless, there is less research on how the Internet is utilised to do homework on mathematics word problems, and exploring wellbeing information. Previous studies have to a great extent disregarded the precision of teacher impressions of how as often as possible the Internet is useful to their learners for these reasons, and this paper sought to investigate and analyse the use of ICT in the foundation phase. Responding to the identified gap in previous studies, this paper developed an exploration model taking into account the TAM. In the current paper the TAM has been altered for the most part to affirm the relationship between the TAM pillars and in addition the impact of moderators suggested in this paper.

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Statement of the Problem

Despite the fact that the South African education system has thought about the necessities of ICT integration in classrooms and invested a huge amount of money on ICT hardware in higher education, there is still a stereotyped teacher-driven mathematics pedagogy phenomenon particularly in the rural section of South Africa. Along these lines research on ICT should show an important commitment to perceive the viability of this helpful learning resource.

Objective of the Study

The study aimed to investigate teachers' use of ICT in teaching mathematics word problems in the foundation phase.

Theoretical Framework

From the research conducted on ICT, numerous hypotheses have been proposed to clarify the relationship between determinants that would influence technology adoption. The most widely recognised elements are perceptions, users' attitudes, beliefs, and the real ICT use. Theories such as, the theory of planned behaviour (TPB) (Fishbein and Ajzen 1975), diffusion of innovation (Rogers 1995), the model of IS success (DeLone and McLean 2003), measurement and analysis of computer user satisfaction (Doll and Torkzadeh 1988), and the unified theory of acceptance and use of technology (Venkatesh et al. 2012), are well known models utilised in the context of computer innovation. A large portion of these models, in any case, concentrate on just mechanical factors.

The TAM is perhaps the most generally utilised model as a part of the field of information systems for measuring technology adoption, and its high legitimacy has been demonstrated for all intents and purposes in numerous studies conducted in the past. In spite of the fact that the TAM is a surely understood and tried hypothesis in the field of information systems, utilising the TAM as a part of foreseeing and clarifying ICT usage has so far gotten little consideration.

The TAM was initially presented by (Davis 1986) around the idea of technology acknowledgment. The TAM places that acknowledgment of another ICT can be anticipated in view of users' behavioural intention (BI), Attitude towards use (A), and two other internal convictions: perceived usefulness (U) and perceived ease of use (E). Perceived usefulness is defined as "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organisational context" and perceived ease of use as "the degree to which the prospective user expects the target system to be free of effort" (Davis 1989: 985).

In line with the TAM, behavioural intention characterises the genuine use of a given information system and in this way decides ICT adoption. The users' attitudes and perceived usefulness together impact behavioural intention. Additionally, the TAM hypothesises that perceived usefulness and perceived ease of use are influenced by outside variables. Along these lines, perceived usefulness (U) and perceived ease of use (E) intervene the impact of outer variables on the person's attitude and behavioural intention, and hence the real use of ICT.

Significance of the Study

The importance of this paper comes from different contemplations. In the first place, no research in the past has tried to examine teachers' behavioural goal to utilise ICT and essentially verify the technology acceptance model in the Eastern Cape primary schools. Also, the consequences of this paper may give more knowledge into teachers' views of ICT. Further, this paper may lay a foundation for future research on technology use within the foundation phase setting in South Africa.

Research Hypothesis

The TAM proposed the accompanying relationship among its core concepts: a) Perceived usefulness will influence the teacher's intention to use ICT to teach mathematics. In this paper, perceived usefulness is characterised as the extent to which an employee trusts that utilising ICT would upgrade his or her occupation execution, while perceived ease of use is characterised as the extent to which teachers trust that figuring out how to utilise ICT requires a moderately low level of exertion.

In this way, the relationship between perceived usefulness and behavioural intention is theorised as follows:

- H_a1 Perceived usefulness will influence the teacher's intention to use ICT to teach mathematics.

METHODOLOGY

The study was quantitative in nature and employed close ended questionnaires for data collection.

Respondents

The respondents in this study were 60 foundation phase teachers who voluntarily participated in the investigation. All respondents were teachers working in public schools under the Eastern Cape Department of Basic Education.

Sampling Technique

Although it is hard to get reactions from the entire population, sampling is an endeavour to reach an inference in light of a little representation in a given population (Jemain et al. 2007). Convenience sampling was used to select the 10 research sites. Convenience sampling is utilised as a part of numerous studies exploring technology innovation. Moreover, the strategy is utilised to guarantee a superior response rate in a short measure of time. Lastly, it is in contradiction of ethical measures to obtain teachers' contacts and email addresses from the Department of Education henceforth, convenience sampling was the ideal technique to be used in this study. The sampling technique used to select the individual respondents in this study was stratified random sampling.

Instrumentation

A structured questionnaire consisted of six main sections with ten sub-variables in each section. The main section incorporated a nominal scale to classify the demographic information of the respondents. The following section (teachers' attitudes), third (teachers' awareness) and fourth section (perceived usefulness) used a 4-point response scale where 1: Strongly disagree, 2: Agree, 3: Disagree, and 4: Strongly Disagree. All the sections included TAM constructs. The fifth section (perceived ease of use) used a 4-point scale where 1: Very easy, 2: Easy, 3: Difficult, and 4: Very difficult. The last section on Teachers' use of ICT also used a 4-point scale where 1: More often, 2: Often, 3: Seldom, and 4: Very seldom.

Questionnaire

To guarantee content legitimacy, the questionnaire utilised as a part of this paper was adjusted from the first estimation scales utilised as a part of TAM and from other writings with a few adjustments and the fundamental wording changes and approval to fit the setting of ICT use (Sánchez and Hueros 2010). To maintain a strategic distance from issues that can happen in wording, estimation and vagueness, the survey was piloted on two teachers. Sekaran and Bougie (2010) maintain that a pilot study is vital on the grounds that wording issues altogether impact precision.

Data Collection

The questionnaires were distributed to schools at the beginning of August in 2014. The questionnaires were conveniently distributed to the selected schools after permission was granted by school principals. The respondents had no option to switch between English and their mother tongue during the survey. All the 60 questionnaires distributed were returned after several phone calls and personal attempts to collect them were made. Out of that, all the 60 answers generated legitimate reactions that were utilised in the data analysis. The general reaction rate was 100 percent.

RESULTS

Demographics

The respondents were the same as far as gender is concerned, with 60 (100%) females ranging from <30 to >60. This might emanate from gender stereotypes that men should be at work and that women should be at home with the family. The majority (48.3%) of respondents were between 40 and 49 years, with 31.71percent from 50 to 59, 10 percent from 30 to 39, 5 percent from 50 to 59, and 5 percent below 30 years.

The study explored the importance of utilising TAM on two gatherings: client bunch and non-client bunch. All the respondents were selected from township schools (semi-urban) all of the respondents (100%) had not used ICT for pedagogical purposes, while they varied in their access to computers and Internet connection.

Teachers' Use of ICT

Pearson correlation analysis was conducted to determine the level of relationship among ten sub variables of teachers' daily use of ICT (job applicability) and their behavioural intention to integrate ICT into teaching. The sizes of correlations to indicate the ranges of largeness, the smallness or the moderateness were regarded as follows (Cohen et al. 2007): Small: $r = 0.1$ to 0.3; Moderate: $r = 0.4$ to 0.6; Large: $r = 0.7$ to 0.9; and Perfect correlation: $r = 1$.

Table 1: Correlation analysis for Job applicability

		VAR 51	*VAR 52*	*VAR 53*	*VAR 54*	*VAR 55*	*VAR 56*	*VAR 57*	*VAR 58*	*VAR 59*	*VAR 60*
VAR 51	Pearson Correlation	1									
	Sig. (2-tailed)										
	Sum of Squares and Cross-products	38.850									
	Covariance	.658									
VAR 52	Pearson Correlation	.790**	1								
	Sig. (2-tailed)	.000									
	Sum of Squares and Cross-products	27.300	30.733								
	Covariance	.463	.521								
VAR 53	Pearson Correlation	.766**	.813**	1							
	Sig. (2-tailed)	.000	.000								
	Sum of Squares and Cross-products	27.400	25.867	32.933							
	Covariance	.464	.438	.558							
VAR 54	Pearson Correlation	.552**	.648**	.500**	1						
	Sig. (2-tailed)	.000	.000	.000							
	Sum of Squares and Cross-products	24.850	25.967	20.733	52.183						
	Covariance	.421	.440	.351	.884						
VAR 55	Pearson Correlation	.871**	.802**	.866**	.502**	1					
	Sig. (2-tailed)	.000	.000	.000	.000						
	Sum of Squares and Cross-products	30.150	24.700	27.600	20.150	30.850					
	Covariance	.511	.419	.468	.342	.523					
VAR 56	Pearson Correlation	.813**	.770**	.866**	.477**	.935**	1				
	Sig. (2-tailed)	.000	.000	.000	.000	.000					
	Sum of Squares and Cross-products	28.150	23.700	27.600	19.150	28.850	30.850				
	Covariance	.477	.402	.468	.325	.489	.523				
VAR 57	Pearson Correlation	.611**	.671**	.706**	.455**	.669**	.697**	1			
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000				
	Sum of Squares and Cross-products	24.300	23.733	25.867	20.967	23.700	24.700	40.733			
	Covariance	.412	.402	.438	.355	.402	.419	.690			
VAR 58	Pearson Correlation	.831**	.737**	.798**	.475**	.865**	.804**	.560**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000			
	Sum of Squares and Cross-products	30.600	24.133	27.067	20.267	28.400	26.400	21.133	34.933		
	Covariance	.519	.409	.459	.344	.481	.447	.358	.592		
VAR 59	Pearson Correlation	.686**	.676**	.758**	.473**	.713**	.740**	.707**	.606**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000		
	Sum of Squares and Cross-products	28.050	24.567	28.533	22.383	25.950	26.950	29.567	23.467	42.983	
	Covariance	.475	.416	.484	.379	.440	.457	.501	.398	.729	
VAR 60	Pearson Correlation	.393**	.474**	.479**	.658**	.380**	.401**	.430**	.367**	.393**	1
	Sig. (2-tailed)	.002	.000	.000	.000	.003	.001	.001	.004	.002	
	Sum of Squares and Cross-products	20.950	22.433	23.467	40.617	18.050	19.050	23.433	18.533	22.017	72.983
	Covariance	.355	.380	.398	.688	.306	.323	.397	.314	.373	1.237

**. Correlation is significant at the 0.01 level (2-tailed).

As shown in Table 1, there was a large positive relationship found [r (60) = +0.790, $p < 0.01$] between keeping a computer database of word problem examples and exercises on a personal computer, and regular use of internet to search and download word problems, videos, notes and practice examples to use in the classroom. The teachers were way behind effective pedagogy on mathematics. This could be due to the fact that one school was remote in terms of geographic position for vehicles and internet bandwidth to reach.

There was a large positive correlation found [r(60) = +0.813, $p < 0.01$] between regular use of internet to search and download word problems, videos, notes and practice examples to use in the classroom, and regular use of online games to make word problem lessons exciting. In one school, the entire school had just three tablets with no modems that were totally not enough for covering three classes (grade 1 to 3). It would at least be expected to ensure no less than one computer with a modem in each classroom for the perfect utilisation of ICT.

The results portrayed a moderate positive correlation [r(60) = +0.500, $p < 0.01$] between regular use of online games to make word problem lessons exciting, and regular communication with other teachers via SMSs, emails, blogs and forums to seek teaching advice, share ideas, receive teaching materials etc. Appropriate usage of the available resources in all the schools was a concern. One school had four personal computers with a modem which they bought over a period of four years, and they were not used for teaching instead they were used for typing question papers for tests.

The study found a moderate positive correlation, [r(60) = +0.502, $p < 0.01$] between regular communication with other teachers via SMSs, emails, blogs and forums to seek teaching advice, share ideas, receive teaching materials etc., and regular use of presentation applications to design colourful slide shows for delivering word problem lessons.

A large positive correlation was found [r(60) = +0.935, $p < 0.01$] between regular use of presentation applications to design colourful slide shows for delivering word problem lessons, and regular use of personalisation software to generate individualised word problem exercises for learners.

A moderate positive correlation was found [r(60) = +0.697, $p < 0.01$] between regular use of personalisation software to generate individualised word problem exercises for learners, and regular sending of SMSs and emails to the parents of learners to give them feedback on their children's progress.

The study found a moderate positive correlation, [r(60) = +0.560, $p < 0.01$] regular sending of SMSs and emails to the parents of learners to give them feedback on their children's progress, and regular use of spread sheet applications to capture learners' marks and to analyse their strengths and weaknesses in word problems.

A moderate positive correlation was found [r(60) = +0.606, $p < 0.01$] between regular use of spread sheet applications to capture learners' marks and to analyse their strengths and weaknesses in word problems, and regular use of word processors for word problem test materials and class notes. Even though it was a requirement that capturing of learners' marks be done on a computer, teachers were still non-compliant.

A small positive correlation was found [r(60) = +0.393, $p < 0.01$] between regular use of word processors for word problems test materials and class notes, and regular use of photo-copying machine for word problem worksheets, exercises and class notes. Most teachers in the foundation phase had a low academic profile to lead intuitive classes to rouse learners to their most extreme fulfilment.

Validity and Reliability

Notwithstanding the strides mentioned earlier to assess the instrument's legitimacy and reliability, a further test was performed. Reliability assessment was done using Cronbach's Alpha (Cronbach 1951). Dependability concerns inward consistency between various estimations of variables, and Cronbach's Alpha is ordinarily used to gauge it (Hair et al. 2006).

George and Mallery (2003:231) give the accompanying general guidelines for Cronbach's unwavering quality measurements: "≥ 0.9 = Excellent, ≥ 0.8 = Good, ≥ 0.7 = Acceptable, ≥ 0.6 = Questionable, ≥ 0.5 = Poor, and ≤ 0.5 = Unacceptable". While expanding the estimation of alpha is in part subordinate upon the quantity of items in the scale, it ought to be noticed this has unavoidable losses. It ought to likewise be

noticed that an alpha of 0.8 is most likely a sensible objective.

In this paper, the quality appraisal was done through Statistical Package for Social Sciences (SPSS) version 22. All measures in this paper demonstrate an abnormal state of unwavering quality, running from 0.929 to 0.951, with an agreeable estimation of 0.940 for behavioural aim to utilise ICT. All measures exceeded 0.70, and therefore the questionnaire was considered reliable.

Data Analysis and Testing of Hypothesis

The aim of data analysis was to give a thorough correlational examination and afterward explore the effect of preceding knowledge on the relationship significance. In accordance with the study objective, Pearson correlations were used to analyse the relationship between the variables used for perceived usefulness and job applicability. Moreover the one-way ANOVA was used to essentially choose whether or not to acknowledge or reject the invalid theory. The construction of the hypothesis testing was as per the following. To start with, the theory was tested taking into account the measure of the entire sample. Lastly, the study examined the part of practice, and along these lines the hypothesis was verified on both users of ICT and non-users of ICT.

As indicated in the results in Table 2, the *p* value for perceived usefulness was significant at the level of $p < 0.05$. This study failed to reject the alternative hypothesis which stated that "Perceived usefulness will influence the teacher's intention to use ICT to teach mathematics".

DISCUSSION

ICT Integration in South African Schools

The results represent some important aspects that are supplementary to the understanding of teacher-child contrasts. To start with, teachers tend to misjudge how frequently their learners can use the Internet to do homework and assignments. It is essential to put this finding into the point of view of prior research, which demonstrates that teachers think little of how frequently their learners utilise ICT for hazardous online encounters, for example, online harassing (Byrne et al. 2014). In other words, it is not just that teachers are overestimating how accommodating the Internet can be, they are likewise thinking little of ways it can be unfavourable to their learners' advancement. Speaking to the absence of teacher mindfulness and parental control over impacts within the bigger biological techno-subsystem, these two findings may represent an example of idealistic predisposition, an unlikely conviction that one's child is less at danger while online than others.

The South African Education system is continually changing as per the Department of Education necessities, for example, the advancement of 21st century learning results which permit learners to utilise data in distinctive settings (Department of Education 2002; Law and Chow 2008b). The teaching of mathematics is an irreplaceable piece of the educational modules and satisfies an essential part in the advancement of higher order thinking aptitudes to perform particular undertakings for the accomplishment of significant pedagogical results, conceptualisation, deliberation, speculation, critical thinking and data handling (Nieuwoudt and Golightly 2006). The main objective is to equip learners to (1) have an intense familiarity with how scientific connections are utilised as a part of social, ecological, social and financial relations; (2) encourage an affection for mathematics; (3) perceive that mathematics is an inventive piece of human action; (4) acquire significant hypothetical understandings keeping in mind the end goal to comprehend science; and (5) apply mathematics in physical, social and numerical issues (DoE

Table 2: One-way ANOVA for perceived usefulness

		Sum of squares	*df*	*Mean square*	*F*	*Sig*
Between people		187.858	59	3.184		
Within people	Between items	112.375	9	12.486	23.702	.000
	Residual	279.725	531	.527		
	Total	392.100	540	.726		
Total		579.958	599	.968		

Grand Mean = 2.5583

2002). The utilisation of ICT gives platform to the financial advancement and building of greatly required aptitudes in a recently industrialised nation (Marais 2009).

The e-Education White Paper specifies a three-stage plan to have a completely incorporated ICT framework into all circles of training, organisation, administration and pedagogy, by 2013 (DoE 2004). However, in this paper it could be stated that this has not happened as planned due to lack of resources in schools. As the position of mathematics education is a highly contested issue in South African schools, all the stakeholders in education need to pay heed to the past discoveries from studies done in South Africa on the fact that we need ICT to be incorporated into our education system if we want to compete with the rest of the world (Prew 2013). In any case, simply bringing ICT into education is not adequate to guarantee its viable use for teaching and learning.

Generally, the statistical analysis demonstrates that the outcomes of the present study are in line with the TAM conclusions. All TAM-related theories used in this paper were demonstrated to have positive connections that are empirically significant. In accordance with different studies, the respondents included in this study demonstrated optimism towards the use of ICT, and they expected to utilise it in future. The study shows that when the teachers' dispositions build, the acceptance and use of ICT improves. Of course, when teachers saw ICT as simple to utilise, the results demonstrated confidence towards using it. Despite what might be expected, the perceived usefulness expanded the level of disapproval of ICT use, which later influenced the behavioural expectation to utilise ICT. Remarkably, the results did not fluctuate among the respondents from all the designated primary schools. From the statistical information it was evident that the non-users of ICT did not demonstrate a higher aim towards utilising ICT, hence we incorporated the lack of ICT resources and job applicability.

Job applicability, adapted from (Venkatesh et al. 2003) showed mostly large positive relationships towards ICT adoption and use in the classroom. Teachers understood that the utilisation of ICT for education is appropriate to their employment and is a valuable matter. Nonetheless, the absence of ICTs influenced the teachers' goal to utilise ICT in their classrooms. From the responses obtained from the questionnaires, the teachers viewed ICT as a difficult resource to use. Education background and gender did not correspond altogether with the other variables; the results indicate that the two did not reveal a huge relationship with the different TAM constructs.

CONCLUSION

Broadly, this paper adjusted the original TAM so as to quantify the teachers' utilisation of ICT. The paper adjusted the centre develops utilised as a part of TAM and particularly, validated the relationship between the teachers' incorporation of ICT, and general effect on the teachers' aim towards utilising ICT as a part of the future. This paper further affirms the relevance of the TAM in the African context, particularly in South African primary school settings.

Initially, the exclusive situation in which information was gathered affected the theoretical structure of this study. As recommended by TAM, this paper has incorporated external variables including absence of ICT resources in schools and job applicability. The teachers' absence of access to ICT during the information accumulation stage was expected to apply a directing impact on the relationship between TAM constructs, particularly their acceptance of ICT. The results demonstrate that the inaccessibility of ICT in schools implied that, teachers viewed the use of ICT as a challenge. The other variable, job applicability, also demonstrated to have a solid association with TAM constructs. Specifically, job applicability within the school primary school context absolutely influenced the teachers' acceptance of ICT. The role of ICT knowledge use was additionally explored in their day by day classroom exercises. The general results for both trained and untrained users affirm the first TAM discoveries. Inside of the study setting, untrained users demonstrated a lower level of ICT reception and use.

RECOMMENDATIONS

The recommendations of this paper are as follows. Firstly, this paper has proposed a theoretical framework based on a vigorous technology acceptance model (TAM). This model can be utilised to anticipate the behavioural goal to utilise ICT even preceding the genuine usage.

Additionally, the technology acceptance model could be tested within one group of ICT users in the foundation phase. Secondly, while a lot of research will keep on examining how learners become vulnerable through the use mobile technology, it is additionally vital to proceed with work on how learners in the foundation phase are utilising ICT in beneficial ways.

RESEARCH LIMITATIONS AND FUTURE RESEARCH

The outcomes of the study propose that the sample size ought to be expanded, as a bigger number of respondents would make conclusions more broad. Likewise, the research model was intended to be utilised with computer technologies. This study was constrained by time and, the results may not be significantly summed up for different reasons. Future research could focus on overall ICT use for teaching and learning. Also, gathering information from distinctive groups could be influenced by the increment of use and experience of users. In this manner, longitudinal exploration may be more suitable to better foreseeing behaviour and attitude, and subsequently encouraging complete comprehension of the connections between variables. Thoughts for studies include: further investigation of the collected information, a personalised programme for teaching of word problems, and learners' acceptance of ICT for mathematics and for word problems in particular. Finally, other measurable tests, for example, structural modelling and factor analysis could be done to affirm the variables' strength.

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