Digital Competencies Required by Teachers when Integrating ICT and Using E-Books in the midst of COVID - 19 Education

Armstrong Siboniso Simelane, Desmond Govender
Department of Computer Science Education, College of Humanities
Faculty of Education, University of KwaZulu-Natal, South Africa

Abstract

The integration of information and communication technology (ICT) and usage of E-Books in schools remains a mammoth task for teachers in a number of countries in Sub-Saharan Africa. Teachers lack the necessary skills to integrate ICT and use E-Books. ICT integration thematic experts are trying to find out which digital competencies are required by teachers to integrate ICT and use E-Books in digital education efforts to meet the COVID-19 challenges. This paper reports findings from a study that collected both qualitative and quantitative data on this subject. Qualitative data analysis and exploratory factor analysis of the collected data indicated 11 digital competencies required of teachers to integrate ICT and use E-Books. The study found that the teachers are highly proficient in 4 of these competencies. The study established that there is a need to train in-service teachers on how to integrate ICT in the classroom. The professional development of teachers should focus on developing teachers' competencies in desktop publishing / graphic designing; web quest designing; accessing the internet; multimedia skills; saving a document; composing questions; encrypting; participation in an ICT community of practice; and hyper-linking. This will enable teachers to access, produce, annotate, store, and also publish E-Books.

1. Introduction

The educational need to integrate information and communication technology and use E-Books dominates the post COVID–19 education agenda. ICT offer great and new possibilities for learning while at the same time creating new challenges for pedagogy and ICT illiterate subject teachers. Studies have shown that over the last two decades colleges and universities have adapted and successfully appropriated the internet, email, chat rooms, instant messaging, course management software, podcasts, personal digital assistants, and much more [7]. This study covers the same angle for high schools now that Digital Education, ICT integration and the use of E-Books has become a priority. Teachers cannot integrate ICT and use E-Books unless they are digitally competent. [2]. *Global standards such as those set by the Millennium Development Goals,* 2030 *Sustainable Development Goals, Agenda 2063 and now the General Education Quality Assessment Framework of UNESCO requires that teachers should be relevant, competent and equal to the task [6]. In this connection teachers should have professional competence in using ICT proficiently, digital fluency to integrate ICT strategically in the classroom, and entrepreneurial understanding to use ICT innovatively as a factory of solutions in classrooms. This will expedite the migration from chalkboard to digital classrooms. The purpose of this study was to find out whether teachers use E-Books to ingrate ICT and to understand which ICT skills and digital competencies are required by teachers to integrate ICT and use E-Books.*

2. Research Rationale

Even before schools were grounded by the pandemic the integration of ICT and usage of E-books was identified as a strategy to reduce drop out rate. Apart from pregnancy, repetition, sickness and transfer; the escalating rise of school fees is one of the major reasons cited by school Principals why learners drop school. In the Kingdom of Eswatini two learners leave at primary school level and one at high school level leave on a daily basis [3]. A closer look at school fees has shown that the second biggest portion of school fees goes towards purchasing printed paper bound textbooks in hard copy format, yet an alternative can be available in an electronic, paperless, soft copy format.

Further more in-depth analysis of school fees has also shown that money paid for academic textbooks is a major contributor to the escalating increase in school fees, other than paid services such as first aid, sports, speech day and television. Money paid towards purchasing textbooks for book rentals ranges from an average of E600.00 to E4000.00 per child per annum in selected schools. One of the latest research in the integration of ICT in mathematics and science classrooms found that the major crosscutting obstacle why teachers do not integrate ICT is lack of digital learning materials in the form of E-Books [10]. This study therefore seeks to understand the role of E-Books in schools and whether teachers in Eswatini have the necessary ICT skills and competencies to use E-Books in the midst of the COVID-19 pandemic.

3. Research Questions

The study research questions were:

- Which digital competencies are required by teachers when integrating ICT and using E-Books?

- Why teachers have not used E-Books?

- How are the proficiency levels of teachers in ICT?

4. Research Methodology

The study was both qualitative and quantitative in nature. The mixed-methods research approach was employed to acquire an understanding of not only the 'what' but also the 'why' [7]. The answers to the 'what happened' part of the main research question were a product of quantitative methods, and answers to the why it happened part were a product of the qualitative methods.

This study drew and built upon the synergy and strength that exists between quantitative and qualitative methods in order to fully understand the phenomenon. Another benefit achieved was that of triangulation [1].

Data collection employed questionnaires and focus group discussions. The average reliability for the four questionnaires was 0.96 and the response rate was 85%.The survey technique applied in this study focused on 44 schools in Eswatini, with 124 participants in all.

Quantitative data was analysed through descriptive statistics and exploratory factor analysis. Use of loadings, Eigen values, Kaiser Meyer Olkin (KMO) measure of sampling adequacy, and Bartlett's Test of Sphericity (BToS) determined significant correlations between items [4]. Representing variables were developed using principal components analysis, which identified common components underlying a set of items in the survey data. Using this approach it was possible to condense the information contained in the original variables into a smaller sets. A set of indicators was then grouped and a score calculated for each of the domains and constructs.

The exploratory factor analysis confirmed the structure of the data and enabled selection of the strongest indicators of each construct. When determining which items to select to represent each latent construct, the factor loading were taken into account along with how well the items related to the overall construct of the latent factor. The factor analysis was conducted using the principal component method of extraction and varimax rotation. Acceptable sample sizes for yielding reliable factors were realized with a KMO measure closer to 1. Values of KMO that were accepted were above 0.5 and an a priori level of 0.001 was set in accordance with the Kaiser criterion [4].

Qualitative data analysis (QDA) looked for common understandings, connections, consensus and values. The focus group discussion (FGD) members were drawn from the three subject panels: Science, Mathematics and ICT. The data was coded, classified and categorized into themes. The researcher focused on emerging themes, patterns and key ideas as the data were crystallized through spider diagrams. The findings were presented in tabular, graphical (pyramids) and narrative format in line with the law of parsimony.

5. Results

Descriptive statistics were first used to analyze the quantitative data. Table 1 indicates the gender and job categories of the respondents. It can be seen that most of the respondents were male (72%)

The results showed that 75% of the Principals, 90% of the Mathematics teachers, 64% of the Science teachers and 18% of the ICT teachers had never used E-Books in their teaching

5.1. Age and ICT profile of respondents

Table 1 indicated that Principals had the highest percentage of the oldest respondents (41–50 years) being 50% and ICT teachers had the highest percentage of the youngest respondents (22–30 years) being 70%. With the Mathematics and Science teachers having 10% and 5% respectively of the respondents left with more than 10 years before reaching the mandatory age (60 years) of retirement. It could still pay off to invest in training this group on how to integrate ICT and use E-Books because most of them (90%) can still serve the education system.

5.2. E-Books usage

As shown in Table 1 the ICT teachers (82%) were the biggest group of teachers using E-Books.

Table 1. Usage of E-Books by Teachers according to Age, Gender and Subject categories of Respondents (n=124)

Age, Gender and Subject categories of Teachers	Have Not Used E-Books	Have Used E-Books	Totals
21- 30 years	16%	27%	43%
31- 40 years	24%	5%	29%
41- 50 years	9%	7%	16%

51- 60 years	9%	3%	12%
Total 1	**58%**	**42%**	**100%**
Male Teachers	39%	35%	72%
Female Teachers	19%	7%	26%
Total 2	**58%**	**42%**	**100%**
Science Teachers	64%	36%	100%
Mathematics Teachers	90%	10%	100%
ICT teachers	18%	82%	100%
School Principals	75%	25%	100%

5.3. Digital Competencies

Table 2 summarize the digital competencies discussed by subject teachers during the focus group discussions. The table indicates that the subject teachers highlighted 7 digital competencies to be required when using E-Books including hyperlinking, encrypting and accessing the internet.

The four common required digital competencies when using E-Books for all three groups of subject teachers are starting a program, typing, desktop publishing and web quest designing. Mathematics teachers included hyperlinking and participation in the ICT community of practice, while Science teachers listed encrypting and ICT teachers suggested multimedia skills and accessing the internet as additional competencies that were required when using E-Books.

Table 2. Views of Teachers on Digital Competencies Required when using E-Books Usage

MATHS TEACHERS VIEWS	SCIENCE TEACHERS VIEWS	ICT TEACHERS VIEWS
Starting a program	Starting a program	Opening and Saving documents
Typing Skills	Typing Skills	Typing Skills
Scanning	Graphic Design	Desktop publishing
Web quest design	Encrypting	Web quest design
Hyperlinking		Accessing the internet
Participation in an ICT community of Practice		Multimedia Skills

5.4. Proficiency levels in ICT

Table 3 presents the results on proficiency levels of the subject teachers. The results indicate that subject teachers of mathematics and Science are highly proficient in four digital competencies. This is switching the computer on and off; starting a program; Typing skills and multimedia skills which generally involves playing music. The subject teachers were found to be not-proficient in scanning, graphic design, accessing the internet, web quest design, hyperlinking, encrypting and visual presentation.

It is clear why the subject teachers during the FGDs expressed the need for in-service and professional development. The FDG|s emphasised that any intervention training to help teachers integrate ICT to use E-Books should focus on developing teachers' competencies in the following seven areas:

a) Desktop publishing / graphic designing

b) Web quest designing

c) Accessing the internet and saving a document

d) Multimedia skills

e) Composing questions

f) Encrypting

g) Participation in an ICT community of Practising hyperlinking

Table 3. Proficiency levels in using E-Books

Digital Competencies	Mean / SD	Final response Result
Switching the computer on and off	. 2 / 1.13	Highly proficient
Starting a program	. 2 / 1.13	Highly proficient
Typing skills	3.8 / 1.	Highly proficient
Multimedia skills	3.8 / 1.	Highly proficient
Scanning	3.0 / 1.11	Not proficient
Graphic design	3.0 / 1.11	Non proficient
Accessing the internet	2.8 / 1.12	Not proficient

Accessing the internet	2.8 / 1.12	proficient
Web quest design	2.8 / 1.12	Non proficient
Hyperlinking	2.8 / 1.12	Not proficient
Encrypting	2.8 / 1.12	Not proficient
Visual presentation	2.8 / 1.12	Not proficient

Response options on level of proficiency
1. Not proficient   4. Proficient
2. Very low proficiency   5. Highly proficient
3. Low proficiency

6. Thematic areas and constructs in ICT integration

The Table 4 summarises the digital competencies required by teachers into four thematic areas. The Table illustrates the Eigen values and correlation varimax for the high-loading principal components.

The Teachers indicated during the FDGs that they need workshops:

".. Conduct workshops to help teachers on how to use the E-Books".

Table 4. Loading components in ICT integration

Description of construct	Correlations varimax (KMO) BToS	Eigen values	Loading components yielded labels
Opening a document	0.873 (0.5)**	13	**Operation** (6 variables)
Typing skills	0.874 (0.5)**	3	**Computing** (7 variables)
Scanning and graphic design	0.811 (0.5)	2	**Integration** (4 variables)
Accessing the internet, composing questions, hyperlinking and encrypting	0.774 (0.5)**	1	**Digitising** (3 variables)

*** Acceptable sample size to yield reliable factors.*

The ICT specialist or trainer which is considered an extremely important facilitating condition will be able to organize the workshops following the four thematic areas.

The Figure 1 illustrates the digital competencies required by teachers hierarchically. At the base of the pyramid is computer operation followed by computing, integration and digitising at the apex of the pyramid.
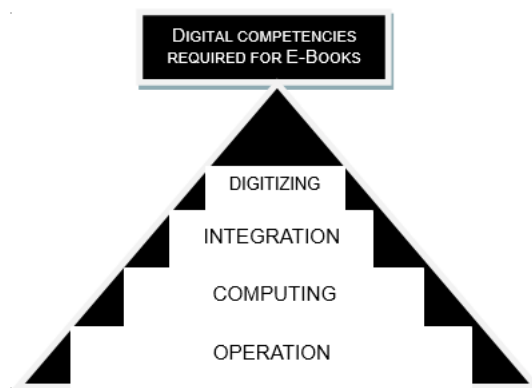

Figure 1. Thematic areas and constructs for competent teachers and learners

7. Why teachers have not used E-Books

In addition to phobia and attitude as impediments the FGDs included poor infrastructure in most schools, lack of skills, and little knowledge to reasons that have made teachers not to use E-Books. The major cross-cutting reasons teachers have not use E-Books are as follows:

- Lack of appropriate skills

- Non-usage by other schools and

- Lack of computer access and Internet

Margaryan [8] also established that E-Books are not used by teachers because of the following:

- Lack of appropriate digital skills

- User resistance and reluctance to change

- Poor ICT infrastructure which includes lack of networked computers, document scanners and internet.

- Phobia and attitude

- Lack of initiative by administrators and

- Lack of role models to follow

Iluzada [5] demonstrated that pedagogical and technical readiness of teachers and administrators is an important facilitating condition if teachers are to

integrate ICT in their practice and use E-Books. In relation to the teachers' pedagogical beliefs and technical readiness, the results from the factor analysis have shown that for teachers to use E-Books the following are required:

- Digital competencies

- Model to follow when using E-Books and

- ICT infrastructure

It was interesting to note during the FDGs that the use of E-Books by subject teachers was not depended on learners ICT skills but on digital competencies possessed by teachers. The research learnt from the FDGs that most learners being digital natives are intuitive and need to be introduced to the E-Books and then can learn faster on their own.

8. Conclusion

As previously stated, the purpose of the study was to evaluate whether teachers in Eswatini have the necessary ICT skills and competencies to use E-Books .The research revealed vital information on digital competencies required by teachers when integrating ICT and using E-Books. The study explained the ICT proficiency levels of teachers and why Eswatini teachers have not used E-Books.

The 11 digital competencies required when using E-Books are switching the computer on and off; starting a program; typing skills; multimedia skills; scanning; graphic design; accessing the internet; web quest design; hyperlinking; encrypting and visual presentation.The four common required digital competencies when using E-Books for all three groups of subject teachers of mathematics, ICT and science are starting a program, typing, desktop publishing and web quest designing. Mathematics teachers included hyperlinking and participation in the ICT community of practice, while Science teachers listed encrypting and ICT teachers suggested multimedia skills and accessing the internet as additional competencies that were required when using E-Books. The teachers were highly proficient in only two competencies: operating a computer (switching it on and off) and opening and closing a program.

The proficiency level of the remaining competencies, including accessing the internet was minimal. Any professional development intervention should therefore focus on developing teachers' competencies in the following nine areas: desktop publishing/graphic designing, web quest designing, accessing the internet, multimedia skills, saving a document, composing questions, encrypting, participation in an ICT community of practice, and hyper-linking.

The study observed that the highest percentages of teachers who have used E-Books are ICT teachers (82.4%) and the lowest percentages of teachers who have used E-Books are mathematics teachers (10.3%) (Two times lower than the 23.8% of principals who have used E-Books). Analysis of the results has shown that 76.2% of the principals, 89.7% of the mathematics teachers, 64.3% of the science teachers and 17.6% of the ICT teachers had never used E-Books. Although analysis of the results showed that 76.2% of the Principals, 89.7% of the mathematics teachers, 64.3% of the science teachers and 17.6% of the ICT teachers have not used E-Books, the demographics suggest that 90% of the mathematics teachers and 95% of the Science teachers can be trained to use E-Books because they still have more than ten years before they retire. The competencies that are required by teachers in order to produce and use E-Books can be developed when teachers are working with an ICT specialist.

In terms of the dynamics of using E-Books that teachers should be trained on how to access, produce, annotate, store, publish and encrypt E-Books. Training of subject teachers focus on developing teachers' competencies in the following seven areas of ddesktop publishing / graphic designing; web quest designing; accessing the internet ;multimedia skills; saving a document; composing questions; encrypting; participation in an ICT community of and practising hyperlinking.

The digital competencies required by teachers fall into four hierarchically thematic areas of computer operation at the base of the pyramid followed by computing, integration and digitising at the apex of the pyramid.

9. References

[1] Creswell, J.W. and Clark, P. (2007). Mixed Methods Research Designs in Counselling Psychology. Journal of Counselling Psychology, 52(2), 224-235.

[2] Cumaoglu, G., Sacici, E., and Torun, K. (2013). E-book versus Printed Materials: Preferences of University Students. Contemporary Educational Technology, 4(2), 121-135.

[3] Education Management Information Systems (EMIS) (2011). Annual Education Census (AEC) Report.

[4] Field, A. (2011). Discovering Statistics using SPSS (3rd ed.). London: Sage.

[5] Iluzada, E.S. (2012). Exploring the pedagogical and technical readiness of teachers in ict integration to non-formal education https://www.scribd.com/document/1708 07009/Exploring-the-Pedagogical-and-Technical-Readines s-of-Teachers-in-ICT-Integration-to-Non-Formal-Educatio n. (Access Date: 13 September 2022).

[6] Jansen, J.D. (2005). Targeting Education: The Politics

of Performance and the Prospects of 'Education for All'. International Journal of Educational Development, Volume 25 Number 4. p368-380 July.

[7] Kroc, R. and Howard, R. (2007). Using Mixed Method Approaches in Institutional Research. Tucson, Arizona: Arizona Association for Institutional Research.

[8] Margaryan, A., Littlejohn, A., and Vojt, G. (2010). Are digital natives a myth or reality? University students' use of digital technologies. Computers and Education, 56, 429-440. http://elsevier.com/locate/compedu (Access Date: 3 August 2022).

[9] Rossing, J.P., Miller, W., Cecil, A.K., and Stamper, E (2012). iLearning: The future of higher education? Student Perceptionss on Learning with Mobile Tablets, Journal of the Scholarship of Digital education, Vol. 12, No.2, June 2012, pp. 1 – 26.12(2), 1-26. http://files.eric.ed.gov/fulitext/EJ978904.pdf (Access Date: 22 November 2015).

[10] Simelane, A. S., (2013). Investigating the integration of ICT in Mathematics and Science in Swaziland classrooms. Dissertation for the Magister Educationis (Faculty of Education, University of Pretoria.