Teachers' Self-efficacy on Integration of Augmented Reality in Teaching-learning activities: Comparison among Selected Schools in Nigeria

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Abstract

Digital technology is redefining teaching-learning engagements and challenging the professional teachers to match the advancement; such as integration of augmented reality (AR) in education. Apparently, change often encounters reluctance to embrace it. As a lot of teachers still battle phobia for computer technologies, the integration of sophisticated AR could be a problem. No matter the challenges, reliable data could assist in planning towards mitigating the problems. Pertinently, self-efficacy data on stake holders (teachers) are relevant to assist in planning, to maximise innovative potentials of AR in teaching/learning. Therefore, this study investigated teachers' self-efficacy on integration of AR in teaching-learning activities among selected schools in Nigeria. In this descriptive survey research, cluster and random sampling techniques were used to select sample. The target population was all the secondary school teachers in Lagos state, Nigeria; the sample comprised 178 participants. Validated Teacher Self-efficacy Questionnaire (TSQ) on 4-Likert scale, of 0.89 reliability coefficient, was used to collect data (ordered into three categories – Low, Medium and High self-efficacies for analyses). The data were computed using percentage, bar-charts and Chi-square. The results revealed that differences in the levels of self-efficacy are not enough to make the teachers in public schools perform differently when compared to counterparts in private schools, if AR is integrated into teaching methods. Based on the results, it was recommended that awareness seminars should be organised for the teachers on how to use AR technology. Moreover, required software should be provided and the teachers should be given competency-based training to use it.

Key words: Augmented Reality, Integration, Teachers, Schools, Self-efficacy

Introduction

The Augmented Reality (AR) can be defined as a computer-generated image that overlays virtual objects (augmented components) into the real world (Akçayır & Akçayır, 2017). The three types of AR technology are marker-based AR, markerless AR and location-based AR. Though very new in the developing country, the AR digital technology is speedily finding its way into many nations, since smart phones and other mobile devices could be used to integrate the software for teaching and learning activities. Other types of digital technology realities are Virtual Reality (VR) and Mix/Merged Reality (MR).

The Mix Reality is combination of VR and AR; While VR aims to replace the real world experiences, AR enhances the real world experiences. Collectively, AR, VR and MR are referred to as Extended Reality – XR. Though how soon the VR or MR would be put into use would be determined by how quickly the high cost of VR software and devices would be subsidised, the AR software on the other hand just need smart phone or other common mobile devices with or without internet connection, for it to be used, depending on the mode of delivery. Meanwhile, constraints on access to the internet should be anticipated and resolved and a good way to do this is by providing diverse digital learning contents that could be accessed through devices owned by the students. Thus, Ismail & Hassan (2019), Stanica, Moldoveanu, Dascalu, Moldoveanu, Radoi & Nemoianu (2019), as well as Shahroom & Hussin (2018) opine that, in line with the issue of industrial revolution 4.0, augmented reality is an alternative to digital-based learning. Though, Sulisworo, Fatimah, Sunaryati & Sanidi (2020), Sulisworo, Kusumaningtyas, Bergita, Wahyuningsih & Rahmadhani (2020), also Chen, Chou & Huang (2016) asserted that in the environment of students who cannot get internet access, providing learning resources that can improve learning performance with independent and group learning becomes very important.

Augmented reality can enrich existing media by adding various deeper and more complete activities available on smartphones (Georgiou & Kyza, 2018). This feature will be activated when obtaining a trigger from the material contained in the AR marker (Pombo & Marques, 2017). Besides, the educational use of AR has been studied and a common conclusion of several researches is that AR integration in teaching and learning activities by the schools can enhance the learning process, learning motivation and effectiveness (Huang, Chen & Chou, 2016; Bacca, Baldiris, Fabregat, Graf & Kinshuk, 2014). In all these, the teachers' role is very important. Equally, the extent of teacher's self-efficacy is expedient to integration of AR in the school curriculum content delivery.

Literature review

The AR is an emerging technology (with a novel dimension) that is full of creative potentials to facilitate productive teaching, interactive and flexible learning, authentic assessment, immediate knowledge of result and satisfactory learning experience. All these are possible if AR is appropriately integrated by the supposed educators or end-users. The educational use of AR has been studied from elementary school to university levels (Scrivner, Madewell, Buckley & Perez, 2016), both in formal and informal learning environments (Koutromanos & Avraamidou, 2014). Other research on AR has reported that it improved outdoor educational activity (Nikou & Economides, 2016). The main difference between VR, AR, and MR lies in the amount of digital content that is mixed with reality (Elbamby, Perfecto, Bennis & Doppler, 2018). In the cultural heritage field, integration of AR applications can improve a visitor's experience of a cultural heritage site, enhance student understanding (Noh, Sunar & Pan, 2009), and help users learn history through game-based or tour explorations of urban environments (Zarzycki, 2013). Meanwhile, AR applications improve students' laboratory skills and their attitudes towards their labs (Akçayır, Akçayır, Pektas & Ocak, 2016), and help students develop skills such as critical thinking, problem solving and communication (Akçayır & Akçayır, 2017).

However, most educators who suppose to use AR for teaching activities have digital phobia; thus, proactive solution should be prepared towards this problem. Having reliable information regarding self-efficacy of AR end-users could reflect possibility of reluctance or acceptance to integrate AR as innovation in teaching and learning; indeed, computer literacy of the teachers or educators could be a serious factor. Further on this innovation, irrespective of acclaimed level of computer literacy, the information on self-efficacy of teachers in using AR software could greatly help to plan and strategise, in order to cater (prevent, reduce to minimum or overcome) any possible phobia in the teachers. Self-efficacy simply means expression of assurance on one's personal ability to perform or carry out certain necessary activities meant to achieve specific targeted outcomes. The concept of self-efficacy is essential in the social cognitive theory. Self-efficacy beliefs are especially critical in educational settings and give the learners the impetus to overcome the various challenges often present in

situations that demand adaptation to and learning of new skills (Lehikko, 2021). Besides, not only do teachers with high self-efficacy appear to be more prevalent in higher performing schools (Olivier, 2001) but there is evidence that teacher self-efficacy may be a key mediating factor between a school's climate and professional culture and its educational effectiveness (Bobbett, 2001; Tshannan-Moran, Hoy & Hoy, 1998). Self-efficacy is also reflected in the resilience people demonstrate when working towards goals (Bandura, 2008; Pajares, 1996). Though other teachers could motivate their colleagues, it is noteworthy that persons with low self-efficacy make more negative comparisons between the model and themselves, which may cause them to benefit less from the vicarious information (Wilde & Hsu, 2019).

The teachers in secondary schools were purposely selected as focus of this study because they occupy bridge-building position in educational sector (the teachers in secondary schools have direct links with the teachers in primary/basic schools and with the teachers in tertiary institutions). In addition to this, the students are prepared at this level of schooling towards making decision on possible career interest; hence, the quality of teaching and learning should be enhanced to get the students ready for on-line learning in tertiary institution. Though the teachers' areas of teaching subject, in the category of either science teaching subjects or non-science teaching subjects, could affect their extent of involvement, they often embrace research activities. The teachers whose area of teaching subject is science-based could show certain interest in technology inclined activities (in teaching methods that they integrate) while those teachers whose area of teaching subject is non-science-based could show different interest; yet vice versa due to other relevant factors. Such factors include the status of schools, with respect to public or private schools.

School status does affect some critical policies that define culture and practices obtainable in each category of the school. Standard private secondary schools are always in competition with one another, and this reflects on staff development in the schools, which may be different from what is obtainable in some public schools. Altogether, there are many ways that such factors could define nature of self-efficacy of the teachers towards integrating AR into teaching-learning activities. Hence, this study investigated teachers' self-efficacy on integration of augmented reality in the teaching-learning activities as found among some secondary schools in Nigeria.

Objective of the study

The objectives of this study were:

1. to examine the teachers' self-efficacy on integrating augmented reality software in teaching-learning activities in schools, in Nigeria.
2. to examine the public school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in schools, in Nigeria.
3. to examine the private school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in schools, in Nigeria.
4. to examine the way that school status affects teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in schools, in Nigeria.
5. to examine the way that field of teaching subjects affects teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in schools, in Nigeria.

Research question

This study was guided by three research questions which state that:

1. What is the level of teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?
2. What is the extent of public school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?
3. To what extent is private school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?

Hypothesis

Two null hypotheses was formulated and tested at 0.05 level of significance.

1. There is no significant difference between self-efficacy of teachers in public and private schools, towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria.
2. There is no significant difference between self-efficacy of science subject and non-science subject teachers, towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria.

Significance of the study

This study is significant because it would provide empirical information on readiness of the teachers, in term of self-assurance to perform if AR software is provided to improve their professional teaching content delivery. This in turn will improve motivation that students will receive due to digital teaching method that is appropriate to learners in digital generation. Besides, this study could create positive reflection in the policy makers to appreciate the need to provide professional supports towards enhancing self-efficacy when planning to integrate digital methods of teaching.

Methodology

In this study, descriptive survey research design was employed. The instrument used for data collection was a validated Teacher Self-efficacy Questionnaire (TSQ), on 4-Point Likert scale; adapted by the researchers and subjected to reliability by test -retest on 17 teachers who were replica of the sample in the study. Reliability coefficient of the instrument was computed to be 0.89. The target population was all the secondary school teachers in Lagos state, Nigeria. Cluster and random sampling techniques were used to select sample, who were secondary school teachers in public and private school; and the sample comprised 178 participants. Out of the six educational districts in Lagos state, two educational districts were randomly selected as representative sample. Each of the selected educational districts has four Local Government Areas – L. G. A.'s, which is eight L. G. A.'s altogether. These L. G. A.'s were randomly distributed for selection of four public schools (one school from each L. G. A.) and for selection of four private schools (one school from each L. G. A.).

The questionnaire comprised two sections A and B. Section A is on demography of the respondent while section B contains ten (10) questions (items) on self-efficacy. However, the aggregate scores of items on the 4-Point Likert scale questionnaire (of each and every respondent) were ordered into three categories namely – Low self-efficacy, Medium self-efficacy and High self-efficacy, for analyses in the study. The questionnaires were distributed by the researchers and their assistants, covering eight secondary schools; and were collected immediately for analysis. The questionnaire was given to all the teachers in the selected schools to fill voluntarily. Only 178 teachers (about 70% of teachers in the participating schools) filled and returned the questionnaires while the remaining teachers (about 30% of teachers in the participating schools) did not fill the questionnaire (with excuse that they were conducting and supervising second term examinations).

Data Analysis and Results

Following the three stated research questions and two hypotheses, the data analyses in the study are presented as follow.

Research question 1:

What is the level of teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?

To answer the research question 1, as shown in Fig. 1 below, most of the teachers demonstrated high level of self-efficacy towards integration of AR in teaching-learning activities. Even, those with medium self-efficacy on AR are much in population, that only one participant had low self-efficacy.

Research question 2:

What is the extent of public school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?

To answer the research question 2, referring to Fig. 2 below, more than two-third of the teachers in public secondary schools demonstrated high level of self-efficacy on AR and no participant is with low self-efficacy.

Research question 3:

To what extent is private school teachers' self-efficacy towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria?

To answer the research question 3, referring to Fig. 2, though there is one participant with low self-efficacy on AR among the teachers in private schools, more than half of the private schools teachers demonstrated high level of self-efficacy; while a little less than half of the population was in the medium category of self-efficacy on AR software use.

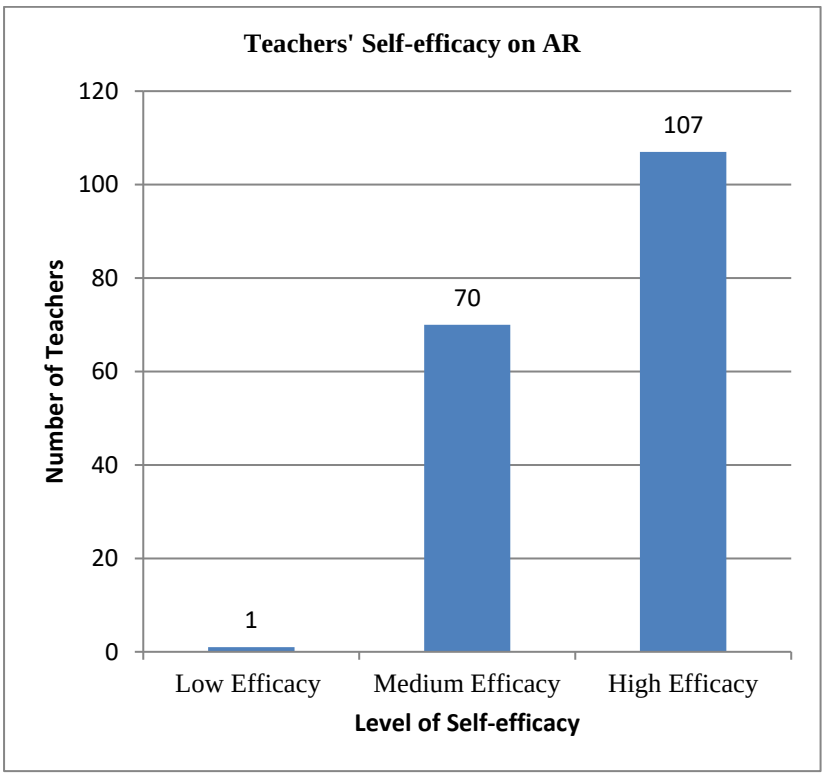

Fig. 1

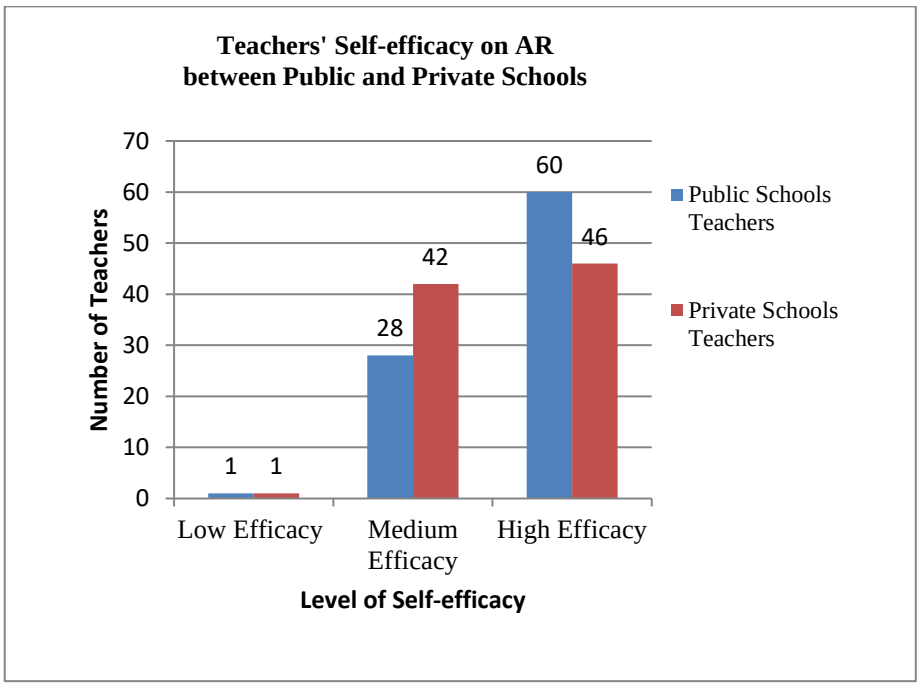

Fig. 2

Table 1: Chi-Square Analysis on Teachers' School status and AR Self-Efficacy

School status		Level of Efficacy			df	P-Value	Sig.
		Low	Medium	High			
Public	count	1	28	60			
	% within School status	1.1%	31.5%	67.4%			
					2	4.87[F]	.06 ns
Private	count	1	42	46			
	% School status	1.1%	47.2%	51.7%			
	Count	2	70	106			
Total	% within School status	1.1%	39.3%	59.6%			

ns = Not significant at P > .05

Table 2: Chi-Square Analysis on Teachers' Area of specialisation and AR Self-Efficacy

Specialisation		Level of Efficacy			df	P-Value	Sig.
		Low	Medium	High			
Science	count	1	35	55			
	% within specialisation	1.1%	38.5%	60.4%			
					2	.412[F]	.88 ns
Non-science	count	1	36	50			
	% within specialization	1.1%	41.4%	57.5%			
	Count	2	71	105			
Total	% within specialization	1.1%	39.9%	59.0%			

ns = Not significant at P > .05

Hypothesis 1:

There is no significant difference between self-efficacy of teachers in public and private schools, towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria.

As shown in the Chi-square analysis in Table 1 above, there is no significant difference in the levels of self-efficacy between teachers in public and private schools (0.06 > 0.05); hence, the hypothesis is not rejected.

Hypothesis 2:

There is no significant difference between self-efficacy of science subject and non-science subject teachers, towards integration of augmented reality software in teaching-learning activities in secondary schools, in Nigeria.

Also, the Chi-square analysis in Table 2 above revealed that, there is no significant difference in assurance by the individual teachers, based on science and non-science fields of specialisation, to perform better than the other in using AR for teaching purpose (0.88 > 0.05). So, the hypothesis is not rejected.

Discussion of results

This study has reported that the differences in the levels of self-efficacy are not enough to make the teachers in public schools perform differently when compared to their counterparts in private schools, if AR is integrated as part of teaching methods in Nigeria. The implication of this is that AR integration would widen the existing opportunities available to the students to maximise learning achievement across school status, via digital approach in the 21st century. This is in consonance with the submission of Klopfer and Sheldon (2010) that AR can offer great potentials for the benefit of student learning by granting them to see an augmented world that they never experienced before due to geographical and cultural differences. This would definitely create positive

impact on sustainability of the AR software integration for learning content delivery in the developing country. This agrees with the actual findings of Sulisworo, Drusmin, Kusumaningtyas, Handayani, Wahyuningsih, Jufriansah, Khusnani and Prasetyo (2021) in terms of optimism for AR implementation, that the teachers' responses showed a high opportunity in the use of AR in science learning. Furthermore, it is found in this study that there is no significant difference in assurance by the individual teachers to perform in using AR for teaching purpose, based on science and non-science fields of specialisation. This implies that the teacher's subject of specialisation should not be considered as an obstacle that could hinder integration of digital tool for teachers' professional practice. This is more so because the individual teachers use smart phone and some other digital or mobile devices as part of everyday life (and learning), though may not be technology savvy and may still demonstrate degree of phobia based on level of sophistication. This aligns with the finding of Huang, Chen & Chou (2016) that the students are not familiar with the use of mobile technology in the learning process, although they are familiar with mobile technology in everyday life. Furthermore, this could ascertain sustainability projection regarding AR integration in teachers' professional practice.

Conclusion

Technology has become cornerstone of a lot of things being done in the society. It is also the driver of future that evolves everyday because advancement in digital technology is so dynamic that nobody could claim to be the very best. This is seriously affecting educational sector but this could be explored for positive result of improving teaching and learning activities; in designing, planning, implementing and evaluating learning experiences. The AR application has been found useful almost in every field of endeavour.

Just that it is not yet accessible easily to the teachers and students in the developing countries. The potentials of AR and its generic technology – VR, MR or XR – keep on improving everyday in that they could mitigate a lot of challenges in educational sector, such as problems of over population in the class, inadequate equipment and tools for practical class, preventing learners from being exposed to dangerous leaning activities, accessing knowledge that is not possible in real life, real time "tele-presence" collaboration, simplifying explanation and illustration of highly difficult concepts to learn, just to mention some of what the AR technology could be used to achieved if appropriately integrated for teaching and learning.

Though full of creative potentials to facilitate productive teaching, interactive and flexible learning, authentic assessment, immediate knowledge of result and satisfactory learning experience, yet AR must be used by human beings which are teachers and students in this case. Then, these concerned people should be ready to embrace the AR technology. This would help the developing countries towards assuming same standard with the developed nations.

Recommendations

Based on the findings in this study, the following are recommended.

1. To further enhance their self-efficacy, the secondary school teachers in public and private schools should be encouraged to possess and use smart phone that has 4G feature, as this could have contributed to levels of self-efficacy demonstrated by the participants across board, irrespective of the school status.
2. Since the participants demonstrated good assurances to perform in using AR software, the government and policy makers in educational sector should start awareness campaign for the teachers on AR application, in order to explore it to render quality learning content delivery and fun filled engaging learning activities.
3. Government should add training on utilisation of AR to the curriculum of teacher education programme in the country. This is because it would only require the appropriate authority to procure the software since the trainee teachers have smart phones that could be used for AR application. As well, it would make it easier for them to be competent on it before the end of their programme.

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