Technology-Enhanced Teaching: A Technology Acceptance Model to Study Teachers' Intentions to Use Digital Games in the Classroom

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***Abstract*—This research to practice paper uses a Technology Acceptance Model (TAM) to explore the factors that affect teachers' intentions to use digital educational games in the classroom. Research shows that using computers and other digital technologies like digital games is one way to influence young people's career aspirations and improve their digital literacy. This is particularly important as the world of work is changing and emerging jobs becoming more intensive in their use of digital technologies. In the developing world and in particular Nigeria, there have been calls to improve the digital literacy skills of young people to help them make informed career choices, and fully participate effectively and equally in the digital world. However, many of the computing and digital technology education initiatives have not produced the positive results intended. The lack of awareness, readiness and buy-in of the relevant stakeholders are some of the factors that has been identified as a barrier here. For example, for computing and digital technology-based projects in schools, the success largely depends on the support and attitude of teachers. As one of the major stakeholders in the classroom, teachers need to be consulted in decisions that affect the way they deliver their lessons; especially when novel ideas and approaches that challenge tradition are introduced. It is therefore important to consider their acceptance or otherwise of digital games in the classroom. A Technology Acceptance Model (TAM) was modified to include constructs previously identified by teachers that potentially influence their intention to use digital games in the classroom. The extended TAM was developed into a questionnaire and tested with 220 teachers in Nigeria. Analyses of the results show that syllabus connectedness, perceived usefulness and self-efficacy are significant predictors of the intention of teachers to adopt digital game-based learning in the classroom. Furthermore, the teachers' demographics including experience of teaching, age and gender all mediated the intention of the teachers to use digital game-based learning. The results and findings present recommendations for school leaders and developers of digital educational games. The practical insights from this are also important here and helpful for guiding the deployment of such games particularly in areas where such technological interventions have not been used before.**

Keywords*—*Technology Acceptance Model, technology enabled learning, teachers, digital games, Nigeria

I. INTRODUCTION

The World Bank 'Connecting to Work' report recommends that developing countries need to "bridge education to employment by developing skills for ICT jobs and promoting digital literacy using innovative models" [1]. Closing the digital literacy gap is critical in achieving several of the United Nations (UN) Sustainable Development Goals (SDGs) including SDG 4 which seeks to "ensure inclusive and quality education for all and promote lifelong learning" and SDGs 1: No Poverty, 5: Gender Equality, and 8: Decent Work and Economic Growth [2]. Despite the growth and pervasiveness of computers and other digital technologies, half of the world's population is still offline; most of these 3.9 billion people are women; and the majority are in developing countries [3].

Sub-Saharan Africa is the world's 'youngest' region with 60% of its population under the age of 25. It contains 13% of the world's working age population, second only to Asia [4]. According to the World Economic Forum (WEF), it lags behind in human capital with Nigeria at 49% compared to a global average of 65% on the WEF's Human Capital Index [4]. Furthermore, the majority of workers in Nigeria are in lower skilled jobs [5] and most of these are females [6]. To secure a better future, Nigeria needs to invest in developing skills among its young people, both male and female, to help them gain decent meaningful employment and seize the opportunities arising from newer and emerging technologies. Research suggests that this requires a change in schools from rote learning to match the way people need to increasingly work and collaborate for the future [7]–[9]. This also includes "updating the quality of science, technology, engineering and mathematics education at the secondary level", bringing in career skills and guidance at an earlier stage and encouraging "critical thinking, creativity, cognitive flexibility and emotional intelligence" [4]. Digital literacy is at the core of this transformation, developing the capabilities for young people to live, learn and work in the 21st Century digital society and going beyond purely functional technical skills to encompass a rich set of digital behaviours, practices and identities [10]– [12].

In the classroom, teachers have a critical role in integrating technology and improving the digital literacy skills of their students [13]. However, research has shown that teachers themselves struggle with integrating technology in their teaching practice [14], [15] even though they are relatively comfortable using it for personal purposes [16]. Literature suggests that more often than not, the main reason teachers are reluctant to use technology in the classroom is that they are scared of looking incompetent or unprepared in front of their students [17]. Other common reasons may include the fear of equipment failure [18] and lack of technical support [19]. In Nigeria, research suggests that many teachers have not been trained in the application

of technology in education. Thus, they are often fearful of taking a more practical, active and student-centered learning approach in their classrooms that involves the use of technology [20]. In this study, the authors employed the widely-used Technology Acceptance Model (TAM) to explore the factors that predict the behavioural intention of teachers to accept digital educational games in their classrooms in order to find out how teachers can be supported in the integration process.

II. THEORETICAL FRAMEWORK: THE TECHNOLOGY ACCEPTANCE MODEL

Originally derived from the Theory of Reasoned Action (TRA), the TAM has been widely modified and extended to cater for several studies and fields. The TRA seeks to predict an individual's behaviour through their behavioural intention, which is a function of their attitude and the subjective norm – which is the perception of the expectation of other influencers. These influences may be societal or organisational towards the performance of a particular behavior [21], [22]. In the TRA, attitude is defined by the belief that performing a particular behaviour yields a certain result, and the desirability of that result is the determinant of the attitude of the individual [23].

On its own, the TRA has been used in various research fields – IT, health as well as business – to study and predict the behaviours of individuals. [24] investigated the behaviour intention for the adoption of green information technology among IT practitioners. Their findings indicated that behavioural intention has a positive influence on the actual behaviours as workers with positive intentions towards Green Information Technology are actually practicing it in their professional capacities. Similarly, [25] applied the TRA alongside the Theory of Planned Behaviour to evaluate the intentions of women and men to receive the Human Papillomavirus Virus (HPV) vaccine. According to the authors, the TRA posits that the intention to be vaccinated is influenced by the attitude toward HPV vaccination and the perceptions of the social support for HPV vaccination. Their findings confirm the propositions of the TRA.

Despite the usefulness of the TRA, its use in other fields of study exposed some of its limitations, one of the main shortcomings being its inadequacy with individuals who have little control (or feel they have little control) over their attitudes and behaviours [26]. In an attempt to cater for individuals' feelings of different levels of control of their attitudes and behaviours, [27] added an extra concept – perceived behavioural control – to the original TRA, which resulted in the Theory of Planned Behaviour (TBP). The TBP sufficed for the limitations of the TRA with respect to predicting the influences that motivate the behaviour of individuals who are not under their own voluntary control.

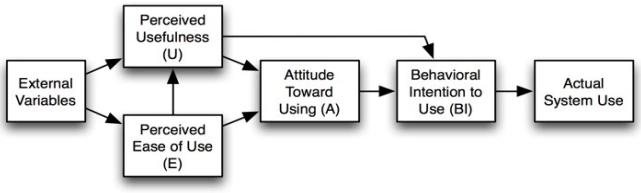

Fig. 1. Technology Acceptance Model (Davis, 1989)

Davis [28] first modified the main theory of the TRA to analyse the adoption process of an information system to produce the original TAM –Figure 2.4. While adapting the TRA, he maintained 'behavioural intention' as the determinant of a person's actual behaviour (which was, in that case, the actual use of the information system), but removed the subjective norm as a determinant of actual behaviour. Instead, he considered only the person's attitude, which he said would be determined by the perceived ease of use and perceived usefulness of the information system by the individual [28].

III. TAM IN EDUCATION

Advancements in technology as well as the drive to ensure that deliverers of formal education keep up with happenings in the 'outside world' make the study of technology acceptance a major element in the integration of technology in education [26]. TAM application in education broadly consists of studies aimed at measuring either the intention to use or the actual use or acceptance of technologies in school. [29] extended the TAM to include social, institutional and individual factors in order to empirically measure if students were willing to adopt and use e-learning systems. The factors include quality of work life, computer self-efficacy and facilitating conditions. They found out that in addition to perceived usefulness and perceived ease of use, all the factors had a significant positive influence on the adoption and use of electronic blackboard systems.

Sawang et al. [30] extended the TAM to include external variables aimed at understanding the relationship between the intention to use and the actual use of keypads. Their model was tested with 131 first year undergraduate students in a university in Australia. They found that attitude towards the keypad system; social pressure to use the new technology facilitating conditions to use the keypad system and students' personalities would all significantly affect the intent to use, which would subsequently affect the actual use of the keypad. In a bid to understand in-service teachers' intention to use technology, [31] used five variables (perceived usefulness, perceived ease of use, subjective norm, facilitating conditions, and attitudes towards use) to develop a modified TAM and formulate nine hypotheses. Data gathered from 592 teachers from schools in Singapore were used to test the model and hypotheses. Results and analyses suggested that the model was a good fit with eight out of the nine hypotheses supported. An interesting finding from that sample and study was that 'subjective norm' was not a significant determinant of teachers' intention to use technology, unlike in other research [32]–[34].

This brings to bear the challenge with TAM research: the inconsistent results of the factors that influence the intention to use or actual use of technologies.

IV. SIGNIFICANCE OF STUDY

This study is significant in a number of ways. [35], [36] suggest that despite the fact that the TAM has been widely used studying adoption and acceptance of technologies in education, studies continue to show mixed results about the effect and influence of the different constructs that make up the TAM. [37] suggests that existing literature provides two possible explanations to the discrepancies in TAM findings: Firstly, in some of the tested models, the effect sizes of the paths vary depending on the types of technology and the type of user under study; this is more common in TAM research in education. Studies have found inconsistencies

between the adoption factors between teachers and student, and also between educational technologies used to enhance teaching and more office or class management tools [38]. Secondly, the original TAM is inadequate in accounting for peculiar individual, organisational and contextual characteristics that may affect adoption or acceptance. These shortcomings have prompted researchers to call for more contextual studies of the adoption and acceptance factors [29] as well as more focus on the study of the influence of moderating factors such as age, gender and experience especially in educational settings [39]. Furthermore, previous studies have argued that the primary constructs of the original TAM (perceived usefulness and perceived ease of use) are usually not sufficient to explain a user's acceptance of new technologies [40]. Therefore, it is important to conduct research to understand the factors that influence perceived usefulness and perceived ease of use. Finally, this study looks particularly into 'behavioural intention to use' rather than 'actual use' (as on the original TAM) as the teachers involved in this study do not currently use technology to teach in their classrooms.

V. RESEARCH METHODS AND SAMPLE

The authors, in a previous work [41] detailed the development of the extended TAM. The background study produced an additional five constructs (syllabus connectedness, engagement and learning opportunities, experience with technology, self-efficacy and enabling environment) to the original constructs on the TAM (perceived ease of use, perceived usefulness, and subjective norm). Figure 2 and the hypotheses are presented in table 1.

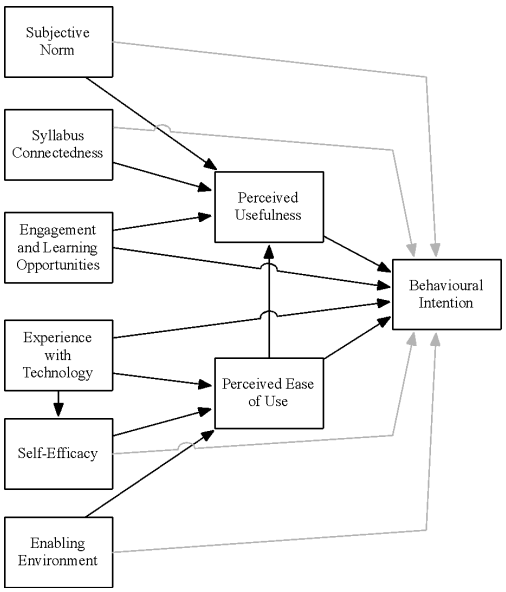

Fig. 2. Extended Technology Acceptance Model

Construct	Hypothesis
Perceived usefulness	H1 Perceived usefulness will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Perceived ease of use	H2 Perceived ease of use will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Perceived ease of use	H3 Perceived ease of use will be positively associated with perceived usefulness of digital educational games to teach mathematics in the classroom.
Self-efficacy	H4 Teachers' self-efficacy will be positively associated with their behavioral intention to use educational games in the classroom.
Self-efficacy	H5 Teachers' self-efficacy will be positively associated with their perceived ease of use.
Syllabus-connectedness	H6 Syllabus-connectedness will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Syllabus-connectedness	H7 Syllabus-connectedness will be positively associated with perceived usefulness of digital educational games to teach mathematics in the classroom.
Enabling environment	H8 Enabling environment will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Enabling environment	H9 Enabling environment will be positively associated with perceived ease of use of digital educational games to teach mathematics in the classroom.
Experience with technology	H10 Experience with technology and technology-enhanced teaching will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Experience with technology	H11 Experience with technology and technology-enhanced teaching will be positively associated with perceived ease of use of digital educational games to teach mathematics in the classroom.
Experience with technology	H12 Experience with technology and technology-enhanced teaching will be positively associated with self-efficacy.
Subjective norm	H13 Subjective norm will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Subjective norm	H14 Subjective norm will be positively associated with perceived usefulness of digital educational games to teach mathematics in the classroom.
Engagement and learning opportunities	H15 Engagement and learning opportunities will be positively associated with teachers' behavioral intention to use digital educational games to teach mathematics in the classroom.
Engagement and learning opportunities	H16 Engagement and learning opportunities will be positively associated with perceived usefulness of digital educational games to teach mathematics in the classroom.

TABLE I. EXTENDED TAM CONSTRUCTS AND HYPOTHESES

Following the development of the modified TAM from the identified constructs, a questionnaire was developed to test the TAM across a wider audience of teachers. The first part of the questionnaire contains measures for the constructs in the model. The second part examined constructs related to the career of the teachers under study and the third part collects demographic information about the teachers. For the extended TAM, just as in similar studies, the researchers adapted and modified scales from previous research to exploit well-validated psychometric measures [42]. The scale items were measured on a five-point Likert scale (1 strongly disagree – 5 strongly agree). A pilot study tested the instrument with twenty teachers in three of the partner schools. In addition to this, suggestions and recommendations were taken from four teachers and 5 university academics in order to remove any ambiguity in the questionnaire. Minor changes to the language of the items on the questionnaire were made based on the comments of the experts and the test sample. In order to ensure the validity of this study and considering the exploratory nature of this research, the researchers used a convenient sample of teachers who currently teach across schools in Ado-Ekiti, Nigeria. A range of school types were used – public and private funded, primary and secondary. Initial contact was made with the head teacher of each school to explain the purpose of the study and how teachers would be required to participate. Pamphlets detailing information about the research were given to the teachers one week before the data collection exercise and questionnaires were only given to teachers who showed willingness to participate in the research. Paper samples as well as link to the online version of the questionnaire were provided to the teachers. Of the 220 teachers contacted, only 212 returned the completed questionnaire. 17 of these were discarded, as they were not completely filled thus presenting an 87% response rate. This left the researchers with 195

valid questionnaires. The results of the analysis are presented in the following section

VI. ANALYSIS AND RESULTS

SPSS version 24 was used for the analysis of this data. The data was coded for easy analysis and inputted into the statistical package for analysis. Table 2 contains the breakdown of the sample for this study.

Characteristics	N	%	Significant difference (agree)
Gender			
Male	101	52	Chi-square = 9.553; p = 0.004
Female	94	48	Male= 58%; Female = 42%
Age			
21-30	23	12	
31-40	72	37	Chi-square = 28.49; p = 0.001
41-50	89	45	21-30 = 83%; 31-40 = 58%
51-60	11	6	41-50 = 39%, 51-60 = 18%
Over 60	0	0	
Teaching Experience			
1-10	99	51	Chi-square = 19.158; p = 0.005
11-20	83	42	1-10 = 63%; 11-20 = 40%
21-30	13	7	21-30 = 23%
Over 30	0	0	
Technology proficiency			
High	70	36	Chi-square = 138.727;p=0.001
Medium	50	26	Low = 7%; Medium = 34%
Low	75	38	High = 95%

TABLE II. BREAKDOWN OF SAMPLE

A. *Instrument validity*

Cronbach's Alpha analysis was used to examine the internal consistency of the scale based on the data collected from the teachers. The internal consistency is the strength with which each of the questions in the questionnaire are related to one another and it should be at least 0.70 to be considered acceptable [43]. The Cronbach's Alpha coefficients demonstrate a high level of internal consistency among the scale items with values well higher than the acceptable value ($\alpha = 0.934$). Based on these findings, the researchers conclude that the instrument is reliable and valid and was able to be used to measure the intended constructs of the extended TAM.

B. *Descriptive statistics*

Descriptive statistics and frequency distributions were calculated for each of the construct items in the questionnaire. The results are presented in table 3.

Construct	Mean	Std.
Perceived usefulness	3.21	1.415
Perceived ease of use	2.75	1.026
Syllabus connectedness	2.86	1.008
Enabling environment	2.44	1.055
Experience with technology	2.64	0.949
Self-efficacy	2.82	0.910
Engagement and learning opportunities	3.47	1.194
Subjective norm	2.91	0.744
Behavioural intention	3.05	1.399

TABLE III. DESCRIPTIVE STATISTICS. NOTE: ALL SCALES RANGE FROM 1(STRONGLY DISAGREE) TO 5 (STRONGLY AGREE)

C. *Regression analysis*

In order to ascertain a relationship between a dependent variable and an independent variable, an equation called a regression equation can be used. According to [44], regression means that the average value of the dependent variable can be explained as a function of the independent variable. There are two types of regression analysis: simple and multiple. Simple linear regression is focused on examining the impact one independent variable on a dependent variable. Multiple linear regression examines how much multiple variables affect the dependent variable. Given that this study examines the relationship between nine variables, multiple linear regression is appropriate. Looking at the model, the researchers carried out multiple linear regressions on the hypothesised paths (H1 – H16) in the conceptual model. The F-ratio in the ANOVA table (Table 5) tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, $F(8,186) = 33.694$, $p < .0005$ (i.e., the regression model is a good fit of the data).

Model	Sum of squares	df	Mean square	F	Sig.
Regression	269.553	8	33.694	69.306	.000[b]
Residual	90.426	186	.486		
Total	359.979				

TABLE IV. ANOVA TABLE FOR THE OVERALL REGRESSION MODEL (B- PREDICTORS I.E. SN, PEU, SA, ET, EE, EL, PU, SC)

Results of the multiple linear regression are presented in table 5. The paths of the model were examined by checking the hypotheses formulated earlier in section. 14 out of the 16 hypotheses were confirmed. Unsurprisingly, perceived usefulness ($\beta = 0.810$, $R2 = 0.656$) comes out as the biggest predictor of teachers' behavioural intention to use digital games to teach in the classroom supporting H1. It also explains 66% of the variance in behavioural intention to use digital educational games.

H	IV	DV	β	t-value	p	R^2	Supported ?
H1	PU	BI	0.81	19.177	0.001	0.656	YES
H2	PEOU	BI	0.735	15.037	0.001	0.540	YES
H3	PEOU	PU	0.714	14.171	0.001	0.510	YES
H4	SE	BI	0.724	14.58	0.001	0.524	YES
H5	SE	PEOU	0.642	11.647	0.001	0.413	YES
H6	SC	BI	0.773	16.906	0.001	0.597	YES
H7	SC	PU	0.732	14.937	0.001	0.536	YES
H8	EE	BI	0.645	11.714	0.001	0.416	YES
H9	EE	PEOU	0.629	11.248	0.001	0.396	YES
H10	ET	BI	0.651	11.901	0.001	0.423	YES
H11	ET	PEOU	0.618	10.919	0.001	0.382	YES
H12	ET	SE	0.569	9.619	0.001	0.324	YES
H13	SN	BI	0.529	8.662	0.065	0.280	NO
H14	SN	PU	0.507	8.168	0.096	0.257	NO
H15	ELO	BI	0.739	15.23	0.001	0.546	YES
H16	ELO	PU	0.68	12.886	0.001	0.462	YES

TABLE V. REGRESSION ANALYSIS

The paths of the model were examined by checking the hypotheses formulated earlier in section. 14 out of the 16 hypotheses were confirmed. Unsurprisingly, perceived usefulness (β = 0.810, R2 = 0.656) comes out as the biggest predictor of teachers' behavioural intention to use digital games to teach in the classroom supporting H1. It also explains 66% of the variance in behavioural intention to use digital educational games. Syllabus connectedness, perceived ease of use and engagement and learning opportunities are all positively associated with perceived usefulness supporting hypotheses H3, H7, and H16.

However, syllabus connectedness (β = 0.732, R2 = 0.536) is the strongest predictor of perceived usefulness, and it explains 54% of the variance in perceived usefulness. Results show that subjective norm is not positively related to perceived usefulness (β = 0.507, R2 = 0.257) and the variance explained shows that it explains only 25% of the variance in perceived usefulness. In the same vein, subjective norm is not positively related to behavioural intention to use (β = 0.529, R2 = 0.280) and as a result only 28% of the variance in behavioural intention can be explained by subjective norm. These results about subjective norm therefore made the researchers reject hypotheses H13 and H14.

Perceived ease of use (β = 0.735, R2 = 0.540) too is a strong predictor of behavioural intention to use, thus supporting H2. Furthermore, it explains 54% of the variance found in behavioural intention to use. The constructs of self-efficacy, enabling environment and experience with technology are all positively related to perceived ease of use confirming hypotheses H5, H9 and H11. Results however show that self-efficacy is the strongest predictor (β = 0.642, R2 = 0.413) of perceived ease of use. Self-efficacy explains 41% of the variance found in perceived ease of use. In all, results show perceived usefulness as the main predictor of behavioural intention to use and subjective norm as the only construct that does not predict behavioural intention to use.

VII. DISCUSSION

Tables 2 and 3 show more detail about the descriptive statistics and breakdown of the population used for this research. The descriptive statistics show that teachers in the population are fairly mixed in their technology proficiency (m=3.07, sd = 1.043). 36% consider themselves highly proficient in the use of technology while 38% consider themselves very low. The technology proficiency significantly affects the intention to use digital games in the classroom. Results show that 95% of teachers who consider themselves highly proficient in the use of technology are positively disposed to use digital games in the classroom. This is similar to earlier findings about self-efficacy and confidence [45]–[47]. It is interesting to note that only 34% of teachers that consider themselves moderately proficient in technology are positively disposed to using digital games in the classroom. This indicates that teachers need to be confident in their ability to properly use technology before they will consider using digital games to teach in the classroom.

The teachers' age group also significantly affects the teachers' intention to use digital games in the classroom. Results show that older teachers are less likely to want to use educational games in the classroom. While 83% of teachers between 21 and 30 years old are positively disposed to using games to teach, only 18% of teachers aged over 50 responded positively. This agrees with studies that suggest that younger and older teachers may have different attitudes and levels of confidence towards technology use [48]. This may also be further explained by the little exposure older teachers may have had to computer training and use. It is a strong possibility that many of the teachers aged 40 and above have little or no experience with technology.

These findings are consistent with the influence that teaching experience has on intention to use digital games in the classroom. 63% of teachers with 1-10 years of experience are positive about using digital education games in the classroom. On the other hand, only 23% of the teachers with over 20 years of teaching experience agree that they would use digital games in the classroom. A possible explanation is that in Nigeria, phones, computers and other digital technology tools became popular almost two decades ago and as such many teachers trained before then would not have been trained to use or work with these devices. It is therefore a possibility that these results mirror the peculiarities of the study population.

However, the findings of this research are in contrast to the findings of [49] who suggest that teaching experience has a negative direct effect on technology use. Although they originally hypothesised that teaching experience would have a negative effect on intention to use technology, they found out that it had a positive effect. They explained that while teachers with more experience were likely trained in more traditional ways and at such shouldn't be very familiar with technology, the teaching experience may be beneficial to them in that they have some fundamental knowledge of education and how technology can be incorporated into it.

Findings also show that gender is a factor that significantly differentiates the population in this study. Male teachers are 16% more likely to use digital games in the classroom than female teachers. This supports [48] submission that intention to use technology is moderated by gender. The differences in inclination may be explained by the confidence in the use of technology. While male teachers may not necessarily be more experienced or skilled in the use of technology in the classroom, it is possible that they are more confident in their ability to learn and get familiar with it than females are. As several studies [50]–[52] suggest, the opinion that females think technology is generally more for men and gender stereotypical views can also make females doubt their ability to use digital games to teach.

In terms of constructs, results are generally neutral with most of the means around 3 (on a scale of 1 to 5). This is with the exception of 'enabling environment' (m = 2.44) and "experience with technology" (m = 2.64) that had mainly negative responses. Other constructs with negative means are self-efficacy (2.82), subjective norm (2.91), perceived ease of use (2.75) and syllabus-connectedness (2.86). Results are somewhat complex in terms of perceived usefulness and ease of use. On one hand, the teachers in the sample tend to believe that digital games would be useful in the classroom (m= 3.21, sd = 1.415) but disagree that they would be easy to use (m= 2.75, sd = 1.026). This is consistent with the results of another construct – engagement and learning opportunities (m= 3.47, sd = 1.194), which is the most positive of all the constructs. It suggests that teachers somewhat agree that using digital games in the classroom will be beneficial especially in engaging pupils but doubt if they have the skills to use it in

teaching syllabus contents (m= 2.86, sd = 1.008). This is similar to previous findings that suggest that usefulness in providing learning opportunities is not a major concern for the teachers [53] but are also not convinced that it can improve their own job performance e.g. in teaching syllabus contents [54].

VIII. IMPLICATION FOR PRACTICE

The results and findings present recommendations for policy makers, school leaders as well as developers of digital educational games. These practical insights are also very useful in guiding deployment activities especially in places where such technological interventions have not been used before. It is interesting to note that ease of use is not as important to the behavioural intention to use digital games as much as perceived usefulness. This is in contrast to many similar studies [55], [56]. The explanation in the literature that perceived ease of use has a greater influence on users' intention to use a technology when they had little experience of it, and that perceived usefulness has more when the population had more experience [57] is challenged here as the population of teachers studied here has had no experience with using technology in the classroom. This finding suggests that a greater awareness about the usefulness of digital educational game is of more importance to teachers. Teachers need to be conscious of how games can be used to improve their professional duties as it does not matter how complex or easy they are to use if they do not make their work more effective and efficient.

However, it is also important to evaluate and understand how easily these teachers are able to integrate digital games in their teaching practices [58]. For the population of teachers studied who are new to technologies in the classroom, the advantages and possibilities offered by digital games may not be immediately obvious. This means that any attempt to introduce digital games in the classroom should be preceded with more than a briefing session for the teachers. It will be necessary to expose them to workshops and training focused on raising their awareness of the uses of games in the classroom. Examples of successful implementation of game-based learning and its impact on teachers' productivity and pupil's performance could go a long way in making teachers aware of its usefulness and ultimately prepare them to adopt it in their own classrooms. However, findings about technology proficiency, self-efficacy and experience with technology also suggest that training should not just be focused on the use of digital games in education. Teachers want to be confident in their own ability to use whatever tool they are bringing into the classroom. Findings suggest that they are more comfortable with using technology in everyday life and those that consider themselves highly technologically proficient are more positively disposed to using digital games to teach in the classroom. This is consistent with recommendations from [59] and [60]. Training should therefore be holistic, starting from computer appreciation, and general tools like Microsoft Office Suite applications such as Microsoft Excel to improve classroom administration and then gradual introduction of more complex tools such as games. Improving teachers' self- efficacy and experience with technology can significantly increase their readiness to accept and use digital games in the classroom.

Another factor that strongly predicts perceived usefulness is syllabus connectedness. This suggests that in order for teachers to see digital games as useful, they should be able to see how the syllabus content can be taught with it. It is not enough for the teachers to know games could improve engagement and create more fun in the classroom. They believe that completing their syllabus is their primary duty and so if they are adopting games, the games must be useful in delivering their lessons and getting pedagogical outcomes. One way of achieving this is by involving teachers in developing game stories. [37] maintain that just promoting digital games as a new popular teaching method would not be as effective as allowing teachers to take an active role in the process. Teachers can specifically suggest which parts of the curriculum that developers should focus on when designing digital games. Being part of that process in itself can potentially improve their intention to use digital games in the classroom.

Interestingly, the findings of this research downplay the importance of social pressure on the teachers' intentions to use digital games in the classroom. The study suggests that teachers' intentions to use digital games in the classroom would be greatly influenced by their own opinions rather than those of others. This is in contrast to the findings of [37] and [61]. This suggests that in the teachers' decision-making processes, they do not significantly consider what other teachers, parents and pupils think about the subject matter. This may be due to the fact that teachers consider themselves experts in this matter and that the parents/guardians of their pupils are not as well informed about teaching methods or classroom activities and so are not in a position to put them under any form of pressure. This may be more noticeable in Nigeria as a result of the literacy levels of many parents and guardians. Further findings suggest that subjective norm is mediated by technology proficiency. Subjective norm exerted more influence on the intentions of teachers towards using digital games in the classroom when they have low technology proficiency.

Our findings also suggest that teachers' demographics and characteristics mediate their intention to use digital games in the classroom. Interestingly, younger teachers are more likely to readily accept to use games in teaching than older teachers. Earlier it was suggested that is most likely due to the increased exposure the younger generation have to technology compared to older teachers. Again, this is a confidence issue that can be handled by strategic training and support. Before the teachers are introduced to games for teaching, it is important to assess them with respect to their technology proficiency. This need not be specifically about games as it was noted earlier that general technology proficiency strongly predicts intention to use digital games. It is therefore necessary to provide varying levels of support and training that address the specific needs of the teachers.

Gender mediates perceived ease of use, technology proficiency, as well as self-efficacy, as males are generally more positive than females. As suggested earlier and from the literature, this is not mainly due to an actual skills gap between the genders but due to a difference in identity and a belief that males are generally better with technology that females. Given that self-efficacy and perceived ease of use significantly impacts on behavioural intention to use technology in the classroom, it is important to address this during any practical deployment of digital educational games in the classroom. One way this may be done is to project images of females using games in the classroom or generally working with technology in day-to-day work. Training materials like slides, pictures and narratives should

be gender-balanced. In addition, and as much as possible, training personnel should be balanced as well.

Finally, the introduction of digital games in the classroom needs to take a holistic approach that incorporates awareness and exposition on the advantages and possibilities it offers to teachers, training as well as continuous technical and usage support.

IX. CONCLUSION

The use of digital technology in the classroom can help to close the digital literacy gap and prepare young people for the world of work. There is a need to successfully integrate digital technology in classrooms in Nigeria. This study was carried out to identify the critical factors in digital educational games acceptance in Nigeria. Analysis of the results showed that syllabus connectedness, perceived usefulness and self-efficacy are significant predictors of the intention of teachers to adopt digital game-based learning in the classroom. In addition, the results showed that teachers' demographics affect their intention to use digital educational games. The study provides a deeper understanding of the characteristics of teachers and how these influences their disposition to adopt digital educational games for classroom use.

Although this work is all within the context of the schools in Nigeria and the insights acquired may differ in other settings, the extended TAM should be easily modified for use in other settings. More specifically, this study provides this understanding for environments where technology is not very common and elicits teachers' concerns to adoption, use and effectiveness. The study also contributes to the body of research around the TAM and provides valuable and critical insight for schools, policy makers, technology practitioners and other stakeholders involved in the implementation of technology in the classroom and other digital literacy initiatives.

X. LIMITATIONS AND FUTURE WORK

As with other research studies, this study had some limitations and shortcomings. These shortcomings could be addressed in future work. Firstly, the research sample was drawn from a part of Nigeria and as such is not representative of the whole population. Thus, findings from this research cannot be generalised and should be treated with caution as states and regions in Nigeria have varying levels of development, especially with respect to digital penetration. The constructs in this study were the population of study was not representative of the research sample and may produce different results if taken into another context. Finally, the behavioural intention construct was measured at a single point in time and as such the researchers may have missed out on capturing some changes that may have occurred if the study was conducted over a period of time. This kind of research would thus benefit from a more longitudinal approach.

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