Development of Interactive Multimedia-Based Courseware for Early Childhood Education using Authoring Systems

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Abstract

The study developed an interactive multimedia-based courseware (IMBC) for preschools using authoring systems. Five specific purposes, five research questions and three null hypotheses guided the study. The Research and Development (R&D) design based on the theoretical foundation of Incremental Software Development Model (ISDM), was adopted for the study. The study involved four phases: Phase I (Needs assessment); Phase II (Development of the IMBC); Phase III (Validation of the IMBC); and Phase IV (Trial-testing the IMBC). The participants for the study comprised five (5) ICT experts, nine (9) lecturers in the Department of Computer & Robotics Education, 69 parents, and 35 preschool teachers. Structured questionnaire were developed and used for data collection. The reliability of the questionnaire was determined using the Cronbach Alpha method, and an overall reliability coefficient of 0.83, was obtained. Mean and standard deviations were used to answer the research questions while t-test statistic was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed that IMBC proved to be effective in teaching basic literacy and numeracy to preschoolers. Preschool teachers and parents were satisfied with the contents of the IMBC. The study also revealed that preschoolers were excited with the IMBC, because, it actively engaged them in the learning process, and helps them in identification and classification of objects shown on the screen as well as in spelling and pronunciation of words. Based on the findings of the study, the researchers recommended that preschools should be equipped with modern ICT gadgets to encourage the integration of innovative products into the curricular of early childhood education. The preschool teachers should be trained regularly on the effective ways of implementing ICTs in the classroom.

Keywords: Multimedia, Interactive Multimedia, Preschool, Authoring Systems, Courseware

Introduction

Early childhood education is the type of education given to children in their formative early years in order to prepare them for further education. Section 2 of the National Policy on Education (NPE) refers to early childhood/pre-primary education as education given in an educational institution to children prior to their entering the primary school (Federal Republic of Nigeria (FRN), 2004). It includes the creche, the nursery and the kindergarten (FRN, 2004). The objectives of early childhood education, according to the NPE document, include inculcating in the child the spirit of enquiry and creativity through the exploration of nature, the environment, art, music and playing with toys, etc.; developing a sense of co-operation and team-spirit; learning good health habits; and teaching the rudiments of numbers, letters, colours, shapes, forms, etc.

Children are seen as the future hope for tomorrow and it is the desire of parents to provide their children with the basic knowledge and skills that will improve their wellbeing and guarantee their future education and career. It would therefore be disappointing if the expectations of parents, communities and the society were not actualized because of poor training of children at the early

stages of life especially in this era of digital technology. According to Preradovic, Unic, and Boars (2014), introducing innovative teaching and learning approaches in early education are vital in educating the digital citizens who grow up in the world of modern technologies.

Today's young learners grow up in the world of internet technologies unlike the previous generations (Nwangwu et al., 2024). Several studies have revealed that digital technologies such as interactive multimedia-based courseware gives young learners the opportunity to be actively involved in their learning experience, enhances their social, language and cognitive skills as well as enables them to discover the world around them (Overton, 2015; Kneas & Perry, 2015; Munoz 2018; Scott 2021). Interactive multimedia-based courseware (IMBC) refers to digital content that allows user interaction with dynamic and immersive experiences by integrating multiple forms of media, such as text, audio, video, images, and animation that simplify the learning process. According to Encyclopedia Britannica (2017), interactive multimedia-based courseware is any computer-delivered electronic system that allows the user to control, combine, and manipulate different kinds of media, such as text, sound, video, computer graphics, and animation. It is one of the innovative strategies that can be employed in teaching and learning process in early childhood education. Children of nowadays are born into the world of digital technologies and would prefer being taught with interactive multimedia courseware to enable them compete favourably with their counterparts globally. The benefits of age-appropriate interactive multimedia-based courseware include its ability to make learning fun, motivate pupils to learn and to create an opportunity for them to become active participants in the learning process (Nwangwu, 2024; Rvachew 2021; Open Colleges 2020).

Children learn fast by what they see and hear which makes them audio-visual learners. However, Baird (2022) pointed out that children of nowadays do not only visualize and listen to contents but also manipulate devices at their disposal for interactive learning, which could improve their mastery of learned contents, knowledge retention, motivation to learn, control over what they learn, and improvement in their academic achievements. In order to achieve this aim, there is need to digitalize the curricular of the early childhood education especially the basic literacy and numeracy curricular to augment the face-to-face mode of teaching and learning. Education stakeholders should encourage the development and use of indigenous-based interactive multimedia courseware in early childhood education since most of the available courseware are foreign-based. This will help in promoting the African culture, language, teaching and learning patterns, among others. According to Nwangwu (2021), most foreign-based multimedia tutorials are often linear, somehow blurred with inaudible narrations, and often play so fast that learning with them can be challenging. These limitations motivated the researchers to develop an indigenous-based interactive multimedia courseware for teaching literacy and numeracy in early childhood education in Nigeria.

The implementation of interactive multimedia courseware in early childhood education requires the dedication of the teacher in ensuring that the pupils are well guided in using digital technologies for their learning. The teacher input makes facilitation of the learning process easy, provides support to the children, and guides them in using digital technologies responsibly. A study by

Ganyaupfu, (2013) revealed that teacher-student interactive method was the most effective teaching method, followed by student-centered method while the teacher-centered approach was the least effective teaching method.

Interactive multimedia-based courseware (IMBC) are developed using authoring tools such as Adobe Animate, iSpring Suite, Adobe Captivate, Camtasia Studio, etc. Nichols (2024) defined an authoring tool as a program that enables developers to create a digital course and publish it in select formats. Instead of using code to manually create a course, an authoring tool lets developers use drag-and-drop and other user-friendly interfaces to make a course – no coding required (Nichols, 2024). According to Stanojevic (2024), authoring tools are those used to create, collaborate, integrate, and publish engaging and interactive content meant mostly for training and educational purposes. Similarly, Andreev (2024) refers to authoring tool as software application or platform that enable users to create multimedia content, including text, graphics, audio, and video, in a cohesive and interactive format. The use of the authoring systems for the development of the courseware is because such systems allow the use of scripting language and pre-programmed elements for the development of interactive multimedia software titles, and they are easy to use by non-programmers to create enriching contents. According to Avelino (2023), authoring software applications are designed to improve and simplify the entire process of digital learning content creation; are easy to use and have many useful features, like course customization, gamification, and quiz creation; and are primarily used by experts, managers, and trainers looking to train, educate, and upskill their workforce.

The present study developed an IMBC for teaching literacy and numeracy using Adobe Animate and other authoring/multimedia tools. Adobe Animate was developed by Adobe for use in designing vector graphics and animation for television series, online animation, websites, rich web applications, game development, commercials, and other interactive projects (Wikipedia, 2024). The program also offers support for raster graphics, rich text, audio video embedding, and ActionScript 3.0 scripting. With Adobe Animate, developers can quickly publish to multiple platforms in just about any format and reach viewers on any screen (Adobe, 2024).

Despite the benefits of interactive multimedia-based courseware in early learning, it is surprising that in this era of ICT proliferations, most public and private preschools in Nigeria still subject the young learners to learning basic literacy skills (numeracy, writing, reading and life skills), in a hard way, using marker and whiteboard (and in some cases, blackboard and chalk). The children, who are supposed to learn through animated audio-visual contents projected on the digital screen or installed in the school tablets, are made to read abstract contents that are difficult to understand. Children are forced to resort to rote memorization, which do not promote mastery and long-term retention of learned concepts. This negatively affects children's interest in learning leading to possible drop out of school, refusal to go to school, or loss of interest in education. Therefore, teaching children with digital technologies such as interactive multimedia-based courseware will expose children to real-life practical-oriented concepts in areas of literacy and numeracy. Studies (Wong & Neuman 2016; Barasa, Barasa, & Omulando 2020; Rvachew 2021) revealed that the use of multimedia in preschools provokes the interest of young learners in learning, simplifies their

understanding of abstract and difficult concepts, boosts their confidence in approaching new issues creatively, and improves their problem-solving skills.

Statement of the Problem

Early childhood education in Nigeria is struggling to adopt and implement best practices required to educate young learners in ways that motivate them to engage in learning activities. The Covid-19 pandemic crises exposed the low level of integration of digital technologies in early education and training. In Nigeria, the young learners, who were locked down at home due to the Covid-19 pandemic, were mostly taught remotely through radio broadcast, and in some cases, with the use of WhatsApp to post scanned notes or written texts. These deprived children who learn through animated interactive audio-visual materials of quality learning during the pandemic era.

Some other challenges faced in teaching young learners include the use of foreign-based cartoons that are not appropriate for African culture since most of them teach children violence, sex abuse (or pornography), as well as the challenge of language barrier, among others. Furthermore, the production of indigenous digital contents for early childhood education has not been given adequate attention it deserves. In Nigeria, content creators often focus mainly on creating contents for secondary and tertiary education (Adetona, Ogunyemi & Oduntan, 2021), with little or no attention given to early childhood education. Little wonder Patti (2008) revealed that literacy achievement scores have been declining in Africa; and that young children drop out of school without acquiring the basic literacy skills. These concerns could be addressed by developing interactive multimedia-based indigenous courseware for early childhood education that will complement the face-to-face mode of teaching and learning.

Purpose of the study:

Generally, the study focused on the development of interactive multimedia-based courseware (IMBC) for early childhood education using the authoring systems. Specifically, the study:

1. developed IMBC for teaching literacy and numeracy in early childhood education
2. validated the functionality of the IMBC in teaching literacy and numeracy.
3. determined the level of user satisfaction with the developed IMBC.
4. determined the level of interest of preschoolers in using IMBC for learning literacy and numeracy.
5. determined the challenges facing effective use of IMBC in preschools

Research Questions

1. What is the level of functionality of IMBC based on expert validation?
2. To what extent are users satisfied with the developed IMBC during the trial-testing phase?
3. What is the level of interest of preschoolers in using IMBC for learning literacy and numeracy?
4. What are the challenges facing effective use of IMBC in preschools?

Hypotheses

The null hypotheses formulated to guide the study, which were tested at 0.05 level of significance, are:

HO_1: There is no significant difference between the mean responses of parents and preschool teachers on their level of satisfaction with the developed IMBC.

HO_2: There is no significant difference between the mean responses of parents and preschool teachers on the children's level of interest in using IMBC in learning literacy and numeracy.

Literature review

The use of computers in teaching and learning has been globally advocated in various disciplines of life. The early childhood education is not an exception. According to UNESCO (2022), the period from birth to eight years old is one of the remarkable brain developments for children and represents a crucial window of opportunity for education. Literature has established that the present generation of children who attend institutions of early learning were born in a completely computerized environment (Scott, 2021). They love playing computer ganes, watching cartoons, appreciate colourful presentations, and love hearing sound that keeps them motivated throughout the learning process. A number of digital tools are used to create digital contents that serve as instructional resources used in promoting learning performance in children. One of these digital contents or resources is the interactive multimedia-based courseware (IMBC).

Studies have found that the use of IMBC in early learning provokes the interest of young learners in learning and simplifies their understanding of abstract and difficult concepts (Baird, 2022; Nwangwu, 2024). Furthermore, studies by Zulfitrah (2020) and Gong (2022) revealed that IMBC were very effective in influencing early learning positively; improving efficiency; and enhancing the quality of classroom learning and academic achievement among preschoolers.

Nwangwu (2021) developed an interactive PowerPoint presentation design training package (IPPDTP) for lecturers of tertiary institutions. The findings of the study revealed that the contents of the training package were adequate and appropriate for the package; there were positive ratings of the package by ICT experts based on its level of acceptability; and the respondents were very satisfied with the use of the training package in mastering PowerPoint design and presentation. Akinbadewa (2020); and Mahawar and Bansal (2022) investigated the effect of multimedia instructional packages on students' academic achievement in Biology. The findings revealed that multimedia instructional packages significantly enhanced students learning of Biology concepts than the conventional strategy, regardless of gender and the preferred learning style of students. Similar studies have reported the increased academic success of students where multimedia techniques are applied, and this success was attributed to the ability of multimedia technology to capture students' interest and get them engaged in the course of learning (Park et al., 2019; Son & Simonian, 2016). Son and Simonian (2016) opined that supplementing traditional teaching classroom with multimedia learning tools could enhance students' motivation to learn, and make them active in the learning process, thereby, improving practice. A study on analysis of software

interactivity revealed that the iC-COM courseware conducted by Bahrudin et al. (2011) revealed that the multimedia courseware provides opportunity for interaction with standardized icons and allows learners to discover information through active exploration. According to Eze (2021), multimedia contents have the capability of attracting children to learning contents, through the presentation of multimedia elements such as cartoons, characters, dialogues, sounds and movies that are able to stimulate the curiosity of younger users in learning new things.

Monserate (2018) conducted a study on the impact of technology on teaching effectiveness and academic performance of students. Results showed that students' academic performance was highly influenced by the teacher's effective teaching and by the teacher's computer literacy nor by their competence in technology; and no significant difference was found on self-efficacy among students' levels. Studies by Wong and Neuman (2016), Barasa, Barasa, and Omulando (2020), and Chuang and Jamiat (2023) revealed that educational media has the potential to foster early literacy and problem-solving skills in children, provoke their interest in learning, and simplify their understanding of abstract and difficult concepts.

On the issue of satisfaction with training packages in different disciplines, a study by Bahrudin et al. (2011) revealed that the users of an interactive courseware for learning basic computer system components rated the courseware content reliable, the interactivity sessions standardized, and the screen design helpful in manipulating the courseware. Similarly, a study by Salve-Opina (2014) revealed that users were satisfied largely with a developed computer-based online college English instruction. Nwangwu et al. (2021) assert that a well-developed computer-based interactive package or courseware plays a vital role in promoting active participation of learners during the instructional activities, leading to an increase in their learning achievement since many of such courseware are user-friendly, interactive, educative, and usable at one's own pace.

On the other hand, researchers had conducted studies on the challenges of implementing digital technologies in the early childhood schools. These challenges include lack of access to digital learning tools, distractions, increased workload of teachers, non-professional development of teachers, cost of purchasing modern digital technologies, internet connectivity issues, time factor, limited supply of electricity, and poor funding, etc. (Johnson, et al., 2016; Nwangwu, 2018b ; Nwangwu et al., 2024; Hermanto & Srimulyani 2021; Yildiz et al., 2022; Nikolopoulou 2022; Markuna 2022; Le 2022; Hau et al. 2022). According to Bent and Katja (2013), using multimedia can be time consuming. In terms of competencies, Boardbar (2010) revealed that teachers' computer competence is a major predictor of integrating ICT/multimedia technologies in teaching. The literatures reviewed in this study revealed that there was a consensus among authors and developers on the benefits of multimedia in teaching and learning. However, to the best knowledge of the researchers, no studies addressed the use of authoring system for the development of an IMBC in early childhood education in Nigeria, with particular focus on literacy and numeracy.

Methodology

The Research and Development (R&D) design that is based on the theoretical foundation of Multimedia Waterfall Process (MWP), was adopted for the study. The participants for the study

comprised 5 ICT experts, 9 lecturers in the Department of Computer & Robotics Education, 69 parents, and 35 preschool teachers. Purposive sampling technique was adopted in selecting the respondents and the schools that were involved in the study. This was because of the busy schedule of the respondents, which made the researchers to select only those that agreed to participate in the study. At the Kindergarten level, each class has two teachers: one teacher and one nanny. Both staff were given an equal opportunity to participate in the study. The instrument for data collection was a structured questionnaire developed to elicit information from the respondents on the functionality of the IMBC, their level of satisfaction with the IMBC, the level of interests of the preschoolers in using the IMBC for learning literacy and numeracy, and the challenges encountered during the implementation of the IMBC in preschools. Five experts validated the instrument: two experts from the ICT unit, two preschool teachers that teach the kindergarten section, and one expert from the academic planning unit, all from the University of Nigeria, Nsukka. The reliability of the instrument was determined using the Cronbach Alpha method, and an overall reliability coefficient of 0.83, was obtained. Mean and standard deviations were used to answer the research questions while t-test statistic was used to test the null hypotheses at 0.05 level of significance. For the interpretation of research questions, items >= 3.50 are Strongly Agree (SA); items >=2.50 and <= 3.49 are Agree (A); items >= 1.50 and <= 2.49 are Disagree (D); and items <= 1.49 are Strongly Disagree (SD). On the other hand, when the p-value is less than the significance level of 0.05, the null hypotheses were not upheld. However, the null hypotheses were upheld when the p-value is greater than the significance level of 0.05.

The Basic Contents of Literacy and Numeracy

The researchers conducted a preliminary investigation in the preschools selected for the study in order to find out the contents of the literacy and numeracy subjects that are taught to preschoolers. The literacy and numeracy curricular that are offered by the private and public early childhood schools vary slightly. However, based on the interactions with the preschool teachers, the researchers were able to harmonize the contents according to NERDC recommendations (NERDC, 2013). The literacy and numeracy concepts that were covered in this study include:

1. **Numeracy:**
   a. Identification and Reading of numbers
   b. Writing of numbers
   c. Recognition of numbers
   d. Counting for value

2. **Literacy:**
   a. Reading of letters
   b. Writing of letters
   c. Recognition of letters
   d. Word building

IMBC Development

The development of the IMBC began with the requirements gathering/needs assessment, which involves selection of the basic literacy and numeracy contents for preschoolers, and in seeking permissions from teachers and head teachers to participate in the study. The researchers first approached the head teachers to permit the preschool teachers to select and share with the researchers the areas (contents) of literacy and numeracy for incorporation into the IMBC to be developed. Although the contents vary among the participating early childhood education centres, the researchers harmonized all contents to address those peculiarities.

The study involved four phases: Phase I (Needs assessment/requirements gathering); Phase II (Development of the IMBC); Phase III (Validation of the IMBC) and Phase IV (Trial-testing the IMBC). The Multimedia Waterfall Model (MWP) model (See Figure 1) developed by Henning (2001) was adopted for the development of the IMBC. It is a four-phase model of interactive multimedia product development comprising Integration Planning (Analysis and Design), Multimedia Asset Production (text, images, video, music, animations, etc.), Asset Integration (Edit, Compile, Test), and Rendering (production of the final version of the multimedia product). The IMBC was developed using a number of software and authoring systems: Camtasia Studio (video editing and production), MS PowerPoint 2019 (creating 3D text, screen recording, color scheme and visual layout), Adobe Animate (Animation creation), Photoshop (image creation and editing), Audacity (Audio recording, editing and production), VB.Net (Integrated Development Environment). Smith (2024) identified the three stages of multimedia video production: pre-production (planning), production (shooting or integrating assets into multimedia development platform), and post-production (editing, compilation, testing). ICT/Computer & Robotics Education experts validated the functionality of the IMBC. The experts responded to the "IMBC Functionality" questionnaire and made useful suggestions that led to the final review of the package. The final product was deployed to preschools for use in teaching literacy and numeracy to pupils.

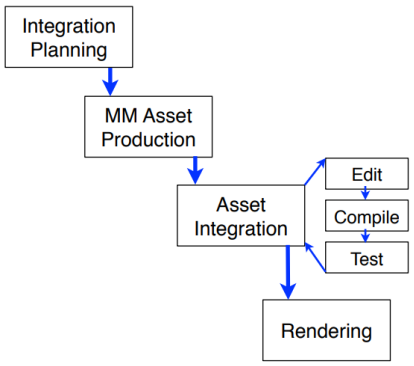
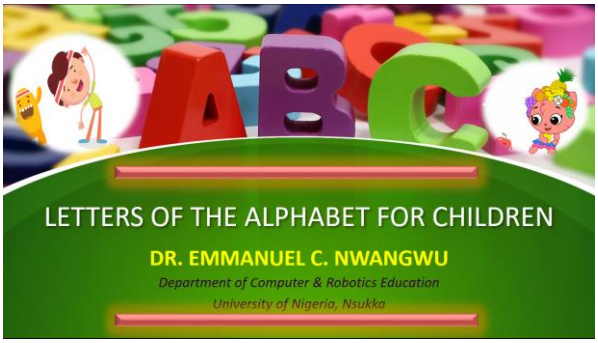


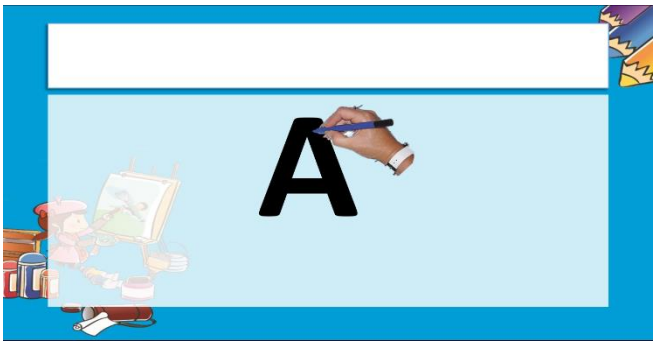
Figure 1: Multimedia Waterfall Process by Henning 2001 (adapted)
Source: https://www.medien.ifi.lmu.de/lehre/ss10/mmp/mmp8.pdf

IMBC Deployment

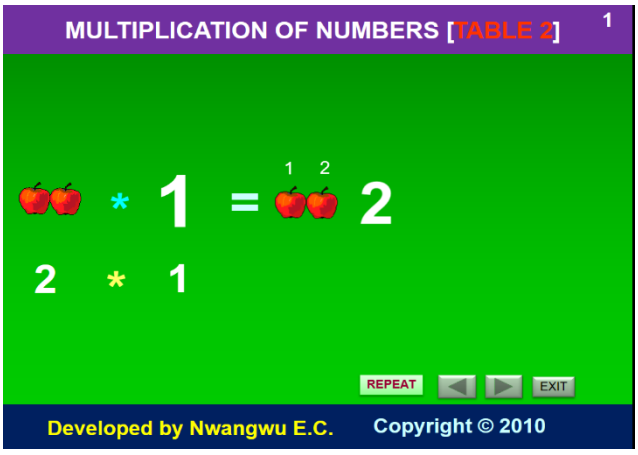
After the phases of development and validation of the IMBC, the researchers deployed the package to the participating preschools. With the permission of the head teachers, the researchers approached the preschool teachers to demonstrate how IMBC works and how it can be projected for students to view using a multimedia projector. The researchers and the preschool teachers agreed on the best ways to teach with the IMBC so as not to disrupt the normal school activities. The IMBC was further deployed to teachers' mobile smart phones through WhatsApp or Xender app. This enabled the preschool teachers to share the IMBC with parents in their respective WhatsApp group platforms while some parents received the IMBC through Xender app. WhatsApp and Xender apps were chosen for IMBC deployment because, Nigerians mostly use WhatsApp for online communication (Statista, 2024) while Xender app does not require the internet for file sharing. The parents were followed-up by the teachers through WhatsApp platform in order to ensure that they use the IMBC at home. After a week of deployment and use of the IMBC, the researchers shared the Google Forms questionnaire to the teachers and parents.



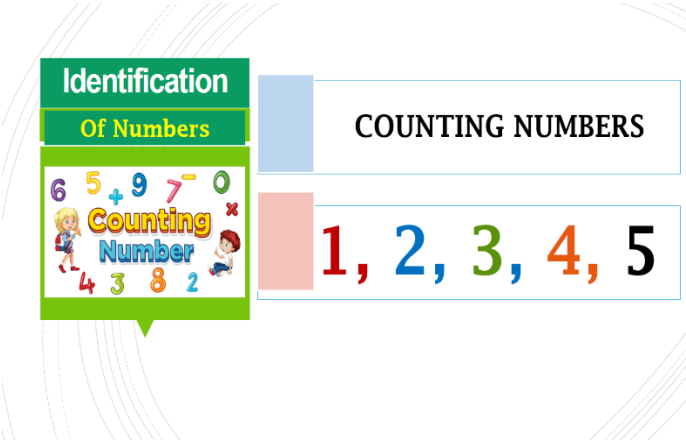
Learning Letters of the Alphabet



Writing Letters of the Alphabet (A)

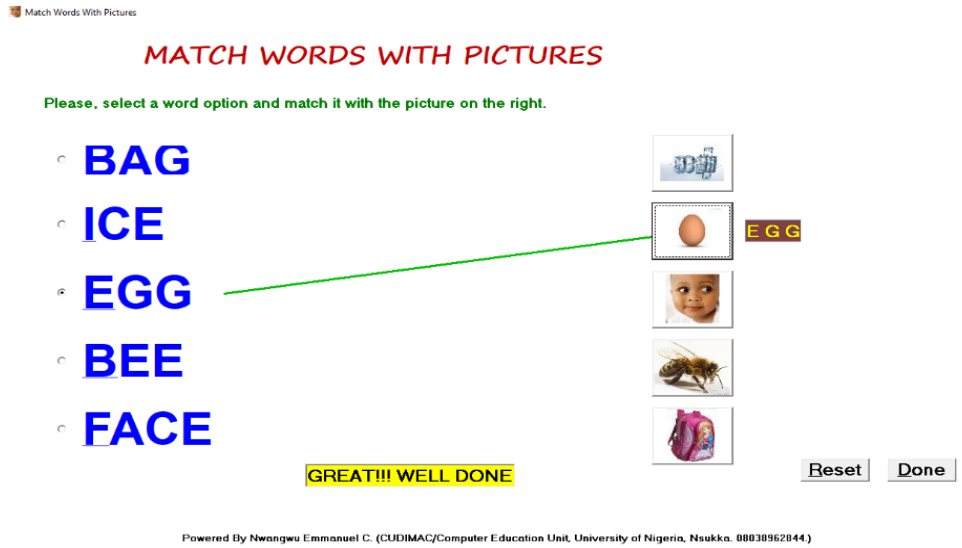


Basic Multiplication of Numbers (2)

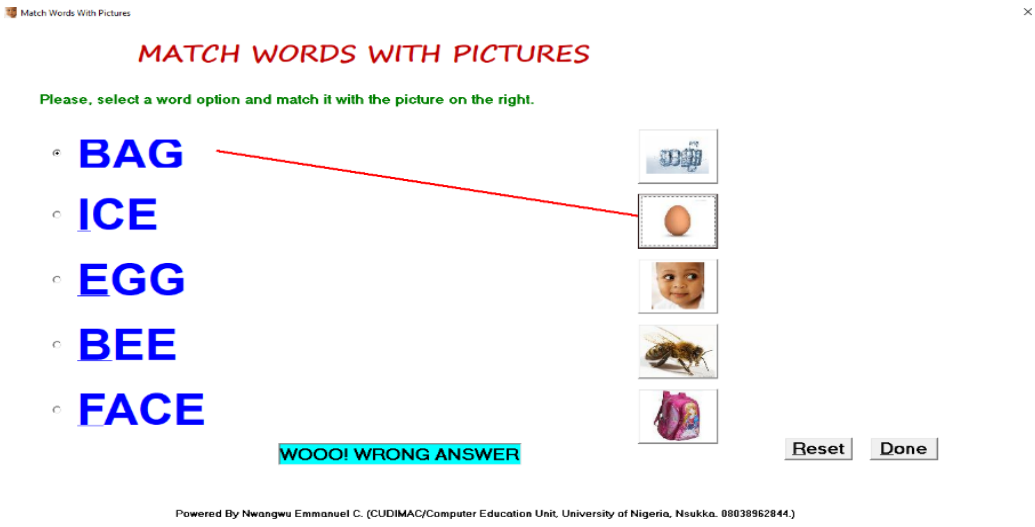


Identifying Numbers 1 - 5

Counting Numbers 1 - 5

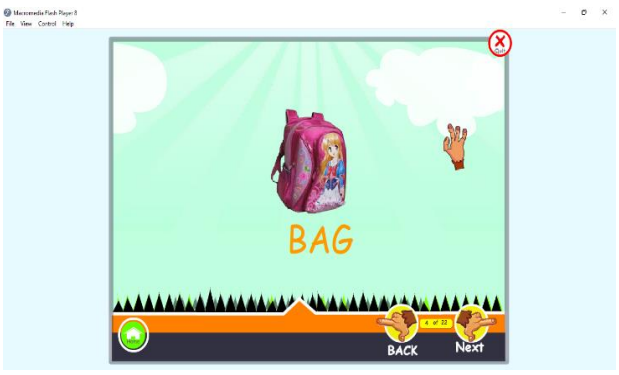


Matching Words with Pictures (Correct Answer)



Matching Words with Pictures (Wrong Answer)

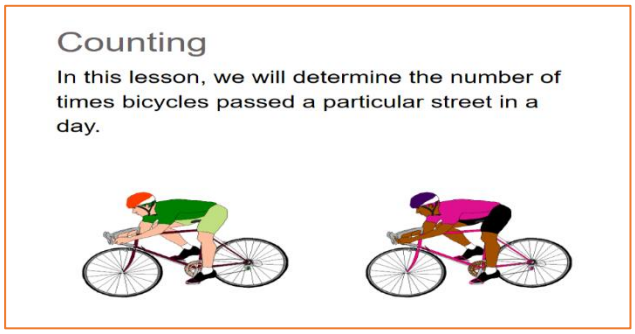
Word Formation Intro Screen



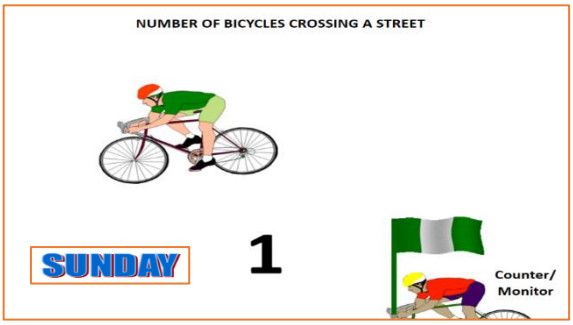
Writing of Words, e.g. "BAG"

Spelling and Pronunciation Intro Screen

Spelling/Pronouncing of Words, e.g. "BAG"



Learning How to Count Objects



Recording the Number of Objects Counted

Presentation of Results and Discussion of Findings

This section presents the results of the data analysis, findings and discussion of findings for the study. The presentation was organized according to the research questions and null hypotheses formulated to guide the study.

Research Question 1: What is the level of functionality of IMBC based on expert validation?

Table 1: Mean Ratings of Responses of Respondents on the Level of Functionality of IMBC based on Expert Validation

S/No	Items Statement	$\bar{x}$	SD	RMK
1	The IMBC accomplishes tasks efficiently	3.62	.50	SA
2	The performance of the IMBC was impressive	3.57	.51	SA
3	Navigating through the IMBC was a herculean task	1.43	.68	SD
4	The documentation or user guides for the IMBC is comprehensive, adequate and self-explanatory.	3.43	.60	A
5	I experienced system malfunction when operating the IMBC	1.12	.84	SD
6	The overall navigation experience was interesting	3.43	.51	A
7	The error messages or prompts embedded in the IMBC, was very helpful	3.38	.50	A
8	The IMBC's interface was user-friendly and easy to understand	3.58	.63	SA
9	It was easy to find the features I need in the IMBC	3.52	.51	SA
10	The IMBC produced accurate test results or answers to questions	3.53	.50	SA
11	The IMBC quickly responds to inputs and actions	3.58	.52	SA
12	The IMBC works well on digital devices like computer, phone, etc.	3.48	.51	A
13	The layout of the IMBC is intuitive and easy to navigate	3.48	.51	A
14	The icons and buttons in the IMBC are functional and easily located	3.58	.61	SA
15	The IMBC loads faster and performs tasks within an acceptable time frame	3.54	.65	SA
16	The IMBC design is consistent across different modules	3.29	.78	A

***Key**: $\bar{x}$ = Mean; SA = Strongly Agree; A = Agree; SD = Strongly Disagree; Rmk = Remark; N = 14*

The results in Table 1 revealed the perceptions of the respondents on the level of functionality of IMBC based on expert validation. The findings indicated that eight items had their mean scores greater than or equal to 3.50 ($\bar{x}$ >=3.50) representing "strongly agree"; six items had mean scores less than 3.50 but greater than 2.49 ($\bar{x}$ <3.50 and $\bar{x}$ > 2.49) representing "agree"; while two items had mean scores less than 1.50 ($\bar{x}$ <= 1.49) representing "Strongly Disagree". From the results in Table 1, it was observed that item 1 ($\bar{x}$ = 3.62); items 8, 11, 14 ($\bar{x}$ = 3.58); and item 2 ($\bar{x}$ = 3.57), had higher mean scores; while item 3 ($\bar{x}$ = 1.43) and item 5 ($\bar{x}$ = 1.12) had the lowest mean scores. These findings are in line with Nwangwu (2021), whose study revealed high level of acceptability with a developed Interactive Training Package by ICT experts. The findings in Table 1 also indicated that the IMBC's interface was user-friendly and easy to understand. This is in agreement with Nwangwu (2018a), Park et al. (2019) and Nwangwu et al. (2021) who revealed that a well-designed interactive multimedia training package that is user-friendly appeals to learners' interest to learn and improves their academic performance. Bahrudin et al. (2011), whose analysis of software interactivity, revealed that the iC-COM courseware provides opportunity for interaction with standardized icons and allows learners to discover information through active exploration. According to Eze (2021), multimedia contents have the capability of attracting children to learning contents, through the presentation of multimedia elements such as cartoons, characters, dialogues, sounds and movies. This indicates that navigating through the IMBC was not a herculean task as agreed by the respondents and that there was no experience of any form of system malfunction when operating the IMBC. Furthermore, the items in Table 1 had their standard deviations ranged from .50 - .84, which is an indication that the respondents were not far from mean and were close to one another in their opinions.

Research Question 2: To what extent are users satisfied with the developed IMBC during the trial-testing phase?

Table 2: Mean Ratings of Responses of Respondents on their Level of Satisfaction with the IMBC during the Trial-Testing Phase

S/No	Items Statement	$\bar{x}$	SD	RMK
17	The IMBC offers good and quality teaching on literacy and numeracy to pupils	3.29	.72	A
18	I am satisfied with IMBC's documentation and help resources	3.33	.66	A
19	The color scheme in the IMBC is capable of attracting pupils to use the package	3.53	.53	SA
20	The IMBC match my children's/pupils' expectations	3.43	.68	A
21	IMBC is easy to use in learning literacy and numeracy	3.52	.51	SA
22	The contents of the IMBC are very understandable	3.54	.52	SA
23	I am willing to recommend IMBC to teachers, parents and preschools	3.33	.66	A
24	The interface of the IMBC is very visually appealing and captivating	3.52	.51	SA
25	There are distracting or unnecessary elements in the IMBC	1.10	.87	SD
26	I often experience lag or delays while using the IMBC	1.13	.81	SD
27	I liked the video clips in the IMBC because they are highly educative and played smoothly to support learning	3.71	.64	SA
28	The IMBC is user-friendly and enjoyable	3.58	.57	SA
29	The audio narrations/voiceover are very audible and easy to understand	3.52	.60	SA
30	I want more of this type of multimedia courseware to be developed for Nigerian pupils	3.62	.50	SA
31	I think the IMBC is not appropriate for the Kindergarten children	1.33	.76	SD

***Key**: $\bar{x}$ = Mean; SA = Strongly Agree; A = Agree; Rem = Remark; N = 104; SD = Standard Deviation*

The results in Table 2 revealed the perceptions of the respondents on their level of satisfaction with the IMBC during the trial-testing phase. The findings indicated that eight items had their mean scores greater than or equal to 3.50 ($\bar{x}$ >=3.50) representing "strongly agree"; four items had mean scores less than 3.50 but greater than 2.49 ($\bar{x}$ <3.50 and $\bar{x}$ > 2.49) representing "agree"; while three items had mean scores less than 1.50 ($\bar{x}$ <= 1.49) representing "Strongly Disagree". From the results in Table 2, it was observed that item 27 ($\bar{x}$ = 3.71); items 30 ($\bar{x}$ = 3.62); and item 28 ($\bar{x}$ = 3.58), had higher mean scores. These are followed by item 22 ($\bar{x}$ = 3.54); 9 ($\bar{x}$ = 3.53) and items 21, 24, 28 ($\bar{x}$ = 3.52); while item 25 ($\bar{x}$ = 1.10); 26 ($\bar{x}$ = 1.13) and item 31 ($\bar{x}$ = 1.33) had the lowest mean scores. The findings are in agreement with Atreja et al. (2008) whose study revealed that the overall course satisfaction in a web-based training was good with more than 75% of the respondents satisfied with the training and 65% preferring web-based training over traditional instructor-led training. Furthermore, a study by Nwangwu (2018a) found that lecturers were highly satisfied with an interactive training package used for mastering PowerPoint design and presentation. The findings in Table 2 also revealed that the respondents strongly agreed that the interface of the IMBC is visually appealing and captivating. This is consistent with Koltow (2018) who asserts that the most visible element of a software is its user interface - the screens, dialog boxes, buttons, panes, and other parts of the application window. However, the respondents strongly disagreed that there are distracting or unnecessary elements in the IMBC. This is in contrast with a study by Knight (2021) who revealed that digital media and technologies are seen as great distraction tools in Australian family life because nine out of ten parents thought digital

devices negatively distracted their own lives, while 83 percent thought that their children were also negatively distracted by digital gadgets. Furthermore, the items in Table 2 had their standard deviations ranged from .50 - .87, which is an indication that the respondents were not far from mean and were close to one another in their opinions.

Research Question 3: What is the level of interest of preschoolers in using IMBC for learning literacy and numeracy?

Table 3: Mean Ratings of Responses of Respondents on the Level of Interest of Preschoolers in Using IMBC for Learning Literacy and Numeracy

S/No	Items Statement	$\bar{x}$	SD	RMK
32	The children/pupils were happy spelling and pronouncing words	3.63	.68	SA
33	The children always smile whenever IMBC was displayed on the board or shown to them on tablets	3.62	.60	SA
34	The children/pupils were able to clearly write letters of the alphabet on their "Learn How to Write" practice books	3.52	.69	SA
35	The color scheme in the IMBC captivates the children's interest in using the package	3.79	.61	SA
36	The movement of the objects on the screen (animated pictures, texts, videos, etc.) keeps the children engaged with the learning contents	3.52	.51	SA
37	The facial expressions of the students indicate that they love learning with the IMBC	3.71	.64	SA
38	After interacting with the package, the children continues to recite what they learn from the IMBC	3.42	.69	A
39	The children/pupils enjoyed all the modules in the IMBC	3.63	.68	SA
40	The IMBC is not appropriate for the pupils, hence, they lost interest in using it for their learning	1.43	.81	SD

***Key**: $\bar{x}$ = Mean; SA = Strongly Agree; A = Agree; Rem = Remark; N = 104; SD = Standard Deviation*

The results in Table 3 revealed the perceptions of the respondents on the level of interest of preschoolers in using IMBC for learning literacy and numeracy. The findings indicated that seven items had their mean scores greater than or equal to 3.50 ($\bar{x}$ >=3.50) representing "strongly agree"; one item had a mean score less than 3.50 but greater than 2.49 ($\bar{x}$ <3.50 and $\bar{x}$ > 2.49) representing "agree"; while one item had a mean score less than 1.50 ($\bar{x}$ <= 1.49) representing "Strongly Disagree". From the results in Table 3, it was observed that item 35 ($\bar{x}$ = 3.79); item 37 ($\bar{x}$ = 3.71); and items 32, 39 ($\bar{x}$ = 3.63), had higher mean scores. These are followed by item 33 ($\bar{x}$ = 3.62); and items 34, 36 ($\bar{x}$ = 3.52); while item 40 ($\bar{x}$ = 1.43) had the lowest mean score. This is in agreement with Park et al. (2019); and Son and Simonian (2016) who revealed that multimedia technology capture students' interest and get them engaged in the course of learning. According to Son and Simonian (2016), supplementing traditional teaching classroom with multimedia learning tools could enhance students' motivation to learn, and make them active in the learning process, thereby, improving practice. Furthermore, studies by Wong and Neuman (2016), Barasa, Barasa, and Omulando (2020), and Chuang and Jamiat (2023) revealed that educational media has the potential to foster early literacy and problem-solving skills in children, provoke their interest in learning, simplify their understanding of abstract and difficult concepts, and build in them the strong will to approach new issues creatively. The results in Table 3 further revealed that the

standard deviations of the items ranged from .51 - .81, which is an indication that the respondents were not far from mean and were close to one another in their opinions.

Research Question 4: What are the challenges facing effective use of IMBC in preschools?

Table 4: Mean Ratings of Responses of Respondents on the Challenges Facing Effective Use of IMBC in Preschools

S/No	Items Statement	$\bar{x}$	SD	RMK
41	The electricity supply in the school or at home has not been stable for effective implementation of IMBC in teaching and learning	3.63	.68	SA
42	The children/pupils displaying some characteristics of addiction with digital technologies	2.56	.75	A
43	The children found it difficult to write letters and words after learning with the package (IMBC)	1.13	.83	SD
44	The video clips in the IMBC load and play slowly because of their large storage capacity	1.48	.76	SD
45	Due to other class activities, there was no enough time for the children to have full and steady access to the IMBC	3.52	.51	SA
46	The IMBC is incompatible with my device which prevented it from working well in my device	1.57	.66	D
47	The video clips embedded in the IMBC plays so fast that it was hard for the children/pupil to comprehend.	1.71	.63	D
48	The activities in the IMBC are not enough to build pupils' cognitive, affective and psychomotor skills	1.43	.68	SD
49	Classrooms have limited ICT gadgets for sustainability of the project	3.33	.58	A
50	Installing or saving IMBC multimedia files take up a lot of space which affects the functionality of my device (e.g. smartphones)	2.21	.71	D
51	The children often got distracted with the visual layout, color scheme and animations included in the IMBC	1.58	.74	D
52	Nigerian teachers don't have the zeal to implement digital technologies in the classroom because of lack of motivation	3.42	.69	A

***Key**: $\bar{x}$ = Mean; SA = Strongly Agree; A = Agree; D = Disagree; Rem = Remark; N = 104; SD = Standard Deviation*

The results in Table 4 revealed the perceptions of the respondents on the challenges facing effective use of IMBC in preschools. The findings indicated that two items had their mean scores greater than or equal to 3.50 ($\bar{x}$ >=3.50) representing "strongly agree". Three items had mean scores less than 3.50 but greater than 2.49 ($\bar{x}$ <3.50 and $\bar{x}$ > 2.49) representing "agree"; four items had mean scores greater than 1.49 but less than 2.50 ($\bar{x}$ >1.49 and $\bar{x}$ <2.50) representing "Disagree"; while three items had mean scores less than 1.50 ($\bar{x}$ <= 1.49) representing "Strongly Disagree". From the results in Table 4, it was observed that item 41 ($\bar{x}$ = 3.63); and item 45 ($\bar{x}$ = 3.52) had higher mean scores. These are followed by item 52 ($\bar{x}$ = 3.42); item 49 ($\bar{x}$ = 3.33); and item 42 ($\bar{x}$ = 2.56); while item 44 ($\bar{x}$ = 1.48); item 48 ($\bar{x}$ = 1.43); and item 43 ($\bar{x}$ = 1.13) had the lowest mean score. The findings in Table 4 revealed that electricity supply in the schools or at home was not stable, which affects effective implementation of multimedia in teaching and learning. Findings also revealed that limited time and limited ICT gadgets in the classrooms are factors inhibiting effective use of multimedia in the classroom. These findings are in line with Bent and Katja (2013) who revealed that using multimedia could be time consuming. The findings of

the study are also in agreement with Johnson, et al. (2016), Nwangwu (2018b), Nwangwu et al. (2024), Hermanto and Srimulyani (2021), Nikolopoulou (2022), and Hau et al. (2022), who highlighted the challenges of implementing multimedia in the early childhood schools, to include lack of access to digital learning tools, non-professional development of teachers, time factor, limited supply of electricity, poor funding, among others. However, the results in Table 4 disagree/strongly disagree with statements like IMBC not compatible with digital devices, slow loading of the IMBC, video files in the IMBC playing faster than the level of comprehension of the pupils, etc.

Hypothesis 1: There is no significant difference between the mean responses of parents and preschool teachers on their level of satisfaction with the developed IMBC.

Table 5:
Summary of t-test Analysis on the Mean Responses of Parents and Preschool Teachers on their Level of Satisfaction with the Developed IMBC

Respondents	$\bar{x}$	SD	t	df	Sig. (2-tailed)	Rmk
Parents	3.55	.30	1.66	19	.11	NS
Teachers	3.34	.25				

Key: *$\bar{x}$ = Mean; SD = Standard Deviation; t = t-calculated; df = Degree Freedom; Rmk = Remark; NS = Not Significant*

The data presented in Table 5 revealed that the p-value is .11, which is greater than the significance level of 0.05, indicating that there was no significant difference in the mean responses of parents and preschool teachers on their level of satisfaction with the developed IMBC. Therefore, the null hypothesis of no significant difference was upheld. This is in line with Nwangwu et al. (2024), who found no statistically significant difference on stakeholders' perceptions of their level of satisfaction with online learning during the COVID-19 era.

Hypothesis 2: There is no significant difference between the mean responses of parents and preschool teachers on the children's level of interest in using IMBC in learning literacy and numeracy.

Table 6:
Summary of t-test Analysis on the Mean Responses of Parents and Preschool Teachers on the children's level of interest in using IMBC in learning literacy and numeracy

Respondents		SD	t-cal	df	Sig. (2-tailed)	Rmk
Parents	3.45	.34	.82	19	.42	NS
Teachers	3.34	.25				

Key: *$\bar{x}$ = Mean; SD = Standard Deviation; t = t-calculated; df = Degree Freedom; Rmk = Remark; NS = Not Significant*

The data presented in Table 6 revealed that the p-value is .42, which is greater than the significance level of 0.05, indicating that there was no significant difference in the mean responses of parents and preschool teachers on the children's level of interest in using IMBC in learning literacy and numeracy. Therefore, the null hypothesis of no significant difference was upheld.

Conclusion

The study focused on the development of an interactive multimedia-based courseware (IMBC) for early childhood education using the authoring systems. The findings of the study, based on the level of functionality of the IMBC, revealed that the respondents (ICT/Computer & Robotics Education experts) acknowledged that IMBC met the requirements and objectives for which it was developed. They agreed that IMBC accomplishes tasks efficiently, the IMBC performance was impressive, navigating through the IMBC was not a herculean task, the IMBC quickly responds to inputs and actions, among others. The study also surveyed the level of satisfaction of the respondents (parents and preschool teachers) with the IMBC. The findings revealed that the respondents were very satisfied with the IMBC in terms of color schemes, visual layout, ease of use, user-friendliness, presentation of high educative video clips, provision of clear documentation and help resources, among others. Furthermore, the study investigated the interest of children/pupils on the use of IMBC in learning literacy and numeracy. The findings revealed that the pupils developed interest in the use of the IMBC for their learning. They were happy spelling and pronouncing words, the visual layout and the color scheme of the IMBC attract the pupils to the package, the animated elements embedded in the IMBC keeps the children engaged with the learning contents, their facial expressions indicate that they love learning with the IMBC, among others. Also determined in this study are the challenges facing effective use of IMBC in preschools. These challenges include limited electricity supply in schools and at home, the children displaying some characteristics of addiction with digital technologies, limited ICT gadgets for sustainability of the project, and the Nigerian teachers do not have the zeal to implement digital technologies in the classroom because of lack of motivation, among others. The null hypotheses tested at .05 level of significance revealed that there was no significant difference in the opinions of parents and preschool teachers on their satisfaction with the IMBC as well as on the children's level of interest with the IMBC.

Recommendations:

Based on the findings of the study, the following recommendations are made:

1. Preschools should be equipped with modern ICT gadgets to encourage the integration of innovative products into the curricular of early childhood education.
2. The government and philanthropists should regularly train and retrain Preschool teachers on courseware development and ICT implementation in schools.
3. Steady electricity should be provided in preschools by the government to encourage and sustain the regular use of ICT in the classroom.
4. School administration and the government should always motivate preschool teachers through provision of free modern ICT gadgets, scholarships for further studies, stipend for data subscription, among others.

Acknowledgement

The authors acknowledged the Tertiary Education Trust Fund (TETFUND) University of Nigeria, Nsukka Chapter as the sponsor of this research with the research project no. (TETF/DR&D/CE/UNI/NSUKKA/BR/2024/VOL.IB). Your financial assistance contributed to the success of this work. We are very grateful for your magnanimity. Thank you so much.

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