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Development and Validation of Digital Photo Series for the Teaching of BT in Ilorin, Nigeria

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ABSTRACT

The essence of basic technology (BT) in the secondary school curriculum is to assist learners to develop an interest in technology and introduce students to the basic rudiment of technology. Thus, BT teachers must use relevant instructional media that would help in achieving the aims of BT in secondary. This study developed and validated a digital photo series to teach BT concepts in upper basic schools in the Ilorin metropolis. The study adopted a design and development model type. Five BT teachers and three educational technology experts were randomly selected to participate in the study. Three research instruments were used in this study, a developed digital photo series on the BT concept, an educational technology expert rating guide, and a subject content validation questionnaire. Digital photo series was successfully developed to teaching upper BT. Educational technology experts agreed that the developed digital photo series satisfied the required expectation. The cost for developing digital photo series was determined. The study concluded that the digital photo series is a powerful instructional tool that can enhance the teaching of BT in Nigeria. The findings imply that schools should adopt the use of digital photo series in the teaching and learning of BT to concretize learning contents and increase students' performance.

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1. INTRODUCTION

The evolvement of science and technology was spun from the everyday efforts of humans trying to improve their way of life. In today's information society that is characterized by the advancement in science and technology, the ability to read and write is crucial for maximizing success in the endeavors of daily life, continuing intellectual growth, and realizing personal potential. So, science and technology are the ground of almost all processes of learning and acquisition of basic literacy skills to become a means of engaging with diverse forms of knowledge, understanding, and communication. Science has been regarded as the bedrock of modern-day technological breakthroughs (Chima *et al*., 2021). Defined science and technology as a dynamic human activity concerned with understanding the workings of the human world and the application of these understandings to the better human world. This understanding helps man to know more about the universe. Technology plays a functional role in wealth federation, improvement of the quality of life, real economic growth, and transformation in any society. Nowadays, countries all over the world, especially the developing ones like Nigeria, are striving hard to develop scientifically and technologically. Science and technology have become the cornerstone of progress upon which Nigeria can depend to attain self-reliance and self-sustaining growth and development.

Science and technology can be seen as an essential tool for national development as well as an instrument for preparing the youth to face the unfolding challenges of the modern world. Science and technology lead to improved human potentials, capacity, and subsequent elimination of reduction of poverty, inequality, unemployment, and generally enhanced conditions for human existence and self-reproduction. Technology for educational purposes will enable students and teachers to build a new educational environment by using tools that not only process information but also allow the learner to investigate, manipulate, test, and extend knowledge (Biletska *et al*., 2021). The adoption of science and technology in national life marks the beginning of development for any nation. Policymakers recognize its importance to both the social and economic growth of a developed and developing country. Education is regarded as a core instrument for national development. It is stated in the National Economic Empowerment and Development Strategy that education is used to empower the people. A good educational system is a strong base for technological development. It equips people with knowledge and skills for designing methods and processes that will enable them to make maximum use of their natural resources for the benefit of society.

Similarly, defined technology as the use of the product of creativity, inventions, and scientific research in the service of man (Spence *et al*., 2021). Described technology as the process by which humans modify nature to meet their needs and wants. Hence, the development of a nation also depends on the type of technology education, the process of impartation inherited or invented, and the ability to train its citizens to sustain the level of such technological education development. In years back, the teaching of technology education was not made a major focus at the lower level of the Nigerian educational system most especially at the secondary school level. To address the lapses, the Federal Ministry of Education brought about the former 6-3-3-4 system that introduced the teaching of introductory technology (IT) as a subject in junior secondary schools in Nigeria. Stated that what is now technology education was formerly restricted to technical education which in essence meant skills training in crafts and certain trades and can be used interchangeably. Due to the overwhelming desires of the world for technological development, the Nigerian government had a new educational reform that birth a new system called Universal Basic

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Education (UBE), and also joined the force for the introduction of the teaching of technology in Nigerian secondary schools, the technology subject is called basic technology (BT). The prescribed BT is a compulsory subject in the 9-year basic education program. Its purpose according to the report is to contribute to the achievement of the national education goals by the inculcation of technology literacy, exposure of students to the world of work to match their talents and interests for wise vocational choice, and inculcation of positive attitudes towards work as a source of human identity, livelihood, and power.

The teaching of BT according to the Report of Nigerian Educational Research and Development Council became necessary due to technological development and increased national policy orientation towards vocational education development. BT that was previously known as Introductory Technology (IT) was structured to assist learners to develop an interest in technology. It is one of the essential pre-vocational and integrated subjects offered in Upper Basic Schools in Nigeria which introduces students to the basic rudiment of technology. BT is a core subject of the 9-3-4 System of Education in Nigeria today that involves the academic and practical study of materials. This subject is expected to whet the appetite of learners for skill subjects. The BT is also an integrated study of skills subjects such as woodwork, metalwork, building technology, auto mechanic, electrical/electronic, ceramics, and technical drawing (Olaniyan & Ojo, 2008). As the subject implies, BT combines so many skill subjects or courses at their basic levels from which learners can choose a career in the future.

The BT curriculum is structured in such a way that, at the end of the first three years in upper basic classes, students should at least be capable to be literate about Artisans and Craftsmen (Babafemi *et al*., 2000). Observed that studying BT will afford one to acquire the knowledge and skill to understand how and what leads to the economic development of the community. We stressed further that knowledge acquired from BT can be applied to all human life such as religion, business, politics, academics, social, among others. In the junior secondary curriculum, BT includes a broad range of fields of study and subjects such as auto mechanics, applied electricity, building, ceramics, metalwork, woodwork, plastics, rubber, food preservation, storage, technical drawing, and other miscellaneous topics. The BT course is meant to provide a holistic view of technology to students. The subject guidelines and contents have been carefully structured into a teaching sequence, which consists of clear explanations and descriptions of how results are obtained by using different tools, machines, and materials. BT is also a skill development course, which aims at providing students with technical literacy for everyday life. BT at this level is also meant to provide basic knowledge about industrial technology. It is designed to develop in students an appreciation of technology and an interest in specific areas of industrial technology.

The broad aim of secondary education, among others, is to equip the students to live effectively in our modern age of science and technology (Okenjom *et al*., 2016). Stated that one of the basic needs for teaching technical and vocational subjects in upper basic schools is to enable each learner to acquire appropriate skills, abilities, and competence as equipment for such learner to live in, and contribute to the development of the society. Despite the relevance of BT, the cry for poor implementation of the curriculum for BT still poses a challenge to secondary education (Odu *et al*., 2013) lamented that unfortunately, a recurring problem besieging BT education since its inception has been the absence of adequate facilities to foster effective teaching and learning . This lamentation by Odu *et al*. (2013) necessitated (Okenjom *et al*., 2016) to suggest the adoption of improvisation of instructional materials by teachers of BT. We assert that improvisation of instructional materials is the preparation and the provision of alternatives to real materials as teaching aids. The

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inadequacy of instructional materials for teaching BT is therefore responsible for the idea of adoption of improvisation by teachers to be able to cover areas of need in the classroom situation.

The teaching and learning of all science subjects in general and in particular BT require a lot of instructional media. Instructional media are channels of communication through which messages, information, ideas, and knowledge are conveyed or disseminated to learners. Teachers use different approaches, methods, and instructional aids in the classroom. With the passage of time, new approaches, methods, tools, techniques, and aids are introduced and integrated into the classroom for instructional purposes to make the teaching-learning process effective. One of the most adopted instructional aid in the classroom is visual aids. Visual aids are those instructional aids that are appealing to the sense of sight and are used in the classroom to encourage students' learning process. According to Ghulam *et al*., (2015) visual aids are those visual sensory objects or images which initiate or stimulate and support learning. Visual aids are tools that help to make an issue or lesson clearer or easier to understand. These include pictures, models, charts, maps, videos, slides, real objects, flashcards, slides, overhead projectors, chalkboards, among others. Out of these visual aids, the use of the chalkboard is the commonest one used in teaching BT. The challenges of classroom instruction increase when prescribed a topic to the class while textbooks are constituted with too many interactive expertise activities that students find unclear Ghulam *et al*., (2015), compare to the use of other visual aids like photography.

Teachers usually adopt visuals aids as instructional material to support oral presentations, to make the concepts clear, situated, and to facilitate focus on relevant elements. Visual aids arouse the interest of learners and help teachers to explain the concepts easily. Photographs support the mediation process and often draw on a representational repertoire. There are many studies about the impact of digital images and text on learning. Identified specific visual functions (communicative and psychological), principles of Multimedia Learning, and the Theory of Cognitive Load, which consider the crucial role of the image in understanding oral and written text are well known. Photographs would be special in opening the way rather than reducing the cognitive and semantic ambiguity. Such ambiguity or the certainty of a number of possible interpretations could be exploited by the teacher. The teacher's role is to guide the learners to deep understanding and one way in which images support brain work is concepts visualization. Photography provides an understanding of advantageous access points, through images, it is possible to play with the WOW effect, or to use images with the intent of stitching, to intrigue, to activate interest through known situations or subject photographs, it is possible to understand what is unknown, urging perceptual stimulation and stress the emotional encoding role (Damasio *et al*., 2012). The combination of images with/without captions or small comments to illustrate ideas, emotions, and concept is a major aspect of photography. This aspect of photography is called photo series or photo essay.

Photo series in its simplest form is a series of pictures that evokes an emotion, presents an idea, or helps to tell a story. Photo essays or photo series can feature text through articles and descriptions, or they can stand alone with simple captions to give context. The versatility of photo series has helped the medium become a part of a different culture for centuries, from the American civil war to modern environmental disasters like the 2010 Earthquake in Haiti. This versatility has also helped photo essays to be a great instructional asset in classrooms today, teachers can use them in any content area and students can also use them to show concepts. Posits that math students can use photo series to show geometric concepts in a real-life situation.

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Photo series is a collection of images that are placed in a specific order to tell the progression of events, emotions, and concepts. We asserted that photo series takes the same storytelling techniques as a normal essay, translated into visual images. A photo essay isn't simply for photojournalists, but can also be adopted by classroom teachers to facilitate instruction in the classroom. Visuals have been an important component of classroom instruction over the years. Ramírez *et al*., (2012) asserted that the use of visuals aids like phot-series for presenting, training, and teaching languages has been around since the 1920s – 1930s, consisting mainly of film strips, pictures, slides, and pass-around objects. The importance of visual material like photo series in the process of knowledge acquisition was researched by scholars belonging to the Cognitive approach. Some of the theories that these scholars have developed are related to the importance of the input, dual-coding theory, and image schema theory, which are deeply linked with the visual and experimental relationship of the human being with the world. Cognitivism alleges that knowledge acquisition can be better understood by focusing on how the human brain processes and learns new information.

Visuals have been considered a useful tool for teachers in almost every trend of teaching in different subjects. Such was an impact of visual materials that several universities have even created catalogs of visual aids that trace the history of using visual literacy and a visual education. Visual aids can be a helpful tool in the classroom as pointed out that they help the teacher to clarify, establish, correlate and coordinate accurate concepts, interpretations, and appreciations, and enable the teacher to make learning more concrete, effective, interesting, inspirational, meaningful and vivid. Visual material or anything uses to help the student see an immediate meaning in the lesson content may benefit the student and the teacher by clarifying the message, if the visuals enhance or supplement the lesson content point. These advantages suggest that visuals can help make a task or situation more authentic. We claim that visual aids help in motivation and maintaining attention by adding variety and making the lesson more interesting. Early researchers such as Petterson *et al*., (2004) seem to agree with the idea that the memory for picture-word combination is superior to memory for words alone or pictures alone (Petterson *et al*., 2004). Memory for pictures is superior to memory for words and this effect has been called the Pictorial Superiority Effect (Petterson *et al*., 2004). Some other researchers as Barry et al., (2001) claimed that persuasion tends to be accomplished in both children and adolescents almost exclusively through imagery and that those images and visuals speak directly to individuals in the same way experience does: holistically and emotionally. Thus, using images in teaching practices is a need, an opportunity, and a challenge for the modern teacher. Hence, the development and validation of a digital photo series for teaching practices especially for BT are quintessential and imperative.

Instructional packages tentatively contain instructions: they are to be designed in ways that would best optimize the best conditions for the learners for learning to take place. Instructional packages should be carefully planned and developed based on the use of instructional models. Teachers should ensure the meticulous use of instructional packages in accordance with the stated instructional goal and objectives (Amosa *et al*., 2013).

Models for developing instructional packages, just to state a few include the ADDIE model, Dick and Carey model, Smith and Ragan model, as well as Gerlach and Ely model. While there are a lot of instructional design models, the ADDIE model still is the most widely used model, which includes the generic phases found in most of the subsequent models. The Dick and Carey model according to made a significant effort to build on the ADDIE model. It adopted a system view of instruction which recognizes instruction as a whole system that focuses on the

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interrelationship between contexts, content, learning, and instructional technique. The Dick and Carey model is a nine-step model of interrelated components. The component summarily includes the need to identify instructional goals, conduct instructional analysis after which the learners and the context are analyzed, the performance objectives are written, and then used to develop assessment instruments and instructional strategy after which the instructional package is then selected and developed. The final component of the aforementioned model is evaluation. Asserted that the model focuses on the learners' objective and achievement before the planning and implementation stage, hence the systems approach. The study went further to highlight the linkage between instructional strategy and desired to learn the outcome. Based on the background of this study, a digital photo series will be developed and validated for teaching BT in upper basic schools in the Ilorin metropolis.

Evidence from different studies shows that the failure rate in science and technology subjects at junior and senior certificate examinations is high (Odu *et al*., 2013). This could be attributed to a number of factors; one of such factors is the lack or total absence of instructional materials. In teaching and learning, instructional materials play a key role in concretizing learning. Instructional materials make learning meaningful and help to improve students' academic achievement. However, these advantages of instructional materials have not been reflected in the education system because of the dearth of these instructional materials in our schools. Hence, the need for the development and validation of a photo series to serve as instructional material to facilitate the teaching-learning process of BT in upper basic schools. Moreover, students are characterized with different learning styles (visual, auditory, and kinesthetic), with the use of visual media like photo series, teachers can now address the needs of each learner according to their learning style. Thus, the development and validation of a digital photo series on BT for upper basic schools are quintessential.

The following research questions were raised and answered to guide this study:

(i) What are the processes involved in the development of a digital photo series to teach BT concepts in upper basic schools in the Ilorin metropolis?
(ii) How did educational technology experts rate the developed digital photo series to teach BT concepts in upper basic schools in the Ilorin metropolis?
(iii) What are the BT teachers' ratings for the validation of the developed digital photo series?
(iv) What is the cost of developing the digital photo series?

Research instruments are:

(i) A developed digital photo series on BT for upper basic schools in Ilorin metropolis.
(ii) Educational technology experts rating guide was used in the validation of the developed digital photo series in BT for upper basic schools in the Ilorin metropolis. The rating guide will contain two sections; Section A contained the demographic information of respondents, while Section B contained items on the rating guide on the developed digital photo series in BT for upper basic schools in the Ilorin metropolis. The items in section B were rated on a modified Likert Mode Scale of Strongly Agree (SA), Agree (A), Strongly Disagree (SD), Disagree (D), and Undecided (U) with a weighted value of 5 to 1 in terms of scoring.
(iii) A subject content validation questionnaire was used in collecting data on the reaction of BT teachers on the developed digital photo series in BT for upper basic schools in the Ilorin metropolis respectively. The questionnaire contained two sections; Section A contained the demographic information of respondents, while Section B contained items on the subject content of the developed digital photo series in BT for upper basic schools in the Ilorin metropolis. The items in section B were rated on a modified Likert Mode Scale of

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Excellent (E), Good (G), Fair (F), and Poor (P) with a weighted value of 4 to 1 in terms of scoring.

In the validation of research instruments, Three lecturers in the Department of Educational Technology, University of Ilorin validated the questionnaire. This was to determine the appropriateness of the instruments and to ascertain their face and content validity. All corrections were effected immediately to improve the quality of the questionnaire. The corrected instrument was used to validate the developed digital photo series.

2. METHOD

The study adopted a design and development model type. The population for this study consisted of all BT teachers and all educational technology experts in Kwara state, Nigeria. Specifically, five (5) BT teachers and three (3) educational technology experts were randomly selected to participate in this study. In all, eight (8) respondents participated in this study.

The data collected and analyzed in this section represents the variables of focus for the study and background information on the development and validation of a digital photo series in BT for upper basic schools in the Ilorin metropolis. The demographic information in which data were collected and analyzed includes respondents gender and educational qualification obtained which are presented in **Table 1** as follows:

Table 1 reveals the distribution of BT teachers that were involved in the study based on gender. 80% of the respondents were BT teachers were male, while,1 (20.0%) were female.

Table 1. Distribution of BT teachers by gender.

Gender	Frequency	Percentage (%)
Male	4	80
Female	1	20
Total	**5**	**100**

Table 2 reveals the distribution of BT experts that were involved in the study based on gender. The table indicates that all the educational technology experts were male.

Table 2. Distribution of educational technology experts by gender.

Gender	Frequency	Percentage (%)
Male	3	100
Female	0	0
Total	**3**	**100**

Table 3 reveals the distribution of BT teachers that participated in validating the development of a digital photo series in BT for upper basic schools in the Ilorin metropolis based on their educational qualification. All the BT teachers were Bachelor's degree holders.

Table 3. Distribution of BT teachers by qualification.

Educational Qualification	Frequency	Percentage (%)
Bachelor's Degree	5	100
Master's Degree	0	0
Doctorate Degree	0	0
NCE	0	0
Total	**5**	**100**

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Table 4 reveals the distribution of educational technology experts that participated in validating the development of a digital photo series in BT for upper basic schools in the Ilorin metropolis based on their educational qualification.2 (66.7%) of the educational technology experts possess the highest qualification of Bachelor's degree, while, 1 (33.3%) of the respondents were Ph.D.

Table 4. Distribution of educational technology experts by qualification.

Educational Qualification	Frequency	Percentage (%)
Bachelor's Degree	2	66.7
Master's Degree	0	0.0
Doctorate Degree	1	33.3
Total	**3**	**100.0**

3. RESULTS

3.1. Research Question One: What are the Processes Involved in the Development of A Digital Photo Series for Teaching the BT Concept in Upper Basic Schools in the Ilorin Metropolis?

The development of a digital photo series for teaching BT in upper basic schools in the Ilorin metropolis was carried out using the Product Oriented Model which is a front-end system design with four phases (Course Outline, Selection of Media, Development/ Production of material, and Course Delivery). The course outline was selected from the BT syllabus. The images and audio file was downloaded from open-sourced websites most especially Google. The downloaded images and audio were further arranged and developed through the use of Microsoft Office 2016 PowerPoint logically and sequentially to create a series of images with captions explaining each woodwork tool and its function.

3.2. Research Question Two: How Do Educational Technology Experts Rated the Developed Digital Photo Series?

To answer research question two, an educational technology experts rating guide was used in the validation of the developed digital photo series in BT for upper basic schools in the Ilorin metropolis. The data were analyzed using mean, while the grand mean was used to determine the validation rate of the developed digital photo series. The benchmark of 3.0 of a 5 point Likert scale was adopted. The results of the analyzed data are shown in **Table 5**.

Table 5 indicates the mean score of educational technology experts on the developed digital photo series. The table revealed that the grand mean score of educational technology experts' rating of the developed digital photo series on BT concepts for upper basic schools in the Ilorin metropolis is 4.47 which is higher than the benchmark of 3.00. This implies that the developed digital photo series was well structured and the expectation in the developed digital photo series was achieved.

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Table 5. Mean score of educational technology experts for the validation of the developed digital photo series.

S/N	Statement	Mean
1.	Objectives are clear and precise	5.00
2.	The content is structured in a clear and understandable manner	4.00
3.	Objectives are observable and measurable	4.67
4.	The package contains detailed and accurate information	4.00
5.	The content of the package is up-to-date and effective for learning	4.67
6.	The content of the package is simple and free from bias to reinforce learning	4.67
7.	The package allows learners to discover information through active exploration	4.00
8.	The package has adequate and clear visuals	5.00
9.	The presentation of information in the package can captivate the attention of learners	4.33
10.	The package uses proper fonts in terms of style and size	4.33
	Grand Mean	**4.47**

3.3. Research Question Three: What are the BT Teachers' Ratings for the Validation of the Developed Digital Photo Series?

Table 6 indicates the mean responses of BT teachers in upper basic schools to the developed digital photo series. Using a benchmark of 3.0, the grand mean result revealed that the mean score for each of the ten (10) items on the questionnaire is above 2.5, while, the grand mean score for the ten (10) items is 3.64. This indicates that upper BT teachers have a positive reaction to the developed digital photo series.

Table 6. Percentages score of BT teachers for the validation of the developed digital photo series.

S/N	Items	Mean
1.	The contents of the digital photo series are inconsonant with the BT curriculum.	3.4
2.	The use of digital photo series to teach some selected concepts in BT will stimulate learners' interest.	3.6
3.	Digital photo series will help to make the teaching of BT easy and seamless	3.6
4.	Digital photo series can concretize the abstraction in BT.	3.2
5.	The use of visual imagery to enhance lesson content in the teaching of BT is wonderful.	3.6
6.	Students will prefer to learn BT with the use of digital photo series comparing to other traditional instructional materials employed to teach BT.	3.6
7.	The time to explain lesson content will be reduced because the captions in the digital photo series already explain better.	3.6
8.	The utilization of digital photo series can facilitate the easy achievement of lesson objectives.	3.8
9.	Better classroom interaction can be achieved with the utilization of digital photo series.	4.0
10.	With the use of digital photo series in teaching BT, effective classroom management can be achieved.	3.8

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3.4. Research Question Four: What is the Cost of Developing the Digital Photo Series?

In answering research question 4, the researcher calculated the total amount of the money spent in the development of a digital photo series on BT for upper basic schools in the Ilorin metropolis. The activities involved 4 steps, the rate at which they were executed and the amount spent on each activity were tabulated and presented in **Table 7**.

Table 7 indicates that the total sum of five thousand, four hundred and four naira (N5404) only was the cost estimate for the development and validation of a digital photo series to teach BT in upper basic schools in the Ilorin metropolis. The benefits of the digital photo series are unquantifiable and incomparable with the cost.

Table 7. The cost implication of developed digital photo series in BT for upper basic schools.

S/N	Activities	Rate	Amount
1.	Internet connectivity data for downloading BT instruments images from google.com	N600/ Per Gigabyte	N1200
2.	Editing of downloaded images	N20/Per Instrument	N700
3.	Uploading and Synchronising of images to produce a photo series	N40/ Per Slide	N1505
4.	Miscellaneous	Rate	N2000
	Total	**N600/ Per Gigabyte**	**N5405**

4. DISCUSSION

Findings revealed that the development of a digital photo series to teach BT concepts in upper basic schools in the Ilorin metropolis can be done using Product Oriented Model which is a front-end system design with four phases (Course Outline, Selection of Media, Development/ Production of material, and Course Delivery). These findings complement the assertion of those who made a significant effort to build on the ADDIE model and postulated that the design of instruction and classroom instructional materials should be based on a whole system that focuses on the interrelationship between contexts, content, learning, and instructional technique.

Findings also revealed that the developed digital photo series for BT was well structured and every expectation in the developed digital photo series was achieved. This finding is in line with the study of the researchers posited that a photo and video series showed higher scores on standardized measures of achievement. Findings revealed that upper BT teachers have a positive reaction to the developed digital photo series. This is in line with the assertion, the researcher opined that visual materials have been an important component of the classroom over the years, and teachers have a positive reaction to the use of visual materials in the classroom. The researcher claimed that visual materials such as film strips, pictures, slides, and pass-around objects are mostly liked and utilized by teachers in the classroom compared to other instructional materials. Thus, visual materials such as digital photo series are considered as a useful tool for teachers in almost every trend of classroom instruction.

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5. CONCLUSION

The study concluded that visual aids or materials such as digital photo series work as a powerful tool in the classroom and can be used to enhance the teaching of BT in Nigeria. Digital photo series is appreciated by the teachers and they are ready to use it in the classroom to provide the opportunity for learners to visualize materials that are not readily available in the school and to show the actual meaning of the lesson content. This conclusion is based on the mean rating of the experts who participated in the validation of this study. This study recommended that Digital photo series should be adopted for the teaching of BT in Upper basic schools in Ilorin to concretize lesson content and abstract content that are inherent in BT. Teachers of BT should be adequately and properly trained to utilize emerging technologies that are useful for the teaching of BT.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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