DEVELOPMENT AND EVALUATION OF COMPUTER AIDED CONCEPT CARTOONS FOR TEACHING COMPUTER SCIENCE AT JUNIOR SECONDARY SCHOOLS IN BIDA, NIGER STATE, NIGERIA

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Abstract
This study aimed at evaluating the development of Computer Aided Concept Cartoons for teaching Computer Science at Junior Secondary Schools in Bida, Niger State. Three research questions and two null hypotheses guided the research, which used a quasi-experimental design. The population comprised 22,876 students, with 265 participants (148 males, 117 females) selected through multistage and random sampling from two out of 16 schools. The instrument was face-validated by experts and had a reliability coefficient of 0.82, determined using Kuder-Richardson formula 20. Data were analyzed using mean, standard deviation, and t-test at a 0.05 significance level. Results revealed that Computer Aided Concept Cartoons positively impacted students' achievement in learning Computer Science, with male students achieving higher mean scores than females. The study recommends employment of qualified teachers, proper utilization of instructional resources, and the use of appropriate evaluation techniques for student performance.

Keywords: Development, Evaluation, Concept Cartoons, Computer and Junior secondary schools.

Introduction

As technology continues to advance, it affects every aspect of human life making it crucial for educational systems to stay updated and relevant (Olaodejo, 2021). It means that education must adapt and respond effectively to help students meet the changing needs of 21st-century employment. According to a study conducted by World Economic Forum (2018), technological advancements such as automation, artificial intelligence and robotics are expected to significantly transform the labour market resulting in the displacement of certain job roles while creating new ones. The study emphasizes the need for education systems to equip students with the skills necessary to thrive in the digital age, this include critical thinking, creativity and adaptability. Additionally, Olaodejo (2021) further reiterated the impact of technology integration on educational outcomes was explored found out that when properly integrated into the curriculum technology can enhance student engagement, motivation, and achievement. He emphasizes the importance of teachers being skilled in using technology effectively and integrating it purposefully into their instructional practices.

There are many technological tools available that can empower teachers and help today's students learn essential content and skills efficiently and effectively (Gorra, *et al.*, 2020). These tools can also be effective in helping to engage students in the learning process and motivate them to attain heights in academic and career pursuit, (Gorra, *et al.*, 2020). Similarly, Zakariyyau (2023), in his study found out some factors responsible for the poor performances of students in schools and concluded that the critical factor is the instructional methods employed in the teaching process. Stephenson and Warwick (2022) added that there are many accounts of the sort of ideas that learners have about the world around them.

Computer Aided Concept Cartoons guides increases student motivation as the computerized program as the student sees it. Despite the way computer studies is taught to students in classes, it appears they are faced with some problems of teaching and learning in those schools. Such problems have often resulted into poor academic performances by students in computer science by both the male and female gender. Supporting this, Yalams and Enoch (2021) in a study of comparative analysis of students` performance in Computer Science at both primary and higher level of learning revealed astonishing poor academic performances. Poor academic performances of students in computer science generally have attracted the attention of educationist and researchers for quite some time as a major problem of teaching and learning. Similarly, Ezeliora (2021) asserted that Computer Science studies have recorded a poor academic performance of students in various courses or subjects in almost all levels of educational system over the years. There is no doubt that the situation needs urgent attention. Similarly, Ishola (2021), in his study on factors responsible for the poor performances of students in schools concluded that the critical factor is the instructional methods employed in the teaching process. Instructional methods are the methods or procedures used by the teachers to deliver the lesson to the students (learners).The desire to solve these widely acknowledged problems of teaching and learning computer studies in our junior secondary schools necessitated the development and evaluation of Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State. The development of computer-aided concept cartoons using the Waterfall Model follows a systematic and sequential approach.

The Waterfall Model is a traditional software development methodology that follows a linear and sequential approach to project management (Kabapinar, 2017). The Waterfall Model provides a structured framework that facilitates a step-by-step progression from conceptualization to deployment, ensuring a methodical and well-documented development process for computer-aided concept cartoons. In this model, the entire package development life cycle is divided into distinct phases including requirements analysis, system design, implementation, testing, deployment, and maintenance. Subsequently, the implementation stage involves developing the package based on the design specifications. Testing is then conducted at various levels, ensuring that the package met quality standards and functions as intended. Once the package passes testing, it is then deployed for use in the classroom.

Statement of the Research Problem

Technology is getting more popular in all the activities of human endeavour daily. Educational sector is not left behind in terms of technology usage in all the educational activities. For instance, the JAMB Examinations have been changed to E-Computer Base Test (CBT), so also in our University system today admission screenings are done via computer online process. More also, schools record keeping mostly is based on computer data base where candidate's information are stored and use anytime such need arises. However, despite the above usage of computer in our educational system today, the teaching and learning of computer science in our junior secondary schools suffers due to limited resources and equipment (Oladejo 2021). Meanwhile, based on the investigation conducted by the researcher which clearly stated that the failure of computer science at junior secondary schools is due to limited resources, equipment and poor teaching methods. The intent to solve the above problems is recommended to the educational stakeholders, and Ministry of Education to give more attention to the training of more computer specialists and the government to supply more computers to the schools especially at the Junior secondary school level so that before they migrate to senior class they will have known more and develop more interest for the learning of computer science in our higher institutions. Finally, it is based on the above challenges that the researcher seeks to

develop and evaluate computer aided concept cartoons for teaching and learning of computer science at junior secondary schools in Bida, Niger state.

Aim and Objectives of the Study

This study aims to develop and evaluate Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State. Specifically, the objectives of the study are to:

1. Develop Computer Aided Concept Cartoons for junior secondary school students.
2. Determine the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary students offering Computer Science in Bida, Niger State.
3. Determine the difference in the achievement scores of junior secondary school students before and after Exposure to Computer Aided Concept Cartoons for learning Computer Science concepts.

Research Questions

The following research questions were raised to guide this study:

1. What are the phases involved in the development of Computer Aided Concept Cartoons for junior secondary school students offering Computer Science in Bida, Niger State?
2. What are the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary school students offering Computer Science in Bida, Niger State?
3. What is the difference in the achievement scores of junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts?

Research Methodology

Quasi experimental research design was used for the study. Waterfall Model was used in the development of the computer aided concept cartoons where it was divided into distinct phases, including requirements analysis, system design, implementation, testing, deployment, and maintenance. The experimental group was treated with the use of computer aided concept cartoon (CACC) package, while students in Control group were treated with traditional method. Both groups were given a Computer Achievement Test (CAT) before and after treatments to assess the participating students' prior understanding of the taught concept and to evaluate the effectiveness of the Computer Aided Concept Cartoon. The population for the study consists of 22,876 Junior Secondary Schools students in Bida, Niger State. The target population for the study comprised Junior Secondary School year II students with sample size of 265 students which were drawn from the intact classes of selected secondary schools in Bida, Niger State. Intact class of the selected schools for the study was 265 in number (148 males and 117 females). Two co-educational schools were purposively sampled for the study. A multistage sampling technique was used and simple random sampling technique was employed to select two (2) schools out of 16 junior secondary schools in Bida, Niger State. The research instrument that was used in this study is grouped into three. They include Computer Aided Concept Cartoons, Computer Science Content Expert Assessment Report (CSCEAR), and Computer Science Achievement Test (CSAT). Sections A and D of the CACCAQ as well as CSAT along with the prototype CACC package, tables of specification, scoring guide, lesson plans and teachers' training manual were validated by three Educational Technologists in the Departments of educational technology, Federal University of Technology Minna, Niger state. In addition, fifty exercises constructed by the researcher were subjected to scrutiny by Subject Matter Experts in line with the stated instructional objectives in stage four of the R & D model as part of the validation process. The experts were requested to suggest modifications on the structure of the items, organization as well as their appropriateness and then rated them according to their suitability for use in the present study. The suggestions made were effected in the final copies of the instruments. For instance, one of the Computer experts opined that the

behavioural objectives in the lesson plans should be stated in measurable terms. The CACCAQ was pilot tested using 46 Computer students in Government Model Science College, Bida. The school used for the trial testing is part of population in the main study. Data obtained was computed using Kuder-Richardson 20 (KR20) and the coefficient of internal consistency of CACCAQ was determined using Kuder-Richardson formula 20 (K-R 20) and it was found to be 0.82. K-R 20 was used in establishing the reliability of CACCAQ because it is a multiple-choice test. The research was conducted within 6 weeks. In the first week, two research assistants were coached in data collection and the installation of the developed Computer Aided Concept Cartoon. Learning activities lasted for 4 weeks after which a Post-test was administered in the 5th week to evaluate the effectiveness of the Computer Aided Concept Cartoon. Research question one was answered by explaining the steps involved in developing the Computer Aided Concept Cartoon. Research questions two was answered using qualitative data derived from the reports issued by Experts. The results from the administered Computer Science Achievement Test (CSAT) was analysed using descriptive statistics of Mean and Standard deviation to answer research question three. However, to test for the null hypotheses, the paired t-test statistics through the aid of Statistical Package for Social Sciences (SPSS) version 23, with a significance level for rejection or accepting any hypothesis fixed at 0.05 alpha level was used.

Results and Discussion

Phases Involved in the Development of Computer Aided Concept Cartoons

The phases for the development of Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State were as follows:

1. **Needs Assessment Phase:** At this phase, the current learning situation in computer science classes as well as challenges in the existing teaching methods were identified through survey.
2. **Concept Development Phase**: This is the phase where the key topics and concepts from the curriculum were determined based on the needs assessment. Drafts of concept cartoons were created for each of these topics to be included in the software.
3. **Design Phase:** At this phase the drafted concept cartoons were designed using computer-aided design tools. The researcher collaborated with subject matter experts to ensure the Computer Aided Concept Cartoons were engaging and accurately portrayed the concepts.
4. **Content Validation Phase:** The Computer Aided Concept Cartoons were reviewed by subject matter experts and teachers for factual accuracy, relevance, and pedagogical effectiveness at the validation phase.
5. **Pilot Testing Phase:** At this phase the concept cartoons were tested in a few classrooms. This pilot run provided feedback from teachers and students about their effectiveness and any potential areas for improvement.
6. **Revision Phase:** Based on the feedback received during the pilot testing, necessary revisions were made to the Computer Aided Concept Cartoons. These changes are related to content, design, and instructional strategies.
7. **Implementation Phase: This** is the phase were the final version of the cartoons was introduced into computer science classes across the study area. Teachers received training on how to use the Computer Aided Concept Cartoons effectively.
8. **Evaluation Phase:** After full implementation, the effectiveness of the cartoons in enhancing teaching and learning was continuously evaluated. The effect of Computer Aided Concept Cartoons was ascertained through quasi-experiment. The collected data after carefully analyzed revealed that the developed Computer Aided Concept Cartoons

is effective in enhancing the academic achievement of junior secondary school students offering Computer Science in Bida, Niger State.

Stages of **validation of Computer Aided Concept Cartoons**

Table 1.1 presents mean responses and standard deviations related to the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary school students studying Computer Science in Bida, Niger State and all the seven items had mean scores between 3.33 to 4.00 and standard deviations between .56 to .60, indicating strong agreement among the respondents about the comprehensibility, structure, relevancy of diagrams, clarity of sub-headings, and the comprehensiveness and simplicity of classwork and assignments in the Computer Aided Concept Cartoons for Junior Secondary School students studying Computer Science. Result revealed that the developed Computer Aided Concept Cartoons is highly appropriate for teaching Computer Science to junior secondary school students in Bida, Niger State, with clear and simple language that was effective for the targeted audience level, comprehensive coverage of topics, and a well-structured course content that added value to the overall learning experience.

Table1.1 Validation of Computer Aided Concept Cartoons for junior secondary school.

No.	Items	Mean	Std. Deviation	Remark
1	The developed course content which you have evaluated adequately covers Computer Studies comment for JSS Two computer students	3.67	.59	Strong
2	The developed course comment can be understood by JSS Two Computer students	3.67	.57	Strong
3	The diagrams in the course content are relevant to the concepts	3.33	.56	Strong
	The various sub-headings are well explained for students to understand the concepts	3.66	.57	Strong
5	The classwork and assignment given are comprehensive enough for students to understand.	3.66	.58	Strong
6	The classwork and assignment conform to the standard and are sequentially arranged	3.33	.57	Strong
7	The language used for the construction of the classwork and assignment is simple for students to comprehend	4.00	.60	Strong

Source: Authors Field Experiment 2024.

Achievement scores of junior secondary school students before and after exposure to Computer

Table 1.2 presents the mean and standard deviation of both pre-test and post-test achievement scores from junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts. In the Control Group, the pre-test mean score was 31.28 with a standard deviation of 3.88, while the post-test mean score was 54.54 with a standard deviation of 4.92. This provides a mean gain of 23.26. In contrast, the Experimental Group exposed to Computer Aided Concept Cartoons for learning, their pre-test mean score was 31.37 with a standard deviation of 4.06 while the post-test mean score was 69.03, with a standard deviation of 6.23, resulting in a mean gain of 37.66. The findings imply that there is a significant increase in the achievement scores of students exposed to Computer Aided Concept Cartoons for learning Computer Science concepts.

Table 1.2: Pre-test and post-test mean achievement scores of junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts

Groups		Pretest		Posttest		
	N	Mean	SD	Mean	SD	Mean Gain
Control Group	150	31.28	3.88	54.54	4.92	23.26
Experimental Group	115	31.37	4.06	69.03	6.23	37.66

Source: Authors Field Experiment 2024.

Findings of the Study

1. The findings of this study shows the needs assessment, concept development, design, content validation, pilot testing, revision, implementation and evaluation phases were phases involved in the development of Computer Aided Concept Cartoons for junior secondary school students
2. The findings of this study revealed that the developed Computer Aided Concept Cartoons is comprehensive, understandable, and well-structured with relevant diagrams, clear sub-headings, comprehensive classwork and assignments, and that these elements are sequentially arranged and written in language simple enough for Junior Secondary School students to comprehend. Furthermore, the qualitative feedback affirms that this educational tool is highly suitable for teaching purposes due to its clarity, simplicity, broad topic coverage, and effective structuring enhancing the overall learning experience.
3. The finding of this study shows that the use of Computer Aided Concept Cartoons has positively impacted student achievement in learning Computer Science concepts.

Discussion of Findings

Findings on research question one found that the development of Computer Aided Concept Cartoons (CACC) for junior secondary schools involved various stage that includes: needs assessment, concept development, design, content validation, pilot testing, revision, implementation, and evaluation. The need assessment phase is crucial because it helps identify the necessity for a new educational tool in a particular context (Balim et al. 2018). The findings from this stage shows a lack in current teaching methodologies or resources used in teaching computer science at the junior secondary school level. It implies a demand for a more engaging, visually appealing, and comprehensible tool like CACC to facilitate learning. The concept development stage involves creating an idea or blueprint for the CACC based on the identified needs (Kogler et al., 2021). These findings affirm the importance of grounding the tool's development in actual classroom needs, thus increasing its relevance and potential effectiveness. Furthermore, during the design phase, the physical creation of the CACC takes place (Pekel, 2019). The outcome emphasizes the role of user-friendly interface and engaging visual content in enhancing students' interest and comprehension of computer science concepts. Moreover, in the content validation phase, subject-matter experts ensure that the educational content is accurate, relevant, and suitable for the target audience (Akbaay, 2020). This step strengthens the reliability of the tool, ensuring that students receive correct information. Also, the pilot testing and revision phases underline the importance of feedback and iterative improvement in instructional design (Atasoy et al., 2020). They offered empirical evidence of the CACC's impact on students' learning outcomes, potentially making a case for its wider adoption. This process mirrors other instructional design models like the ADDIE model (analysis, design, development, implementation, evaluation), suggesting that it is a well-established practice in educational technology development.

Findings on research question two revealed that the developed CACC is comprehensive, understandable, well-structured and suitable for teaching purposes. The comprehensiveness

and structure highlight the tool's quality in delivering complete and logically sequenced information. The clear sub-headings and relevant diagrams make the content more manageable and visually appealing, aligning with Yin and Fitzgerald, (2017) principles of multimedia learning that recommend breaking down complex information into manageable segments and using visuals to support understanding.

This kind of evidence is crucial for persuading stakeholders such as educators, school administrators, and policymakers to adopt new technologies in classrooms (Çelik & Gundogdu, 2019).

Conclusion

The essence of this study is to develop and Evaluate the Computer Aided Concept Cartoons for Teaching Computer Science at Junior Secondary Schools in Bida, Niger State. In the ever-evolving landscape of education, the integration of technology has become imperative. Computer Aided Concept Cartoon development represents a pioneering approach, leveraging advanced software tools to enhance conceptual understanding and foster interactive learning experiences. Within the realm of instructional design models, the Computer Aided Concept Cartoon development aligns with a learner-centred approach by integrating technology to create engaging and interactive educational experiences. The study also found out that the use of Computer Aided Concept Cartoons has positively impacted student achievement in learning Computer Science concepts.

Recommendations

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

1. The State Government, local government and the ministries in-charge and departments of the junior secondary schools in Bida in Niger State should ensure qualified teaching staff are employ to teach student science subjects using Computer Aided Concept Cartoons
2. Teachers should ensure proper utilization of the available instructional resources for teaching science subjects and learning using Computer Aided Concept Cartoons
3. Teachers should cultivate the habit of using the appropriate procedures or techniques for evaluating junior secondary school students performance using Computer Aided Concept Cartoons which will help in promotion, placement and certification.

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