`

Effect of Computer-Science-Unplugged Strategies on Junior Secondary School Students' Academic Performance in Computer Studies' Concepts in Kwara State

[1]OKIKIOLA, Jamiu Muhammed, [2]ALIMI, Adebayo Emmanuel &
[3]ADEDOKUN-SHITTU, Nafisat Afolake
Department of Educational Technology
Faculty of Education
University of Ilorin, Nigeria
[1]okiki91@gmail.com; [2]eaalimi@unilorin.edu.ng; [3]adedokun.sna@unilorin.edu.ng

Abstract
Computer-science-unplugged is a method of teaching Computer Studies in an engaging and entertaining way through free learning activities without using computers. Lack of computer facilities, inadequate systems, and unreliable power supply in Nigerian secondary schools had deprived students of practical activities. This method effectively taught computer studies concepts without relying on computers. This study assessed the academic performance of junior secondary school students in selected computer studies concepts using two unplugged strategies. Determined the impact of the interactive activity strategy on students' comprehension; evaluated storytelling and analogies' impact on understanding; examined students' attitudes towards unplugged methods. A quantitative research design, specifically a quasi-experimental approach was adopted for the study. The sample consisted of 30 students from two schools. Data gathered using a validated questionnaire, and reliability confirmed with coefficients of 0.72 and 0.78 for the performance test and attitude questionnaire, respectively. The findings revealed that the two strategies improved comprehension, problem-solving skills, and student attitude towards the learning of certain concepts in computer studies. In conclusion, the strategies collectively support enhanced learning environment where storytelling emerged more effective, achieving higher average post-test scores of 16.90, which significantly improved students' comprehension. The study recommended among others that, schools in Kwara State should adopt these approaches to create a more interactive, accessible and engaging learning environment in computer studies for junior secondary school students.

Keywords: Computer-Science-Unplugged, Interactive activity strategy, Academic performance, Story-telling analogies, Computer studies

Introduction

The importance of computer studies education in the 21st century is crucial, as digital literacy is essential for navigating a technology driven world. As technology becomes integral to daily life and work, understanding computer science from an early age is vital. Globally, there is a push to include computer studies in school curricula to equip students with the skills needed for future

`

careers and problem-solving (Onifade, Ilevbare, Adelowo, Ajayi, & Jegede, 2021). In May 2023, Nigeria introduced the National Digital Learning Policy, emphasizing the integration of ICT into education to enhance creative thinking and problem-solving (Nigerian CommunicationWeek, 2023; UNESCO, 2023). Education is a key tool for national development, helping individuals reach their potential and contribute to the economy by acquiring knowledge and skills. According to Ornstein et al. (2018), education promotes intellectual and personal growth in both formal and informal learning environments.

Teaching involves imparting knowledge and skills through a systematic process, often in formal settings like schools, but also in informal contexts such as mentorships or online courses (American Psychological Association, 2020). Effective teaching requires educators to connect with learners; ensuring students actively engage and commit to learning (Berdiyeva, 2023). Various strategies, such as teacher-centered and student-centered methods, promote independent learning. In Nigeria, the traditional expository method remains dominant, where teachers lead instruction with verbal explanations (Odutuyi, 2019). Effective teaching is linked to improved student performance, equipping them with essential skills for societal contribution (Obielodan *et al*., 2021). Teaching computer studies is especially important in fostering digital literacy, problem-solving and understanding technology basics (Onifade et al., 2021; Barkatov et al., 2020).

Many students possess misconceptions and negative attitudes toward computer studies concepts. To tackle these challenges, a series of learning activities known as Computer-Science-Unplugged was created (Bell et al., 2009). The computer-science-unplugged method teaches computer studies concepts without using computers, focusing on hands-on activities, to build a strong foundation before moving to coding. Developed by Bell, Witten, and Fellows (2014), this approach uses practical experiences and inexpensive materials, incorporating storytelling to promote computational thinking (Adedokun-Shittu et al., 2016). Initially designed as an outreach tool, it has become a widely adopted teaching strategy in classrooms. It simplifies computer science education, requiring no prior expertise, and is accessible to all educators. By emphasizing computational thinking, it mirrors how computers process information (Bell & Vahrenhold, 2018). Interactive activities like "Binary Bingo" make abstract concepts tangible and engaging, improving students' comprehension (Bell, Witten, & Fellows, 2015).

`

Pardhan *et al*. (2022) highlighted the effectiveness of unplugged activities in teaching computational thinking and basic programming concepts through engaging, hands-on experiences. Activities like the "Sorting Network Puzzle" and "Robot Turtles" enable students to grasp algorithmic thinking practically, underscoring the significance of these skills in computer education. Additionally, storytelling serves as an effective strategy within CS-unplugged, making computer concepts relatable through engaging narratives. For instance, binary numbers can be introduced via a story about a kingdom that makes decisions using only "yes" or "no," symbolizing binary digits. Kim, Coenraad, and Park (2021) emphasized that storytelling enhances learning by helping students visualize and remember abstract ideas in familiar contexts, thereby fostering computational thinking. Accordingly, the researcher compared and examined the effectiveness of two unplugged teaching strategies, that is, interactive activity, and storytelling with analogies, on the junior secondary school students' academic performance in computer studies concepts in Kwara State.

Specifically, the research determined the impact of interactive activity strategy; evaluated the impact of storytelling and analogies strategy on both the mean pre-test and post-test score of students on the two unplugged strategy on students' understanding of the computer studies concepts; and determined students' attitudes towards the adoption of computer-science-unplugged.

Research Questions

For guiding the conduct of this study, the following research questions are generated:

(i) To what extent does interactive activity strategy influence the difference in mean pre-test and post-test scores of students exposed to computer-science-unplugged activities?

(ii) What is the impact of storytelling and analogies on the difference in mean pre-test and post-test scores of students participating in computer-science-unplugged activities?

(iii) What are the attitudes of students towards the adoption of computer science unplugged methods?

Methodology

Quantitative research design was employed, specifically utilizing a quasi-experimental approach across two junior secondary schools in Kwara State. Each school implemented one of the two unplugged teaching strategies: interactive, and storytelling analogies activities. To assess academic performance in computer studies, pre-tests and post-tests were administered before and after the intervention. Additionally, a survey was conducted to gauge students' attitudes toward the use of computer-science-unplugged methods. This methodology was selected because random

`

assignment could disrupt the normal school activities, while using intact classes maintains the natural learning environment. By combining quasi-experimental and survey methods, the study offers a thorough analysis of both academic outcomes and student perceptions. The population consisted of all junior secondary school students in Kwara State, with the target population being JSS2 students enrolled in computer studies. A purposive sampling procedure was employed for the selection process; initially, junior secondary schools in Kwara State were purposively sampled, followed by the selection of schools with computer studies programs. Finally, simple random sampling was utilized to choose the participating 30 JSS2 students for the study.

Results

Research Question One: To what extent does interactive activity strategy influence the difference in mean pre-test and post-test scores of students exposed to computer-science-unplugged activities?

Table 1: Pre-test and post-test mean scores of junior secondary school students exposed to an interactive activity strategy

Score	N	X	SD	MD
Pre-test	15	6.30	4.05	9.9
Post-test	15	16.20	.91	
Total	30			

Table 1 presented the pre-test and post-test mean scores of junior secondary school students exposed to an interactive activity strategy in their comprehension of computer studies concepts. The mean pre-test score was 6.30 with a standard deviation (SD) of 4.05, indicating that students had relatively low initial comprehension and a wide range of performance levels. After the intervention, the post-test mean score increased significantly to 16.20 with a much lower SD of 0.91. This substantial improvement in the mean score, with a mean difference (MD) of 9.9, suggests that the interactive activity strategy was highly effective in enhancing students' understanding of computer studies concepts.

`

The reduction in the standard deviation from 4.05 in the pre-test to 0.91 in the post-test indicates that not only did students' average performance improve, but their scores also became more consistent after the intervention. This consistency suggests that the interactive activity strategy helped to standardize students' understanding, making the comprehension of computer studies concepts more uniform across the group. Overall, the data supports the effectiveness of the interactive activity strategy in improving both the level and consistency of students' academic performance in computer studies

Research Question Two: What is the impact of storytelling and analogies on the difference in mean pre-test and post-test scores of students in computer-science-unplugged activities?

Table 2: Impact of storytelling and analogies on the difference in mean pre-test and post-test scores of students who participated in computer-science-unplugged activities

Score	N	X	SD	MD
Pre-test	15	4.90	1.85	12
Post-test	15	16.90	1.10	
Total	30			

Table 2 presented the impact of storytelling and analogies on the difference in mean pre-test and post-test scores of students who participated in computer-science-unplugged activities, focusing on their understanding of computer studies concepts. The pre-test mean score was 4.90, with a standard deviation (SD) of 1.85, indicating that students had a limited understanding of the concepts before the intervention. The relatively high SD suggests some variability in their initial levels of understanding. Following the intervention, the post-test mean score significantly increased to 16.90, with a lower SD of 1.10. This dramatic improvement in the mean score reflects a substantial enhancement in students' comprehension of the computer studies concepts after being taught through storytelling and analogies.

The mean difference (MD) of 12 between the pre-test and post-test scores highlights the powerful impact of using storytelling and analogies as instructional strategies in computer studies. The substantial increase in the mean post-test score indicates that this method effectively bridged the gap in students' understanding. Additionally, the decrease in the standard deviation from pre-test

`

to post-test suggests that the intervention not only improved overall comprehension but also helped standardize students' understanding, making their performance more consistent. This reduction in variability points to the effectiveness of storytelling and analogies in engaging students and helping them achieve a more uniform level of understanding, regardless of their initial proficiency.

Research Question Three: What is the attitude of students towards the adoption of computer science unplugged methods?

Table 3.1: Students' Attitude towards Using Interactive Activity Strategy for Learning

S/N	ITEM	Mean
1	I find the CS-Unplugged method appealing for introducing computer studies concepts without the use of computers.	3.63
2	I believe that CS-Unplugged activities can enhance students' understanding of complex computer studies topics.	3.52
3	I am open to incorporating hands-on and practical CS-Unplugged activities in my teaching approach.	3.34
4	I think CS-Unplugged can make computer studies education more inclusive and accessible to diverse learners.	3.51
5	I am positive about the idea of using physical activities and games to promote problem-solving skills in computer studies.	3.36
6	I am willing to explore ways to integrate CS-Unplugged into traditional classroom settings to improve learning outcomes.	3.52
7	I see value in the resources available for implementing CS- Unplugged and believe they can enhance teaching effectiveness.	3.22
8	I am interested in attending workshops or training sessions to gain further insights into implementing CS-Unplugged.	3.51
9	I recognize the potential of CS-Unplugged, supported by existing research and literature, to positively impact computer studies education.	3.80
10	I have a favorable attitude towards the role of CS-Unplugged in fostering a deeper understanding of computer studies among students.	3.33
11	I find it easier to grasp new concepts through unplugged activities compared to traditional methods.	3.25

`

S/N	ITEM	Mean
12	I feel more engaged during unplugged activities.	3.12
13	I actively participate in unplugged sessions.	3.43
14	Unplugged activities encourage me to work collaboratively with my classmates.	3.38
15	I feel more confident solving computer studies problems after unplugged activities.	3.10
16	Computer-science-unplugged promotes the application of knowledge.	3.90
17	Computer-science-unplugged activities help me understand computer studies concepts better.	3.65
18	I enjoy participating in Computer-science-unplugged activities.	3.21
19	Computer-science-unplugged activities make learning more fun.	3.22
20	I look forward to Computer-science-unplugged sessions.	3.00
	Grand Mean	**3.04**

Bench Mark 2.5

Table 3.1 presented students' attitudes toward using the interactive activity strategy in learning computer studies. The overall grand mean score of 3.04, which is above the benchmark of 2.5, indicates that students generally have a positive attitude toward this learning method. The highest mean scores were found in statements like computer-science-unplugged promotes the application of knowledge with mean score 3.90 and I recognize the potential of CS-Unplugged, supported by existing research and literature, to positively impact computer studies education with mean score 3.80. The positive attitudes reflected in these scores suggest that students find the interactive activities engaging and beneficial for their learning. However, the lower mean scores in some items, such as I look forward to Computer-science-unplugged sessions with mean score 3.00, might indicate that while students see the value in these activities, they might still prefer other methods of learning or need further motivation to fully embrace these strategies.

`

Table 3.2: Students' Attitude towards Using Storytelling and Analogies for Learning.

S/N	ITEM	Mean
1	I find the CS-Unplugged method appealing for introducing computer studies concepts without the use of computers.	3.50
2	I believe that CS-Unplugged activities can enhance students' understanding of complex computer studies topics.	3.61
3	I am open to incorporating hands-on and practical CS-Unplugged activities in my teaching approach.	3.46
4	I think CS-Unplugged can make computer studies education more inclusive and accessible to diverse learners.	3.09
5	I am positive about the idea of using physical activities and games to promote problem-solving skills in computer studies.	4.11
6	I am willing to explore ways to integrate CS-Unplugged into traditional classroom settings to improve learning outcomes.	3.72
7	I see value in the resources available for implementing CS- Unplugged and believe they can enhance teaching effectiveness.	3.61
8	I am interested in attending workshops or training sessions to gain further insights into implementing CS-Unplugged.	3.20
9	I recognize the potential of CS-Unplugged, supported by existing research and literature, to positively impact computer studies education.	3.76
10	I have a favorable attitude towards the role of CS-Unplugged in fostering a deeper understanding of computer studies among students.	3.23
11	I find it easier to grasp new concepts through unplugged activities compared to traditional methods.	3.08
12	I feel more engaged during unplugged activities.	3.62
13	I actively participate in unplugged sessions.	3.76
14	Unplugged activities encourage me to work collaboratively with my classmates.	3.41
15	I feel more confident solving computer studies problems after unplugged activities.	3.10
16	Computer-science-unplugged promotes the application of knowledge.	3.61

`

S/N	ITEM	Mean
17	Computer-science-unplugged activities help me understand computer studies concepts better.	3.10
18	I enjoy participating in Computer-science-unplugged activities.	3.46
19	Computer-science-unplugged activities make learning more fun.	3.77
20	I look forward to Computer-science-unplugged sessions.	3.43
	Grand Mean	**3.48**

Bench Mark 2.5

Table 3.2 revealed students' attitudes toward the use of storytelling and analogies in learning. With a grand mean score of 3.48, students generally hold a positive view of this teaching strategy. Notably, the highest mean score (4.11) was for the item I am positive about the idea of using physical activities and games to promote problem-solving skills in computer studies, suggesting that students believe in the efficacy of storytelling and analogies in enhancing problem-solving skills. The positive attitude is also reflected in high scores for statements like "Unplugged activities make learning more fun" with mean score 3.77 and "I actively participate in unplugged sessions" with mean score 3.76, indicating that students are engaged and enjoy the process of learning through stories and analogies. This suggests that integrating narrative elements into teaching can be a highly effective way to boost students' comprehension and engagement in computer studies.

Discussion of Findings

The findings of this study indicate that the computer-science-unplugged approach significantly impacts junior secondary school students' academic performance in computer studies in Kwara State. By integrating CS Unplugged activities strategies into the selected concepts in computer studies, students were able to grasp abstract concepts in computer science more effectively without the immediate need for computers. The hands-on, interactive nature of CS Unplugged encouraged active participation and collaboration among students, leading to improved understanding and retention of computer studies concepts.

The findings in Table 2, shows that Storytelling achieved higher post-test mean score of 16.90, indicating greater overall improvement in student performance, although it had moderate variability in scores. Table 1 shows the Interactivity of pre-test post-test, with a mean score of

`

16.20 and the lower standard deviation (SD) of 0.91, demonstrated the most consistent performance across students. These results suggest that storytelling was more effective for overall performance, while interactivity provided consistent results that is in agreement with Ben-Ari, and Dori, (2023) that storytelling could significantly enhance students' understanding of complex concepts by providing relatable and engaging narratives.

The interactive activity strategy led to significant improvements in students' comprehension of computer studies concepts, with consistent performance gains observed post-intervention. Storytelling and analogies substantially increased students' understanding of computer studies, promoting more uniform comprehension across the group. Overall, students displayed a positive attitude toward adopting the computer-science-unplugged method, though some may need additional motivation.

Conclusion

This study on the effect of computer-science-unplugged methods on junior secondary school students' academic performance reveals that the two strategies employed significantly enhance students' understanding of computer studies concepts. Each teaching strategy has distinct advantages, with storytelling emerging more effective, achieving higher average post-test scores and significantly improving students' comprehension. Interactivity provided reliable performance across students, while storytelling and analogies, though effective, exhibited greater variability in outcomes. These findings suggest that storytelling excels in boosting overall performance and interactivity ensures uniform improvement.

Recommendations

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

1. Schools should incorporate interactive activity strategies into the computer studies curriculum to enhance students' comprehension and overall performance;
2. Teachers should also use storytelling and analogies to explain complex concepts, as these methods foster better understanding and more consistent comprehension by making abstract ideas more accessible and engaging; and

`

3. To maintain student enthusiasm for the computer-science-unplugged approach, schools should introduce motivational strategies, such as incentives or engaging activities, to sustain active participation.

References

Adedokun-Shittu, N. A., Yusuf, M. O., & Obielodan, O. O. (2016). Innovation in the teaching of computer science. In I. O. Abimbola, A. S. Olorundare, M. O. Fajemidagba, E. O. Omosewo, Fakomogbo, & Adedokun-Shittu, *Computer Science Method of Teaching Science, Basic Technology and Computer Studies Textbook*.

American Psychological Association. (2020). Teaching. *In Publication Manual of the American Psychological Association* (7th ed., pp. 344).

Bell, T., & Vahrenhold, J. (2018). CS unplugged - How is it used, and does it work? In H. J. Böckenhauer, D. Komm, and U. W. (Eds.) *Adventures Between Lower Bounds and Higher Altitudes*. Lecture Notes in Computer Science (pp. 497-521). Springer, Cham. https://doi.org/10.1007/978-3-319-98355-4_29

Bell, T., Alexander, J., Freeman, I., & Grimley, M. (2009). Computer Science Unplugged: School Students Doing Real Computing Without Computers. *New Zealand Journal of Applied Computing and Information Technology*, 13(1), 20–29.

Bell, T., Witten, I. H., & Fellows, M. (2015). *Computer Science Unplugged: An enrichment and extension programme for primary-aged children*. Retrieved from https://csunplugged.org

Berdiyeva, S. (2023, October). Advantages and disadvantages of teaching through role-playing activities. In *Academic International Conference on Multi-Disciplinary Studies and Education* 1(19), 88-92.

Durak, H. Y. (2020). The effects of using different tools in programming teaching of secondary school students on engagement, computational thinking and reflective thinking skills for problem solving. *Technology, Knowledge and Learning, 25*(1), 179–195.

Nigerian CommunicationWeek. (2023). *FG launches new ICT policy on education*. Retrieved from https://nigeriacommunicationsweek.com.ng/

Obielodan, O. O., Onojah, A. O., Onojah, A. A., Alabi, O. S., & Alimi, E. A. (2021). The teachers' extent of utilizing teaching methods for teaching basic technology. *Journal of Research in Instructional*, 1(2), 61–70. https://doi.org/10.30862/jri.v1i2.14

Odutuyi, M. O. (2019). Effects of activity-based approach and expository method on students' academic achievement in basic science. *Scientific Research Journal, 7*(1), 1–9.

`

Onifade, O. J., Ilevbare, E. O., Adelowo, C. M., Ajayi, P. O., & Jegede, P. O. (2021). Perception of appropriateness of Nigeria's computer science students' curriculum in providing technical skills and knowledge for the labour market. *International Journal of Educational Research, 9*(1), 28-48.

Ornstein, A. C., & Hunkins, F. P. (2018). Curriculum foundations, Principles and Issues (4th ed.). Allyn & Bacon.

Pardhan, H., Cunningham, K., & Kay, J. (2022). Engaging learners in computational thinking through unplugged activities. *Journal of Computer Science Education*, 34(2), 156-172. https://doi.org/10.1080/10494820.2022.2043791

UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC). (2022). *Global universities address gender equality but gaps remain to be closed*. Retrieved from https://www.iesalc.unesco.org/en/2022/03/08/global-universities-address-gender-equality-but-gaps-remain-to-be-closed/.