



## Effect of Interactive Technology on Higher-Level Thinking in Reading Comprehension at Federal University of Education, Zaria, Kaduna State

<sup>1</sup>Areo Kelechi Goodluck, <sup>2</sup>Chukwuma, Doris Ifeyinwa, <sup>2</sup>Solomon, Moses

<sup>1</sup>Department of General Studies Education (GSE),

Federal University of Education, Zaria,

<sup>2</sup>Educational Psychology Department,

Federal University of Education Zaria.

### ABSTRACT

The study investigated the effect of interactive technology on developing higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria, Kaduna state. Two objectives and hypotheses guided the study. The study employed quasi-experimental design involving pre-test, post-test only design. The population consisted of 7,325 N.C.E students in Federal University of Education, Zaria, Nigeria. The target population are N.C.E II students. A purposive sampling technique was used to select a sample of 190 students across different English Language combinations. Two instruments were used namely, Reading Comprehension Skills Test (RCST) and English Comprehension Test (ECT). Both instruments were validated by experts in educational technology, educational psychology and Teaching English as a Second Language. The reliability coefficient was established as 0.75 and 0.79, respectively. Data was analysed using Analysis of Covariance (ANCOVA). The result revealed that there was a significant effect of interactive technology on the development of higher-level thinking skills in reading comprehension questions among students in students in Federal University of Education, Zaria ( $F = 286.574, P = .000$ ) indicating that interactive technology has effect on the development of higher-level thinking skills in reading comprehension questions among the students. Secondly, there was also a significant difference in the pre-test and post-test mean score in comprehension performance among the students ( $F = 70.847, P = .000$ ) implying that higher-level thinking skills were used by the students hence, their performance in comprehension questions was better in the post-test. Based on the findings it was recommended among others that Federal University of Education should incorporate interactive technology as part of its core curriculum to enhance critical thinking skills among students and that the university should invest in digital infrastructure to provide uninterrupted access to interactive technology for all students.

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### INTRODUCTION

In recent years, the integration of technology in education has gained momentum as institutions aim to foster critical thinking, creativity, and problem-solving skills among students. Interactive technology, including digital learning platforms, multimedia resources, and collaborative tools, are

designed to actively engage students, offering dynamic and personalized learning experiences (Bashir & Lawal, 2023). These tools not only make learning more engaging but also develop higher-level cognitive skills by encouraging students to analyze, synthesize, and evaluate information. Reading comprehension, a vital skill in education,

Corresponding author: Areo Kelechi Goodluck

✉ [areoqk78@gmail.com](mailto:areoqk78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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requires students to move beyond basic understanding to make inferences, identify themes, and connect ideas tasks that demand higher-level thinking (Adeyanju & Musa, 2022).

Higher-level thinking skills, such as analysis, evaluation, and synthesis, are crucial for academic success and are especially relevant in reading comprehension (Bloom, 1956). Bloom's Taxonomy, a well-established framework for categorizing cognitive skills, underscores the importance of moving beyond basic comprehension to advanced cognitive functions that allow students to critically engage with texts (Krathwohl, 2002). In reading comprehension, these skills involve drawing connections, making inferences, and evaluating information critically (Duron, Limbach, & Waugh, 2016).

Research suggests that traditional methods often fall short in developing these higher-level skills because they focus primarily on memorization and literal understanding. Interactive technology, however, encourage students to participate actively in the learning process and engage with content in ways that traditional methods do not (Salomon & Perkins, 1998). Interactive features such as digital annotations, quizzes, and multimedia content can make comprehension exercises more cognitively demanding, supporting higher-order thinking development.

Interactive technology, which include digital textbooks, learning management systems (LMS), and collaborative tools, are becoming increasingly common in education. According to Mayer (2009), interactive learning fosters a constructivist approach, where learners actively construct knowledge through interaction and feedback. Studies have shown that students who use interactive technology demonstrate greater levels of engagement and understanding in complex learning tasks (Mayer, 2014).

**Collaborative Tools:** Research indicates that tools like online discussion forums, blogs, and collaborative document editing enhance critical thinking skills by enabling students to analyze information collaboratively and provide peer feedback (Kuh, 2015). Collaboration allows students to explore diverse perspectives, which promotes cognitive flexibility and evaluative skills.

### **Multimedia and Gamified Learning:**

Multimedia elements (e.g., videos, infographics) and gamified tools (e.g., quizzes, badges) embedded within digital platforms help make learning enjoyable and cognitively engaging. As students work through gamified modules, they receive immediate feedback, which reinforces their comprehension and challenges them to think critically (Gee, 2007).

**E-Books and Annotations:** Digital texts with interactive features, such as annotations and highlight tools, encourage students to engage deeply with reading materials. Research by Clark & Mayer (2016) suggests that such features improve comprehension by enabling students to summarize, question, and analyze information in real time.

Reading is the ability to draw meaning from the printed page and interpret this information appropriately (Grabe, 2002). Harmer, (2007) states that reading is useful for acquisition; the more students read, the better they get at it. Subsequently, reading possesses positive effect on students' vocabulary knowledge, spelling, and writing. Reading comprehension is a skill that is critical in the educational success of all individuals. Without adequate reading comprehension skills, students can struggle in many subject areas. Reading comprehension is an important skill needed for all areas of school. Subjects, other than reading or literature, where comprehension skills are significantly important include science, social studies and mathematics. In the area of science research indicates that many students lack prior knowledge and reading strategies to generate inferences; thus, the students comprehend science text poorly. It also found the students lack the specific reading strategies to generate inferences that aid in the understanding of science texts (Best, Rowe, Ozara, and McNamara, 2005). Reading comprehension is the process of simultaneously extracting and constructing meaning through interaction and involvement with written text. The goal of reading comprehension is to help the students understand written language.

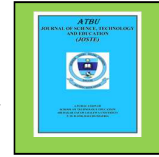
Several studies have explored the effect of interactive technology on students' higher-level thinking skills, with some evidence

Corresponding author: Areo Kelechi Goodluck

✉ [areoq78@gmail.com](mailto:areoq78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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suggesting significant benefits in reading comprehension and cognitive engagement. For example, Adebayo & Thompson (2023) conducted a study among Nigerian secondary school students, examining the effect of digital storytelling tools on reading comprehension. They found that students using interactive storytelling showed higher levels of inference-making, analysis, and synthesis than those who did not use the tools. This study highlights the potential of interactive technology to promote deeper comprehension skills. Similarly, Obi & Chukwu (2022) evaluated the effects of digital collaboration platforms on reading comprehension among Nigerian university students. Their findings showed a positive correlation between the use of collaborative tools (such as online forums and discussion boards) and improved evaluative and analytical skills. They concluded that interactive technology help students approach reading materials from diverse perspectives, enhancing critical thinking.

Lawal & Ayodeji (2024) also, examined the effects of e-books with interactive features (like embedded quizzes and annotations) on students' comprehension skills in a Nigerian university setting. Results indicated that students using interactive e-books had significantly higher scores in comprehension tasks requiring analysis and synthesis compared to those using traditional print textbooks. This study suggested that interactive features enable students to engage actively with the text, thereby fostering higher-order thinking skills. Furthermore, Afolabi et al. (2023) explored the effect of gamified learning platforms on reading comprehension skills among secondary school students in Lagos. Their findings showed that gamification, through elements like quizzes and challenges, increased students' engagement, retention, and higher-level thinking skills. This study supports the idea that interactive technology can make learning experiences both enjoyable and cognitively challenging.

These studies indicate that interactive technology can enhance higher-order thinking skills and suggest that a similar approach could be beneficial at the Federal University of Education, Zaria. However, there remains a need for targeted research in this context to understand the specific challenges

and benefits of these tools in Nigerian tertiary education. While interactive technology offers many benefits, studies also highlight barriers to their effective implementation, especially in Nigerian educational contexts. Inadequate infrastructure, limited access to digital resources, and lack of training for both students and educators hinder the integration of interactive technology (Adegoke & Adebayo, 2022). Additionally, there may be a resistance to change among educators who are accustomed to traditional teaching methods. For interactive technology to be successful, institutions must address these challenges through adequate funding, teacher training, and consistent access to technology (Obi, 2023).

In Nigerian universities, fostering higher-order thinking is essential for preparing students to compete in a globalized workforce that increasingly values problem-solving and critical thinking (Ibrahim, 2024). However, many institutions still rely on traditional pedagogical methods, which limit students' ability to engage deeply with content (Afolabi & Lawal, 2022). Interactive technology can potentially fill this gap by providing Nigerian students with the tools needed to develop critical reading comprehension skills.

The Federal University of Education in Zaria, like many other Nigerian institutions, has started incorporating interactive technology into its curriculum to address students' difficulties in reading comprehension. Despite these efforts, Nigerian students continue to struggle with complex comprehension tasks that require higher-order thinking skills (Ojo & Onabanjo, 2023). Additionally, there is limited research on the actual effect of interactive technology on students' comprehension and critical thinking skills within this context, creating a need for empirical investigation to inform educational policy and practice in Nigeria (Ibrahim & Bello, 2024).

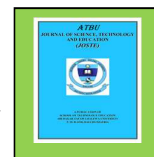
Despite the integration of interactive technology in education, there is an observed gap in higher-order thinking skills among students, particularly in reading comprehension (Ibrahim & Lawal, 2024). Traditional teaching methods often focus on rote learning, which limits students' abilities to think critically and make inferences from reading materials. Consequently, students struggle with complex

Corresponding author: Areo Kelechi Goodluck

✉ [areoqk78@gmail.com](mailto:areoqk78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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comprehension questions requiring deeper cognitive processing. Although interactive technology have demonstrated potential in various studies, their effectiveness in enhancing comprehension skills at the Federal University of Education, Zaria, has not been systematically studied.

Hence, this study is carried out to investigate the effect of interactive technology on developing higher- level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria, and Kaduna State, Nigeria.

### Objectives of the Study

The study was guided by the following objectives:

1. To investigate the effect of interactive technology on the development of higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria in Kaduna State.
2. To assess the differences in reading comprehension performance between students exposed to interactive technology and those who are not.

### Hypothesis

H<sub>01</sub>: Interactive technology do not have a significant effect on the development of higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria.

H<sub>02</sub>: There is no significant difference in reading comprehension performance in the pretest and posttest mean Score among students in Federal University of Education, Zaria.

### METHODOLOGY

A quasi-experimental design with pre-test and post-test only design was used for the study. The population consisted of 7,325 N.C.E students in Federal University of Education, Zaria, Nigeria. The target population are N.C.E II students. The choice of N.C.E II students was purposive because N.C.E II are more stable than NCE I who are newly admitted and are struggling to settle down, while N.C.E III are on teaching practice. Thus, it is impossible to include them in this study. A purposive sampling technique was used to select a sample of 190 students across different English Language combinations. Two instruments were used namely, Reading Comprehension Skills Test (RCST): This test assesses students' higher-level thinking skills, such as analysis, synthesis, and evaluation, before and after the intervention and English Comprehension Test (ECT) to assess the comprehension performance. Both instruments were validated by experts in educational technology, educational psychology and Teaching English as a Second Language. The reliability coefficient was established as 0.75 and 0.79, respectively. Data was analyzed using Analysis of Covariance (ANCOVA).

### RESULT

**Table 1:** ANCOVA test on effect of Interactive technology on the development of higher-level thinking skills in reading comprehension questions among students.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12311.545 <sup>a</sup>	2	6155.772	155.640	.000
Intercept	8167.956	1	8167.956	206.515	.000
PRETEST	893.749	1	893.749	22.597	.000
<b>Group</b>	<b>11334.426</b>	<b>1</b>	<b>11334.426</b>	<b>286.574</b>	<b>.000</b>
Error	7396.118	187	39.551		
Total	274810.000	190			
<b>Corrected Total</b>	<b>19707.663</b>	<b>189</b>			
<b>a. R Squared = .625 (Adjusted R Squared = .621)</b>					

Table 1 showed that F = 286.574, df. 1, p= .000 is less than the alpha level of 0.005 indicating that there is a significant effect of

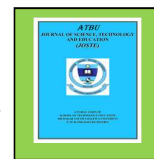
interactive technology on the development of higher-level thinking skills in reading comprehension questions among students.

Corresponding author: Areo Kelechi Goodluck

✉ [areoqk78@gmail.com](mailto:areoqk78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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Therefore, the null hypothesis which state that Interactive technology do not have a significant effect on the development of higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria was rejected.

This finding revealed that interactive technology has effect on the development of higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria.

**Table 2:** ANCOVA test on difference in comprehension performance in the pretest and posttest mean Score among students.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	11994.207 <sup>a</sup>	2	5997.103	182.024	.000
Intercept	4067.421	1	4067.421	123.455	.000
Posttest	727.433	1	727.433	22.079	.000
<b>Group</b>	<b>2334.174</b>	<b>1</b>	<b>2334.174</b>	<b>70.847</b>	<b>.000</b>
Error	6161.036	187	32.947		
Total	277378.000	190			
Corrected Total	18155.242	189			
<b>a. R Squared = .661 (Adjusted R Squared = .657)</b>					

Table 2 showed that  $F = 70.847$ ,  $df = 1$ ,  $P = .000$  is less than the alpha level of 0.005 also indicating that there is a significant difference in the pretest and posttest mean score in comprehension performance among the students. Therefore, the null hypothesis which state that there is no significant difference in comprehension performance in the pretest and posttest mean Score among students in Federal University of Education, Zaria was also rejected. This implies that higher-level thinking skills was used by the students hence, their performance in comprehension questions was better in the posttest.

## DISCUSSION

The study investigated the effect of interactive technology on developing higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria, Kaduna State, Nigeria. Two hypotheses were formulated and tested, and the result is discussed as follows

The first finding revealed that there is a significant effect of interactive technology on the development of higher-level thinking skills in reading comprehension questions among students ( $p = .000$ ) which was found to be less than 0.005 level of significant. The finding implies that interactive technology has effect on the development of

higher-level thinking skills in reading comprehension questions among students in Federal University of Education, Zaria. This finding corresponds with the study of Adebayo & Thompson (2023) who conducted a study among Nigerian secondary school students, examining the effect of digital storytelling tools on reading comprehension. Their finding revealed that students using interactive storytelling showed higher levels of inference-making, analysis, and synthesis than those who did not use the tools. Their study highlighted the potential of interactive technology to promote deeper comprehension skills. Similarly, Obi & Chukwu (2022) concluded that interactive technology help students approach reading materials from diverse perspectives, enhancing critical thinking after finding a positive correlation between the use of collaborative tools (such as online forums and discussion boards) and improved evaluative and analytical skills in their study.

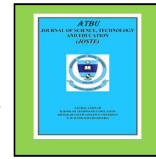
The second result revealed that there is a significant difference in the pretest and posttest mean score in comprehension performance among the students.  $P = .000$  was less than the alpha level of 0.005 which implies that higher-level thinking skills was used by the students when answering comprehension questions. Hence, their performance in comprehension questions was better in the

Corresponding author: Areo Kelechi Goodluck

✉ [areoqk78@gmail.com](mailto:areoqk78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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posttest. The finding is in line with the study of Lawal and Ayodeji (2024) who examined the effects of e-books with interactive features (like embedded quizzes and annotations) on students' comprehension skills in a Nigerian university setting. It found out that students who used interactive e-books had significantly higher scores in comprehension tasks requiring analysis and synthesis compared to those using traditional print textbooks. They concluded that interactive features enable students to engage actively with the text, thereby fostering higher-order thinking skills. Additionally, a study by Afolabi et al. (2023) also showed that gamification, through elements like quizzes and challenges, increased students' engagement, retention, and higher-level thinking skills. After exploring the effect of gamified learning platforms on reading comprehension skills among secondary school students in Lagos. Their finding supported the idea that interactive technology can make learning experiences both enjoyable and cognitively challenging. The current study and several studies suggested that interactive technology has a significant effect on students' higher-level thinking skills, which is beneficial in reading comprehension and cognitive engagement.

### CONCLUSION

The study explored the effect of interactive technology on higher-level thinking skills in reading comprehension among students at the Federal University of Education, Zaria. The hypotheses tested the effect of these technology on critical and analytical skills, overall comprehension performance, and higher-order cognitive skills development. Based on the analysis, the null hypotheses  $H_{01}$  and  $H_{02}$  were rejected, it can be concluded that interactive technology significantly enhance students' higher-level thinking, critical analysis, and reading comprehension performance.

### RECOMMENDATIONS

Based on the findings, the following recommendations were given

1. Federal University of Education should incorporate interactive technology as part of its core

curriculum to enhance critical thinking skills among students.

2. Academic Staff or Teachers should receive training on effectively using interactive technology to stimulate higher-level thinking in students.
3. The university should invest in digital infrastructure to provide uninterrupted access to interactive technology for all students.

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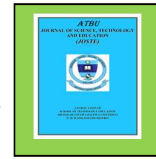
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Corresponding author: Areo Kelechi Goodluck

✉ [areoq78@gmail.com](mailto:areoq78@gmail.com)

Department of General Studies Education (GSE), Federal University of Education, Zaria, Kaduna State.

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