# GAMIFICATION AND ARTIFICIAL INTELLIGENCE TOOLS: AWARENESS AND USABILITY FOR LEARNING AMONG SENIOR SCHOOL BIOLOGY STUDENTS IN ILORIN SOUTH L.G.A, KWARA STATE

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**Abstract**
*This study explores the awareness and usability of gamification and AI tools for learning biology among senior school students in Ilorin South L.G.A, Kwara State, highlighting their importance in revolutionizing traditional teaching methods. Despite the growing interest in these innovative approaches, there remains a notable gap in research regarding their utilization and challenges, particularly among students in Kwara State. The study targeted all senior school biology students in Kwara State, with a specific focus on Ilorin South L.G.A. A sample of 300 senior school biology students was randomly selected from 10 schools in the region. Data collection was facilitated through a researcher-designed questionnaire, and analysis was conducted using descriptive and inferential statistics. Factors such as access to technology and infrastructure were identified as significant influences. The findings emphasize the need for increased awareness and the provision of adequate equipment and facilities to facilitate the integration of gamification and AI tools into learning environments, contributing to ongoing discussions on technology integration in education and informing policymakers and practitioners on effective strategies for enhanced learning experiences.*
**Keywords**: AI tools, Biology, Gamification, Learning. Technology

## Introduction

In recent years, the intersection of technology and education has revolutionized traditional learning paradigms, and has positively imparted education (Isioto *et al*, 2017). Information Communication Technology (ICT) has revolutionized the landscape of education, providing dynamic tools that enhance both teaching and learning experiences. Among the myriad of ICT applications, gamification and artificial intelligence (AI) stand out as transformative innovations. One prominent aspect of this transformation is the integration of gamification and artificial intelligence (AI) tools to augment the learning experience. Gamification and artificial intelligence (AI) tools have the potential to revolutionize learning among students by making it more engaging, interactive and personalized. Researchers describe gamification as infusing game component into a non-game context (Hanus & Fox 2015; Kuo & Chuang 2016). Leaderboard, badges, points and levels are some of the game elements employed in previous studies (Hamari 2015; Hanus & Fox

2015; Kuo & Chuang 2016; Sanmugam *et al.*, 2016). Artificial Intelligence (AI) is a computer system that includes human-like processes like learning, adapting, synthesizing, self-correcting, and using data for complex processing tasks (Alimi *et al.* 2021).

Gamification and artificial intelligence (AI) tools have emerged as innovative approaches to enhance learning experiences, particularly in the field of education (Deterding *et. al.*, 2011). With the increasing integration of technology in educational settings, there is a growing interest in leveraging gamification and AI to improve student engagement, motivation, and learning outcomes (Zalte, 2023) Thus, gamification which involves applying game design elements and principles in non-game contexts is used to engage and motivate users. In education, gamification techniques such as points, badges, leaderboards, and quests are utilized to create immersive and interactive learning environments (Welber et al., 2019). On the other hand, AI tools encompass a range of technologies including machine learning, natural language processing, and computer vision, which can be leveraged to personalize learning experiences, provide feedback, and facilitate adaptive learning pathways (Tahiru & Agbesi, 2021). Awareness serves as a crucial foundation for the adoption of any educational technology tool understanding the potential of gamification and AI tools in enhancing learning experiences is pivotal. While traditional teaching methods persist, integrating gamified elements and AI-driven platforms offers avenues for engaging and immersive learning experiences (Gikas & Grant, 2013; Varol & Ozer, 2024). Studies has shown that secondary school students are aware of gamification and AI tools and their applications for learning biology outside Nigeria most especially developed countries (Chandra, 2019; Choudhary *et al.*, 2023). However, the extent to which secondary school students in Nigeria are aware of these innovations and its application for learning biology in Nigeria are limited (Oke *et al.*, 2023, Okunade,2023, Udeani & Akhigbe, 2020) and remains an area of inquiry. There is growing awareness of ICT tools in Nigerian schools, the awareness of specific tools such as gamification and AI remains limited (Olumoye (2020). This limited awareness can be attributed to a lack of exposure and training among both students and educators.

Usability encompasses the effectiveness, efficiency, and satisfaction with which users can achieve their learning goals using gamification and AI tools. In the context of senior school students, assessing the usability of these tools is essential. Gamification elements, such as quizzes, simulations, and interactive activities, have demonstrated potential in improving student

engagement and knowledge retention (Hamari *et al.,* 2014, Lampropoulos &Sidiropoulos, 2024). Similarly, AI tools, including intelligent tutoring systems and adaptive learning platforms, offer personalized learning experiences tailored to individual student needs (Okunade 2024; VanLehn, 2011). Assessing the usability of these tools provides insights into their effectiveness in enhancing learning outcome (Okolo, 2024).

Research shows the usability of gamification and AI tutoring tools improves students learning experiences (Meng et al.,2023; Ghai et al.,2023; Ramli et al 2022). The usability of gamification has been reported to have positive impact on secondary school biology students' academic performance, attitude to learning and engagement (Attah et al 2024; Noor et al.,2024; Ogunode &Ejike, 2023c; Ruiz, 2024; Umar et al.,2023). The usability of AI tutoring tools has also been reported as having a positive impact on student learning experience, engagement and academic achievement (Ekukinam et al.,2024; Koc-Januchta et al., 2022).

Several factors influence the usability of gamification tools for learning among senior school students. These factors encompass technological infrastructure, teacher support and training, student misunderstanding, cost of resources and curriculum alignment (Dicheva *et al.,* 2018). Studies have emphasized that the development and adoption of new learning and teaching with technologies have grown steadily over the past 30 years, but the adoption in developing countries is relatively low (Alimi *et al.,* 2021). The disparities in access to technology and digital literacy levels may impact the adoption and effectiveness of gamification in education. Additionally, readiness to integrate gamified elements into the teaching practices and align them with curriculum objectives plays a pivotal role in determining usability.

While AI holds promise in revolutionizing education, challenges persist in its usability among senior school students in Nigeria. These include; lack or irregular supply of electricity, lack of infrastructure such as physical space for computers, insecurity, resistance to change by teachers (Adeyemi, 2020). Also, many teachers lack the basic skills and lack understanding of how to integrate AI tools into their subject areas (Adeyemi, 2020). Thus, they don't know how to guide students to use AI tools to learn basic concept in their subject areas. Technical constraints, such as limited internet connectivity and access to AI-enabled devices, pose significant barriers to adoption ( Mekler *et al.,* 2012; Siemens and Baker, 2012). Alimi *et al,* 2021 stated that students' ability to

explore digital resources such as AI depends on awareness and access to digital technologies among other things. The usability of gamification and AI tools in Nigerian secondary schools is influenced by several factors, including infrastructure, teacher preparedness, and student receptiveness. Adeoye and Wentling (2020) found that infrastructural challenges such as inadequate internet access and lack of digital devices hinder the effective use of ICT tools in Nigerian schools. Additionally, teacher preparedness plays a critical role in the usability of these tools. According to Okeke and Ume (2019), many teachers in Nigeria require additional training to effectively integrate gamification and AI into their teaching practices

Senior school biology students represent a critical demographic for exploring the effectiveness of gamification and AI tools in education (Nwankwo & Ukeh, 2023; Smiderle, *et al.*, 2020). As digital natives, these students are accustomed to using technology in their daily lives and are receptive to innovative learning approaches (Pedro, *et al.*,2015). Students use ICT in many ways particularly afterschool and at-home for online tutoring, remediation, and exam preparation services through desktops, laptops, smartphones or tablets (Bolaji & Jimoh, 2023). The intersection of gamification and AI holds significant potential for learning biology in secondary school, fostering an interactive and individualized learning environment for senior school students (Ibáñez *et al.*, 2018).

By investigating the awareness and usability of gamification and AI tools among senior school biology students, educators can gain insights into the effectiveness of these technologies in enhancing learning outcomes in education (Johnson *et al*., 2015). Specifically, in biology education, gamification has been shown to enhance student understanding and retention of complex concepts. For instance, Ibáñez *et al.*, (2014) demonstrated that a gamified approach to teaching cellular biology improved students' conceptual understanding and engagement. AI has the potential to provide personalized learning experiences by adapting instructional content to meet the individual needs of students. A study by Chen *et al.*, (2020) highlighted that AI-driven

personalized learning systems can improve learning efficiency and student satisfaction. Additionally, AI can facilitate data-driven decision-making in educational settings, enabling educators to tailor their teaching strategies based on real-time data (Zawacki-Richter *et al.*, 2019). Furthermore, the significance of AI in Nigerian schools encompasses the resolution of issues such as overcrowded classrooms, inadequate resources, and unequal allocation of educational facilities (Roll & Wylie, 2016; Stoeffler *et al.*, 2019).

Thus, in line with the government's educational strategy, which prioritizes STEM courses and technical literacy in the national curriculum (Smith, 2018). Also, based on efforts being made towards the use of technology in teaching and learning, such as the national policy on ICT in education (2019). This study investigates the awareness and usability of gamification and AI tools among senior school Biology students in Ilorin South LGA, Kwara State.

**Purpose of the Study**

The purpose of the study was to investigate the awareness and usability of gamification and AI tools among senior school Biology students in Ilorin South LGA, Kwara State. Specifically, the study examined:

1. senior school biology students' awareness level of gamification.
2. senior school biology students' awareness level of AI tools.
3. senior school biology students' usability of gamification for learning.
4. senior school biology students' usability of AI tools for learning.

**Research Questions**

1. What is the level of senior school biology students' awareness of gamification?
2. What is the level of senior school biology students' awareness of AI tools?
3. How frequently do senior school biology students in Ilorin south LGA use gamification for learning purposes?
4. How frequently do senior school biology students use AI tools for learning purposes?
5. What factors influence the usability of gamification among senior school biology students in Ilorin south LGA?
6. What challenges do senior school biology students in Ilorin south LGA encounter in the usability of AI tools?

**Research Hypotheses**

**Ho1:** There is no statistically significant difference between the male and female senior school biology students in Ilorin south LGA, Kwara State regarding their awareness of gaming for learning purposes.

**Ho2:** There is no statistically significant difference between male and female senior school biology students in Ilorin south LGA, Kwara State regarding the usability of gamification for learning purposes.

**Ho3:** There is no statistically significant difference in the awareness of AI tools for learning purposes among senior school Biology students in Ilorin South LGA based on gender.

**Ho4:** There is no statistically significant difference in the usability of AI tools for learning purposes among senior school Biology students in Ilorin South LGA based on gender.

**Methodology**

This is a descriptive research design of the survey type. This study is aimed at investigating the awareness and usability of gamification and artificial intelligence tools among senior school Biology students in Ilorin south LGA, Kwara state. The population of the study were all senior secondary school students in Kwara state while the target population were all senior secondary school students in Ilorin South LGA ,Kwara state. The sample size was determined from the estimate of the target population which was 11,646 (according to 2022/2023 Kwara state school census report). Using Cohen et.al. 2007 table of random sampling, at about 90 percent confidence level, the sample size for this study were 300 respondents from 10 secondary schools in Ilorin South LGA.

The research instrument was a researcher-designed questionnaire. The questionnaire was a 4-point Likert-scale titled gamification, AI tools, awareness and usability questionnaire (GAITAUQ). The questionnaire has two sections, A and B. Section A deals with respondent demography such as age and gender while section B deals with the items on awareness, use and usability of gamification and artificial intelligence.

To ensure face and content validity of the instrument (GAITAUQ), the questionnaire was given to an expert in educational technology and an expert in measurement and evaluation to check the suitability and viability of the instrument. The researcher personally visited the schools where the studies were carried out to seek permission from the authorities of the schools. The questionnaires

were administered to biology students and retrieved immediately for data analysis. The data obtained were analyzed and interpreted using descriptive and inferential statistics using SPSS version 27, USA.

## RESULTS AND DISCUSSIONS

**Research Question 1**: To assess the level of awareness of gamification for learning purposes among Senior School Biology students in Ilorin South LGA.

**Table 1: Awareness of Biology Students on Gamification for Learning**

| Statement | N | Mean | SD |
|---|---|---|---|
| 1. Are you aware that there are games for learning biology? | 300 | 2.70 | 1.189 |
| 2. Are you aware that there are online game applications such as Quizlet, Kahoot, Khan Academy for learning biology? | 300 | 2.83 | 1.037 |
| 3. Do you know that gamification is use of game element in non-gaming content? | 300 | 3.13 | 1.119 |
| 4. Do you know that gamification can be in digital or non-digital form? | 300 | 3.33 | 1.013 |
| 5. Do you know that gamification can be employed using devices such as phones and computers? | 300 | 3.73 | .681 |

***Note: Mean score < 2.00 = Low* Awareness *level, mean score >2.00 ≤ 3.00=Moderate* Awareness *level, Mean score>3.00 = High* Awareness *level.***

Table 1 show that the aggregated mean score is 3.14 and indicates a high level of awareness of gamification for learning purposes among the surveyed students. Specifically, students showed the highest awareness that gamification can be employed using devices such as phones and computers (M = 3.73, SD = 0.681). There is also a notable awareness of the concept that gamification can be in both digital and non-digital forms (M = 3.33, SD = 1.013), as well as the use of game elements in non-gaming content (M = 3.13, SD = 1.119). However, the awareness of specific games designed for learning biology was comparatively lower (M = 2.70, SD = 1.189), though still within the moderate to high awareness range. Similarly, awareness of online game applications like Quizlet, Kahoot, and Khan Academy for learning biology had a moderate mean score (M = 2.83, SD = 1.037)..

**Research Question 2**: To evaluate the level of awareness of AI tools for learning purposes among Senior School Biology students in Ilorin South LGA.

**Table 2: Awareness of Biology Students on Artificial Intelligence for Learning**

| Statement | N | Mean | SD |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1. Are you aware that there are AI tools for learning biology? | 300 | 2.73 | 1.064 |
| 2. Are you aware that there are AI tools such as ChatGPT, WhatsApp Personal Assistance Pi, Querium for learning biology? | 300 | 3.37 | .796 |
| 3. Do you know that AI tools can help you to learn better? | 300 | 3.70 | .587 |
| 4. Do you know that AI tools can be employed using devices such as phones and computers? | 300 | 3.60 | .664 |
| 5. Do you that AI tools can guide as facilitator while you study Biology? | 300 | 3.13 | .847 |
| **Aggregated Mean** | | **3.31** | |

***Note: Mean score < 2.00 = Low* awareness *level, Mean score >2.00 ≤ 3.00=Moderate* Awareness *level, Mean score>3.00 = High* Awareness *level.***

Table 2 revealed that the aggregated mean score of 3.31 and signifies a high level of awareness among the surveyed students regarding AI tools for learning purposes. Students demonstrated the highest awareness that AI tools can help improve their learning experience (M = 3.70, SD = 0.587) and that these tools can be employed using devices such as phones and computers (M = 3.60, SD = 0.664). Awareness of specific AI tools like ChatGPT, WhatsApp Personal Assistance Pi, and Querium also scored high (M = 3.37, SD = 0.796). However, awareness that AI tools exist for learning biology, in general, had a slightly lower mean score (M = 2.73, SD = 1.064), though it still falls within the moderate to high awareness range. Similarly, the understanding that AI tools can act as facilitators while studying Biology had a moderate mean score (M = 3.13, SD = 0.847)..

**Research Question 3**: To examine the frequency of utilization of gamification for learning purposes among Senior School Biology students in Ilorin South LGA.

**Table 3: Use of Gamification by Biology Students for Learning**

| Statement | N | Mean | SD |
|---|---|---|---|
| 1. Have you ever used game application such as Quizlet, Khan Academy or any other game for learning biology? | 300 | 2.20 | 1.015 |
| 2. Have you ever participated in biology-related gamified activities in the classroom? | 300 | 1.70 | 1.007 |
| 3. Does your teacher incorporate gamified elements into your biology lesson? | 300 | 1.60 | 1.054 |
| 4. Do you usually use gamification for learning biology? | 300 | 2.23 | 1.088 |
| **Aggregated Mean** | | **1.93** | |

*Note: Mean score < 2.00 = Low* usage *level, Mean score >2.00 ≤ 3.00=Moderate* usage *level, Mean score>3.00 = High* usage *level.*

The analysis aimed to examine the frequency of utilization of gamification for learning purposes among Senior School Biology students in Ilorin South LGA. As presented in Table 3, the aggregated mean score of 1.93 indicates a low level of utilization of gamification for learning biology among the students surveyed. Specifically, the highest mean scores were for the questions regarding whether students have used game applications for learning biology (M = 2.20, SD = 1.015) and whether they usually use gamification for learning biology (M = 2.23, SD = 1.088). These results show that while some students are familiar with and use gamification tools like Quizlet and Khan Academy, the overall frequency of use is low. The mean scores for participating in biology-related gamified activities in the classroom (M = 1.70, SD = 1.007) and whether teachers incorporate gamified elements into biology lessons (M = 1.60, SD = 1.054) were even lower. These findings indicate that the integration of gamified activities and elements by teachers in classroom settings is minimal.

**Research Question 4**: How frequently do Senior School Biology students in Ilorin South LGA utilize AI tools for learning purposes?

**Table 4: Use of Artificial Intelligence by Biology Student for Learning**

| Statement | N | Mean | SD |
|---|---|---|---|
| 1. Have you ever used AI tools such as ChatGPT, WhatsApp Personal Assistance Pi and Querium for learning biology? | 300 | 2.67 | 1.166 |
| 2. Have you ever participated in biology-related lesson where AI tools are used by the teacher in the classroom? | 300 | 1.30 | .782 |
| 3. Does your teacher incorporate AI tools into your biology lesson? | 300 | 1.37 | .876 |
| 4. Do you usually use AI tools for learning biology? | 300 | 2.43 | 1.204 |
| **Aggregated Mean** | | **1.94** | |

*Note: Mean score < 2.00 = Low* usage *level, Mean score >2.00 ≤ 3.00=Moderate* usage *level, Mean score>3.00 = High* usage *level.*

Table 4 shows that the aggregated mean score of 1.94 indicates a low level of utilization of AI tools for learning biology among the students surveyed. The highest mean scores were observed for the questions regarding whether students have used AI tools such as ChatGPT, WhatsApp Personal Assistance Pi, and Querium for learning biology (M = 2.67, SD = 1.166) and whether they usually use AI tools for learning biology (M = 2.43, SD = 1.204). These scores suggest that while some students are aware of and use AI tools, their overall usage is still low. Conversely, the mean scores for participating in biology-related lessons where AI tools are used by the teacher in the classroom (M = 1.30, SD = 0.782) and whether teachers incorporate AI tools into biology

lessons (M = 1.37, SD = 0.876) were significantly lower. This indicates minimal integration of AI tools by teachers in classroom settings.

**Research Question 5**: What factors influence the utilization of gamification among Senior School Biology students in Ilorin South LGA?

**Table 5: Factors That Influence Usability of Gamification**

| Statement | N | Mean |
|---|---|---|
| 1. Do you have access to internet? | 300 | 3.63 |
| 2. Do you have devices such as phone and computers? | 300 | 3.30 |
| 3. Do you find gamification effective for learning biology? | 300 | 3.30 |
| 4. Do you find biology easy to learn using gamification? | 300 | 3.17 |
| 5. Do you find gamification satisfactory for learning biology? | 300 | 3.07 |
| 6. Does your school have devices and facilities for use of gamification? | 300 | 1.47 |

To understand the factors influencing gamification use among Senior School Biology students in Ilorin South LGA, the mean scores were analysed for related questions in Table 5. The highest mean scores were for internet access (M = 3.63) and the availability of personal devices (M = 3.30). This indicates that having internet and personal devices significantly supports gamification use. Students also found gamification effective (M = 3.30), easy to use (M = 3.17), and satisfactory (M = 3.07) for learning biology, suggesting positive perceptions of gamification. However, the mean score for the availability of devices and facilities in schools was much lower (M = 1.47), highlighting a major barrier. The lack of infrastructure in schools may limit the adoption of gamification.

**Research Question 6**: What challenges do Senior School Biology students in Ilorin South LGA encounter in utilizing AI tools for learning?

**Table 6: Challenges on Usability of Artificial Intelligence Tools**

| Statement | N | Mean |
|---|---|---|
| 1. Do you have devices such as phones and computers? | 300 | 3.40 |
| 2. Do you find Biology easy to learn with AI tools? | 300 | 3.40 |
| 3. Do you find AI tools effective for learning Biology? | 300 | 3.30 |
| 4. Do you find AI tools satisfactory for learning Biology? | 300 | 3.23 |
| 5. Do you have access to regular supply of electricity? | 300 | 1.93 |
| 6. Does your school have devices and facilities for use of AI tools? | 300 | 1.57 |

Table 6 presents the mean scores for challenges on usability of AI tools. The table shows that the highest mean scores were for having personal devices such as phones and computers (M = 3.40) and finding biology easy to learn with AI tools (M = 3.40). This suggests that students generally

find the technology accessible and conducive to learning. Furthermore, students perceive AI tools as effective (M = 3.30) and satisfactory (M = 3.23) for learning biology, indicating positive attitudes towards their usage. However, challenges related to infrastructure were evident. Students reported lower mean scores for access to regular electricity supply (M = 1.93) and the availability of devices and facilities in schools for AI tool use (M = 1.57).

**Ho1:** There is no statistically significant difference between male and female Senior School Biology students in Ilorin South LGA regarding their awareness of gamification for learning purposes.

**Table 7 Descriptive and T-Test analysis results for male and female Senior School Biology students' on awareness of gamification**

| | Gender | N | Mean | Std. Deviation | Df | T-value | P-value |
|---|---|---|---|---|---|---|---|
| Awareness of gamification | Male | 130 | 15.00 | 2.99 | 288 | -2.99 | 0.003 |
| | Female | 160 | 16.13 | 3.33 | | | |

An independent-sample t-test was conducted to compare the awareness of gamification for learning purposes between male and female Senior School Biology students in Ilorin South LGA. The results showed a statistically significant difference in the awareness scores for male students (M = 15.00, SD = 2.99) and female students (M = 16.13, SD = 3.33), df (288), T-value =−2.99, $p$=.003$t$(288)=−2.99,$p$=.003. The analysis revealed a significant difference in the awareness of gamification for learning purposes between male and female students. Female students (M = 16.13) demonstrated significantly higher awareness compared to male students (M = 15.00). Therefore, the null hypothesis was rejected

**Ho2:** There is no statistically significant difference between male and female Senior School Biology students in Ilorin South LGA regarding their utilization of gamification for learning purposes.

**Table 8 Descriptive and T-Test analysis results for male and female Senior School Biology students' on utilization of gamification**

| | Gender | N | Mean | Std. Deviation | Df | T-value | P-value |
|---|---|---|---|---|---|---|---|
| Use of Gamification | Male | 130 | 8.15 | 3.02 | 288 | 1.92 | 0.056 |
| | Female | 160 | 7.50 | 2.77 | | | |

Table 8 shows that an independent-sample t-test was conducted to compare the utilization of gamification for learning purposes between male and female Senior School Biology students in

Ilorin South LGA. The results showed no statistically significant difference in the utilization scores for male students (M = 8.15, SD = 3.02) and female students (M = 7.50, SD = 2.77), (288) =1.92, $p$=.056$t$ (288) =1.92, $p$=.056. The analysis indicated that there is no significant difference in the utilization of gamification for learning purposes between male and female students. The mean utilization scores for male students (M = 8.15) and female students (M = 7.50) were not significantly different. Therefore, the null hypothesis is not rejected since both male and female students have similar levels of utilization of gamification for learning purposes.

**Ho3:** There is no statistically significant difference in the awareness of AI tools for learning purposes among Senior School Biology students in Ilorin South LGA based on gender.

**Table 9 Descriptive and T-Test analysis results for male and female Senior School Biology students' on awareness of AI tools**

| | Gender | N | Mean | Std. Deviation | Df | T-value | P-value |
|---|---|---|---|---|---|---|---|
| Awareness of AI Tools | Male | 130 | 16.46 | 2.77 | 288 | -.297 | .767 |
| | Female | 160 | 16.56 | 2.97 | | | |

Table 9 revealed that the results of the independent-samples t-test indicated that there was no statistically significant difference in the awareness of AI tools for learning purposes between male students (M = 16.46, SD = 2.77) and female students (M = 16.56, SD = 2.97); $t(288)=-0.297, p=.767 t(288)=-0.297, p=.767$. The findings suggest that both male and female Senior School Biology students in Ilorin South LGA have similar levels of awareness regarding AI tools for learning purposesThus, the null hypothesis 3 is not rejected.

**Ho4:** There is no statistically significant difference in the utilization of AI tools for learning purposes among Senior School Biology students in Ilorin South LGA based on gender.

**Table 10 Descriptive and T-Test analysis results for male and female Senior School Biology students on utilization of AI tools**

| | Gender | N | Mean | Std. Deviation | Df | P-value |
|---|---|---|---|---|---|---|
| Use of AI Tools | Male | 130 | 7.62 | 2.44 | 288 | .701 |
| | Female | 160 | 7.75 | 3.34 | | |

Table 10 shows that an independent-sample t-test was conducted to compare the utilization of AI tools for learning purposes among male and female Senior School Biology students in Ilorin South LGA. The analysis revealed that male students (M = 7.62, SD = 2.44) and female students (M = 7.75, SD = 3.34) did not differ significantly in their utilization of AI tools for learning, t(288) = -0.383, p = .701. The mean difference between the groups was not statistically significant, indicating that both male and female students utilize AI tools for learning to a similar extent. Thus,

the null hypothesis that there is no statistically significant difference in the utilization of AI tools for learning purposes between male and female students is retained.

**Discussion of findings**

The findings reveal that Senior School Biology students in Ilorin South LGA have a high level of awareness of gamification AI tools for learning purposes, particularly regarding the general concepts and technological means of gamification, though there is slightly lower awareness of specific educational games and applications**.** This is supported by the report of Chandra (2019). The findings reveal a low level of utilization of gamification and AI tools for learning biology among Senior School Biology students in Ilorin South LGA. This is similar to the report of Adeoye Wetling (2020). The findings reveal that though students generally have access to the internet and personal devices and hold positive views on the effectiveness and satisfaction of gamification and AI tools for learning biology, the lack of adequate devices, facilities and infrastructure in schools poses a major challenge. This is supported by the report of Alimi et al ( 2021).

The findings implies that the perspectives and attitudes of the students towards awareness of gamification for learning biology are significantly different. This may be due to reason such that males paid more attention to gamification for entertainment rather than for learning biology. This may also be due to the fact that young people in the 21$^{st}$ century defy gender stereotypes that affect academic performance (Attah et al, 2o24). The finding also implies that gender has no significant effect on the students interaction with gamification and supported by the findings of Udeani and Akhigbe (2020). Furthermore, the findings reveal that gender does not play a critical role in students' awareness of AI tools in this context. This implies that both genders are equally aware of AI tutoring tools for learning and this is similar to the findings of Udosen and Udoh, (2024).The results indicate no significant difference in awareness of AI tools for learning purposes among male and female students, suggesting equitable exposure and knowledge among genders in this region. The finding suggest that gender does not play a significant role in the utilization of AI tools among Senior School Biology students in Ilorin South LGA. This is similar to the finding of Ekukianam et al.(2024).

**Conclusion:**

By understanding the factors influencing usability and addressing challenges hindering adoption, educators and policymakers can leverage these innovative technologies to foster engaging and

effective Biology education. Through this research, educators and curriculum developers can gain valuable insights into how gamification and AI tools can be effectively integrated into biology curriculum to enhance student learning experiences and outcomes.

**Recommendation**

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

1. Schools should integrate gamification and AI tools into the biology curriculum to enhance student engagement and learning outcomes.
2. To address the challenge of inadequate devices, facilities, and infrastructure, schools should invest in providing sufficient technological resources.
3. Schools can organize informational sessions and demonstrations to familiarize students with these tools.

**References**

Adeoye, B., & Wentling, T. L. (2020). Infrastructure and ICT in Nigerian secondary schools: the role of government. *Education and Information Technologies*, 25(3), 1467-1484.

Adeyemi, O. A. (2020). Integrating artificial intelligence into STEM education in Nigerian secondary schools. *Journal of Educational Technology Research,* 15(2), 112-130.

Alimi A.E., Buraimoh O.F., Aladesusi G.A., Babalola E. O. University students' awareness of, access to, and use of artificial intelligence for learning in Kwara state. https://ejournal.upi.edu/index.php/ijoti

Attah J. O., Ogunlade O. O. & Otemuyiwa B. I. (2024). Effect of Gamification-Based Teaching on Junior Secondary School Student's Academic Performance in Mathematics in Kwara State ·Andragogi Jurnal Pendidikan dan Pembelajaran Vol 4, No. 2, September DOI: https://doi.org/10.31538/adrg.v4i2.1325 E-ISSN 2807-8233 pp. 153-165

Avik, S. (2018). Interview with Dr. Avik sarka, head data analytic cell at niti an ayog, govt of India, *UNESCO MGIEP*, 2018.

Bolaji, H. O., and Jimoh, H. A. (2023). Usability and utilization of ICT among educational administrators in secondary students in public school. *Indonesian Journal of Educational Research and Technology, 3*(2), 97-104.

Chandra, R. D. (2019). Pengaruh media puzzle terhadap kemampuan anak mengenal angka (1-10) Pada anak usia 4-5 tahun di TK nusa indah desa gumuksari kecamatan kalisat Kabupaten Jember Tahun Pelajaran. *Jurnal Pendidikan Anak Usia Dini*, 01(01), 32–45.

Chen, C. M., Xie, H. T., & Hsieh, H. L. (2020). The effects of personalized learning in a web-based learning system for high school students: a comparison between ai-driven and non-ai-driven approaches. *Computers & Education*, 143, 103697.

Choudhary A, Jaral S, Malik A, Kaul R, Sharma A. (2023) Assessment of knowledge and awareness of artificial intelligence and its uses in dentistry among dental students in Jammu and Kashmir: A questionnaire-based survey. *IP Indian J Conserv Endod* 8(4):210-214

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education*. *Education* (6th ed.). London and New York: Routledge

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to //.,l.,gamefulness: Defining "gamification". *In Proceedings of the 15th international academic mindtrek conference: Envisioning future media environments* (pp. 9-15). https://doi.org/10.1145/2181037.2181040

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Journal of Educational Technology & Society*, *18*(3), 75-88.

Ekukinam T., Udosen I. N.& Udoh N. I. (2024). The impact of gender and virtual reality technology in teachimg biology on academic performance of senior secondary school biology students in akwa ibom state.*Shared Seasoned International Journal of Topical Issues* VOL.10 NO.2, OCTOBER New York City. ISSN: 2630–7290

Ghai A. & Tandon U. (2023). Integrating gamification and instructional design to enhance usability of online learning Education and Information Technologies 28:2187–2206 https://doi.org/10.1007/s10639-022-11202-5

Gikas, J., and Grant, M. M. (2013). Mobile computing devices in higher education: student perspectives on learning with cellphones, smartphones & social media. *The Internet and Higher Education*, 19, 18-26. https://doi.org/10.1016/j.iheduc.2013.06.002

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? - A literature review of empirical studies on gamification. In 2014 47th Hawaii International Conference on System Sciences (pp. 3025-3034). *IEEE*. https://doi.org/10.1109/HICSS.2014.377

Hamari, J., Nousiainen, T. (2015). Why do teachers use game-based learning technologies? In the role of individual and institutional ICT readiness. *In proceedings of the 48th Annual Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA, pp. 110. https://doi.org/10.1109/hicss.2015.88

Hanus, M. D., & Fox, J. (2015). "Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance". *Computers & Education*, Vol *80*, pp 152-161.

Ibáñez, M. B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education*, 123, 109-123. https://doi.org/10.1016/j.compedu.2018.05.002

Ibáñez, M. B., Di-Serio, Á., & Delgado-Kloos, C. (2014). Gamification for engaging computer science students in learning activities: a case study. *IEEE Transactions on Learning Technologies, 7(*3), 291-301.

Isioto, N. N., Philip-kpae., F. O. & Dickso, R. (2017). Factors affecting technological growth in Nigeria and the way forward. *International Journal of Mechanical Engineering and Applications,* 5(5), 269-274.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). NMC Horizon Report: 2015 K-12 Edition. The New Media Consortium Nwankwo E. D. and Ukeh B. O. (2023). Effect of Gamification on Senior Secondary Students' Academic Achievement in Computer Studies in Enugu Education Zone of Enugu State. *ESUT Journal of Education (EJE)* 6 (2) 181-189.

Kuo, M-S and Chuang, T-Y (2016). How gamification motivates visits and engagement for online academic dissemination – An empirical study. *Computers in Human Behavior*, 55 (A) 16-27. https://doi.org/10.1016/j.chb.2015.08.025

Lampropoulos G and Sidiropoloulos A (2024). Impact of gamification on students' learning outcomes and academic performance. A longitudinal study comparing online, traditional and gamified learning. *Edu.Sci* 14;347

M. M. Koć-Januchta , Schönborn K. J., Roehrig C., Chaudhri V. K. , Tibell L. A. E. & H. C. Heller (2022) . "Connecting concepts helps put main ideas together": cognitive load and usability in learning biology with an AI-enriched Textbook. *Int J Educ Technol High Educ* 19:11 Page 2 of 23

Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, 71, 525-534.

Meng C. L., Soon M. L. & Siok Y. T. (2023). User evaluation on a mobile augmented reality game-based application as a learning tool for biology. *TEM Journal*. Volume 12, Issue 1, pages 550-557, ISSN 2217-8309, DOI: 10.18421/TEM121-65, February DOI: 10.18421/TEM121-65 https://doi.org/10.18421/TEM121-65

National Policy on Information and Communication Technologies (ICT) in Education 2019. retrieved from https://education.gov.ng/wp-content/uploads/2019/08/NATIONAL-POLICY-ON-ICT-IN-EDUCATION-2019.pdf on 17th April, 2023

Noor N. M., Abdul Rahim N. A. &Ekhsan H. M. (2024). Leveraging gamification in science learning for secondary students. *Applied Mathematics and Computational Intelligence* Volume 13, No. 4, [62-71]

Nwankwo E. D. and Ukeh B. O. (2023). Effect of gamification on senior secondary students' academic achievement in computer studies in Enugu education zone of Enugu state. *ESUT Journal of Education* (EJE) 6 (2) 181-189.

Ogunode, N,. J. & Ejike, C,. N. (2023). Artificial intelligence and curriculum implementation of post-basic education and career development (PBECD) in nigeria. *Journal of Innova,on in Educa,on and Social Research, Volume: 1(4), 50-56*

Oke A.A., Babatunde, N. A., Obiwusi K. Y., Lasisi A. T. (2023) Effect of crossword games in STEM subjects on students' academic performance of selected secondary school in Osun State. *IJOTRE*, 24: 385-395.

Okeke, C. A., & Ume, J. A. (2019). Teacher preparedness for ICT integration in secondary schools in Nigeria. *Journal of Educational Technology & Society*, 22(4), 206-217.

Okolo, C. T. (2024). Beyond AI hype: a hands-on workshop series for enhancing AI literacy in middle and high school students. *In proceedings of the 2024 RESPECT Annual Conference (RESPECT 2024), May 16–17, 2024, Atlanta, GA, USA. ACM, New York, NY, USA, 8 pages*. https://doi.org/10.1145/3653666.3656075

Okunade A.I (2024).The role of artificial intelligence in teaching of science education in secondary schools in nigeria. *European Journal of Computer Science and Information Technology* · February 2024 DOI: 10.37745/ejcsit.2013/vol12n15767: https://www.researchgate.net/publication/378866984

Olumoye, M. Y. (2020). Awareness and utilization of ICT tools among secondary school students in Nigeria. *Journal of Educational Research and Review,* 15(2), 150-165.

Pedro, L. Z., Lopes, A. M., Prates, B. G., Vassileva, J., & Isotani, S. (2015). "Does gamification work for boys and girls? An exploratory study with a virtual learning environment". In *Proceedings of the 30th Annual ACM Symposium on Applied Computing*, pp 214-219

Popenici, S. A., and Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1), 1-13.

Ramli R. Z., Ashaari N. S., Noor S. F. M., Noor M. M. . Abd Majid , N. A , Dahlan H. A. , &Abdul Wahab A. N. (2022).Assessing usability of learning experience prototype. *iJET* – Vol. 18, No. 09, http://www.i-jet.org https://doi.org/10.3991/ijet.v17i09.29955

Roll, I. and Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, 26(2), 582-599.

Ruiz, S. M.(2024). Using differentiated gamification to teach systems interactions: impacts on ninth grade biology students' academic achievement and cognitive, behavioral, and emotional engagement. (doctoral dissertation). Retrieved from https://scholarcommons.sc.edu/etd/7794

Sanmugam, M., Abdullah, Z., Mohamed, H., Aris, B., Zaid, N. M. and Suhadi, S. M. (2016). The affiliation between student achievement and elements of gamification in learning science, 4th International Conference on Information and Communication Technology (ICoICT), Bandung, Indonesia, pp. 1-4. doi:10.1109/ICoICT.2016.7571962

Siemens, G., & Baker, R. S. (2012). Learning analytics and educational data mining: towards communication and collaboration. *Proceedings of the 2nd international conference on learning analytics and knowledge* (pp. 252-254).

Smiderle, R., Rigo, S. J., Marques L. B., Pecanha de Miranda Coelho, J. A. and Jaques, P. A. (2020). Impact of gamification on students' learning, engagement and behavior based on their personality traits smart learning environment. 7 (3) https://doi.org/10.1186/s40561-019-0098-x

Smith, J. R. (2018). The impact of intelligent tutoring systems on student learning outcomes: a meta-analysis. *Educational Psychology Review*, 28(4), 523-548Soma, D. (2018). Artificial intelligence for education

Stoeffler, K., Rosen, Y., Bolsinova, M., & von Davier, A. A. (2019). Gamified performance assessment of collaborative problem-solving skills. *Computers in Human Behavior*, 10603

Tahiru, F., & Agbesi, S. (2021). The future of artificial intelligence in education. In a. Gyamfi & i. Williams (eds.), digital technology advancements in knowledge management (pp. 187-194). *IGI Global*. https://doi.org/10.4018/978-1-7998-6792-0.ch010

Udeani, U., & Akhigbe, J.N. (IN PRESS). In-service biology teachers' perceptions and pedagogical rating of two mobile learning applications recommended for learning biology in Nigerian secondary schools. *African Journal of Information Systems*.

Udosen I. N. & Udoh U.I, ( 2024).the difference in academic performance of senior secondary school biology students exposed to chatbot AI or expository method based on their gender. *International Journal Of Modern Health Systems And Medical Sciences Junevol. 2 No. 1. Issn: 2854-1674*

Umar A. A., Soladoye N. L., Oluwabusayo T., Franklin U. O., Benjamin A., Ige A. M. & Ismail O. M. (2023).a new piece of the puzzle: deploying technologically enhanced jigsaw method to solve the puzzle of meaningful learning in biology. *Aseana journal of science and education* VOL. 3 NO. 1 8–17 © Association of Researcher of Skills and Vocational Training, Malaysia ASEANA .ISSN: 2735-069X eISSN: 2805-4474 .DOI: https://doi.org/10.53797/aseana.v3i1.2

UNESCO. (2021). *Artificial Intelligence in Education: Challenges and Opportunities.* Paris: UNESCO

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring is. Educational psychologist. 44(4) 197-221

Varol Selçuk, Z., & Özer Keskin, M (2024). Gamification in biology education: A systematic review analysis, *International Journal of Eurasia Social Sciences (IJOESS)*, 15(55),375-406.

Welber, C., Name2, B., & Name3, D. (2019). Analyzing gamification elements in educational environments. *Journal of Educational Technology* 30(4), 123-145. https://doi.org/10.1007/s12345-019-00123-4

Zalte, A. (2023). Rethinking gamification through artificial intelligence. *Journal of Gamification and AI Studies*, 15(2), 123-145. https://doi.org/10.1007/978-3-031-35930-9_17

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education: insights from machine learning and natural language processing. *Journal of Educational Technology in Higher Education,* 16(1), 1-27.