



Utilization and Perception of Intelligent Tutoring Systems Among Undergraduates in Ondo State, Nigeria

Ayelaagbe, S. O.

Department of Educational Technology, Adeyemi Federal University of Education, Ondo, Ondo State, Nigeria.

Corresponding author email: oayelaagbe@yahoo.com

Abstract

This study investigated the Intelligent Tutoring System (ITS) utilization and perception among undergraduates in Ondo State, Nigeria. A descriptive survey research design was used in the study respectively. Two research questions and one null hypothesis were answered and tested in the study. The sample size consisted of (620) undergraduates randomly sampled from the three (3) universities selected using a cluster sampling technique. (206) were selected from UNIMED, Ondo, from OASTEC Okitipupa (232) were selected and from AAU, Akungba, (192) were selected. The instrument for data collection was the researcher's self-developed questionnaire titled: "Intelligent Tutoring System Utilization and Perception Questionnaire (ITSUPQ)". The instrument was validated by three experts. The reliability coefficient of 0.70 for perception and 0.78 for usage of ITS for learning. Research questions were answered using mean and standard deviation, while the hypothesis was tested using ANOVA. The finding of the study showed that undergraduates perceived the usage of ITS and they also derived maximum benefits from the usage of ITS for learning. It was also revealed that there was no significant difference in the perceived usage of ITS by undergraduates based on area of specialization. The study therefore recommends that stakeholders in education should provide ITS infrastructural facilities to universities and undergraduates and lecturers should be trained towards the usage of the Intelligent Tutoring System (ITS).

Keywords: Intelligent Tutoring System, Undergraduates, Perception, Usage, Infrastructural Facilities

Introduction

In recent times, the Intelligent Tutoring System (ITS) has become very popular and useful in our schools, universities and factories. Intelligent Tutoring Systems can be described as Computer-based instruction systems that employ methods of artificial intelligence to present learners with opportunities for self-directed and individualized learning by giving intelligence that will help and guide (Abdulkadir et al., 2018). The increasing usage of ITS implies that computer-based Instruction can be combined with artificial intelligence and the design web-based and this has made ITS becoming important research area. (Freedman et al., 2019). The necessity of fortune and place-independent learning has updated ITS as a major teaching platform that allows learners to learn at their own pace and receive adaptive feedback on their advancement. (Freedman et al., 2000). ITS comprises four components that is the students' models, the teaching model, the expert knowledge model and the user interface model. The students' model stores information about their learning history, especially the topics, login and logout times, duration of learning on the system, their answers to the questions and test scores. The teaching model employs the information stored in the students' model and the expert knowledge model needs to represent and manipulate the learning content. The students' and expert knowledge models provide input for the students' model to perform its tasks. The user interface model enables the students to interact with the content of the lesson and with the behaviour of ITS.

Jiang et al. (2020) investigated the rationale for the low level of ITS adoption among American Schools. In their study, it was revealed that the perceptions of teachers and school administrators and their effects on the adoption of technologies are low. Also, while investigating an enhanced Technology Acceptance Model (ATM) for web-based learning environments, Gong et al. (2019) revealed the importance of a user-centred and proactive design approach to learning systems and increased students' perception of the system's usefulness and ease of use as well as teachers'

willingness to adopt the technology. An E-learning system enables learners to actualize their potential for providing effective learning only after they are introduced to and used by real users. These interactions shape users' perceptions about system use and acceptance over time, which are paramount for assisting in the development of the system (Mastrom, 2019).

In the research study carried out by Abdulkadir et al. (2018), on students' perceptions of an intelligent Tutoring system. It was revealed that 64.12% of the students perceived the system to be usage, 14.50% perceived ease of usage and 21.37% reported an intention to use the instruction system. Also, in the study of Al-aqbi et al. (2019) on the effect of Intelligent Tutoring Systems on Education. It was revealed that it significantly enhances students' learning more greatly than traditional teaching methods. Through the usage of ITS, students gained better perceptions of their work, including positive expenses with ITS (Baker et al. 2020). ITS enables students to be more stimulated and engaged in the teaching and learning process. The effectiveness of ITS on students' help-seeking, learning interest, engagement, attitude and confidence are some of the benefits students derive from using ITS in schools (Wijekumar et al., 2020). ITS can be used to determine the learning path, select and suggest the learning content to students, provide support and help students busy in dialogue and simulate one-to-one tutoring, among others (Zawacki-Richter et al. 2019). ITS can also provide personalized experiences for different students, teachers and tutors (Churi et al., 2022). Li and Wong, (2021) opined that ITS have enormous potential to support teaching and learning, especially in large-scale distance teaching institutions where one-to-one tutoring is very strenuous.

ITS is a pedagogical supplementary component that has an effective functionalist which allows students' active engagement and participation in their learning and it is an essential instructional tool that increases students' satisfaction. (Cuellar-Rojas et al., 2021). ITS also provides self-regulated learning materials for a student's learning experience which entails the interaction between cognitive presence, social presence and teaching presence (Feng et al., 2021). Also, Karaci et al. (2018) stated that the usage of an intelligent tutoring system enables students to perform better academically than students who did not use the system but relied on conventional education. ITS offers a variety of relevance and greatly supports personalized learning, such as keeping learners' retention for longer periods, enabling students to learn at their own pace, ensuring that personalized learning is more interactive and user-friendly, improving ICT skills, increasing motivation, better time management and save cost at long run (Yasar, 2020). Intelligent Tutoring Systems (ITS) have been applied to support learning in many subject areas, such as language, Mathematics, Sciences, Computer Sciences, Medicine, History, Economics, Geometry and engineering. (Huanhuan et al., 2023). In their study, Mathematics score 33%, Language 24% and Science 17% were the primary subject areas where ITS was applied to support learning and teaching. In contrast, engineering scored 5%, history 2% and economics 2% these were the areas where relatively less study were researched on. Ahuja et al. (2022) demonstrated that intelligent tutoring system have been used in many educational area such as information technology, engineering, languages, Mathematics, programming and medicine and many tools were available to develop intelligent tutoring system for non-programmers with the possibility of programming software system such as web-based and mobile-based system. The study (Francisco & Silva, 2022) reported on the survey on ITS for-Computer Science Education and software engineering education. It was revealed that computer programming was the discipline with the highest number of ITS proposals. According to Mousavinasab et al. (2018), ITS was used in Computer Science education to search students programming skills, also in medical education and Mathematics education. It was revealed by Mousavinasab et al. (2018) that it was used to help medical students learn anatomy, Physiology and diagnosis-related knowledge and skills. ITS can be used in Mathematics to facilitate the learning of numbers, spaces, patterns and structures (Mousavinasab et al., 2018).

Statement of The Problem

The traditional system of education has been used for many centuries, has developed very slowly and cannot be managed with different training styles and levels of preparation. It enables many students who interact with a teacher who does not meet the student's individual needs are identified by the traditional education. Hence, many students felt frustrated and unable to reach their educational opportunities. The Intelligent Tutoring System (ITS), an Information Technology (IT) application that provides students with tailored tutoring for the student's pace and styles of learning, has been of researchers' interest to improve student learning.

In recent decades, the application of Intelligent Tutoring System (ITS), particularly machine learning, has developed in educational institutions and students have become increasingly reliant on applications and software in a variety of

fields, including learning as information technology has advanced and computers have been more widely used. Therefore, this study investigated Intelligent Tutoring System (ITS) utilization among undergraduates in Ondo State, Nigeria.

Aim and Objectives of the Study

This study investigated the Intelligent Tutoring System (ITS) utilization and perception among undergraduates in Ondo State, Nigeria. This research study determined to:

1. investigate the perception of undergraduates utilizing Intelligent Tutoring System for learning.
2. assess the benefits derived by undergraduates utilizing Intelligent Tutoring System for learning.
3. investigate the differences in the undergraduate's utilization of ITS for learning in the universities based on area of specialization

Research questions

To achieve the research objectives of the study, the following research questions were raised:

1. How do undergraduates perceive the usage of ITS for learning in the universities?
2. What are the benefits derived by undergraduates in utilizing ITS for learning in the universities in Ondo State?

Hypothesis

The null hypothesis was tested at 0.05 level significance.

H₀₁: There is no significant difference in the perceived usage of ITS by undergraduates for learning in the universities based on area of specialization

Methodology

The study used a quantitative research design based on a descriptive method through questionnaires. The survey method was employed for this research study because it is an efficient way for collecting information from a large number of respondents. The sampling techniques used for this study were cluster and simple random sampling techniques and the entire population consisted all undergraduates in all the universities in Ondo State, Nigeria. Cluster sampling was used to select three (3) universities from all universities in Ondo State. The Universities selected were: The University of Medical Sciences, Ondo (UNIMED), Olusegun Agagu University of Science and Technology, Ondo (OAUSTEC) and Adekunle Ajasin University, Akungba-Akoko (AAUA), Ondo State. Six hundred and twenty (620) were selected using a simple random sampling technique. The respondents were selected as follows: UNIMED, had two hundred and six (206), OAUSTEC had two hundred and thirty-two (232) and AAU had hundred and ninety-two (192) were randomly selected, making the total respondents selected for the study to be six hundred and twenty (620). The main instrument for this study is researchers' designed questionnaire titled "Intelligent Tutoring System Utilization and Perception Questionnaire" (ITSUPQ). The questionnaire consists of two (2) sections: Section "A" contains demographic data of the respondents, section "B" contains items on the undergraduate's perception of the use of ITS for learning and the benefits derived by undergraduates in using ITS. The instrument is on a rating scale of Strongly Disagreed (SD), Disagreed (D), Agree (A) and Strongly Agree (SA). The questionnaire was subjected to both face and content validity to check the appropriateness and adequacy of the content of the instrument. Three (3) lecturers from the Department of Educational Technology, Adeyemi Federal University of Education, Ondo, Ondo State validated the instrument. After they deemed it fit to be validated, their advice and suggestions were used to modify the questionnaire to produce a final draft.

The questionnaire was tested for reliability on fifty (50) randomly selected students from the Federal University of Education, Ondo who were not part of this study. The data gathered from the trial test was analysed to check for internal consistency in reliability and the Cronbach Alpha was 0.70 for perception and 0.78 for usage of ITS for learning. This indicated that the research instrument was highly reliable. The researcher with the help of research assistants in the three universities administered copies of questionnaire to the students after getting official permission from the Head of the Departments involved. At the end of the exercise, six hundred and twenty (620) valid copies of the questionnaire were retrieved from the students upon which analysis of results were carried out using mean, standard deviation and ANOVA to answer the research questions raised and tested the research hypothesis formulated for the study.

Results

Research Question1: How do undergraduates perceive the usage of ITS for learning in the universities?

Table 1: Undergraduate Perception of ITS Usage for Learning

Item	SA	A	D	SD	Mean	Std.D	Remark
It provides me the opportunity to learn new things	174	320	97	29	3.03	.79	Accepted
I have no problem in viewing the posted information in the ITS	63	117	210	230	2.02	.98	Not Accepted
I can easily download the available teaching materials in the ITS	176	382	54	8	3.17	.62	Accepted
I have encountered a problem in logging in the ITS	298	195	119	8	3.26	.81	Accepted
I am satisfied with the speed of the ITS	47	126	279	168	2.08	.87	Not Accepted
The quality information available in ITS are correct and accurate	274	253	64	29	3.24	.82	Accepted
ITS matches my interest	138	342	84	56	2.90	.84	Accepted
ITS suits all aspects of my study	38	186	183	213	2.07	.94	Not Accepted
ITS provides me with up-to-date information	284	183	145	8	3.19	.83	Accepted
I learn better using ITS than without it.	233	221	158	8	3.09	.82	Accepted

Key; *SD* = Strongly Disagree, *D* = Disagree, *A* = Agree, *SA* = Strongly Agree

Decision Value for Remark: *Not Accepted* = 0.00-2.44, *Accepted* = 2.45-4.00

Table 1 shows how undergraduates perceive the usage of ITS for learning. The table shows that the respondents agreed to the following items: ITS provides them with the opportunity to learn new things ($\bar{x} = 3.38$), they can easily download the available teaching materials in the ITS ($\bar{x} = 3.17$), have encountered problems in logging in the ITS ($\bar{x} = 3.26$), quality information available in ITS are correct and accurate ($\bar{x} = 3.24$), ITS matches their interest ($\bar{x} = 2.90$), ITS provides them with up-to-date information ($\bar{x} = 3.19$) and learn better using ITS than without it ($\bar{x} = 3.09$). The table further shows that the undergraduates disagreed with the following: have no problem viewing the posted information in the ITS ($\bar{x} = 2.02$), they are satisfied with the speed of the ITS ($\bar{x} = 2.08$) and ITS suits all aspects of their study ($\bar{x} = 2.07$). Based on the result from this table and mean score acceptance by the decision rule, it can be concluded that the ways undergraduates perceive the usage of ITS for learning in universities are: ITS provides them with the opportunity to learn new things, can easily download the available teaching materials in the ITS, have encountered a problem in logging in the ITS, quality information available in ITS are correct and accurate, ITS matches their interest, ITS provides them with up-to-date information and they learn better using ITS than without it.

Research Question2: What are the benefits derived from usage of ITS by undergraduates in Ondo state?

Table 3:Benefits of ITS Usage

Item	SA	A	D	SD	Mean	Std. D	Remark
Keep students engaged for a longer time	205	331	55	29	3.14	.76	Accepted
It enables students to learn at their own pace	285	239	96	0	3.30	.72	Accepted
It is user assistance	218	191	187	24	2.97	.89	Not Accepted
ITS improves ICT skills	328	229	35	28	3.38	.78	Not Accepted
It increases motivation	272	267	81	0	3.30	.68	Accepted
ITS saves cost at the long run	121	341	133	25	2.90	.74	Accepted
It connects students to experts	258	119	223	20	2.99	.95	Not Accepted
ITS saves training materials for the future	284	230	106	0	3.28	.73	Not Accepted
It is good for time management	248	231	82	59	3.07	.95	Accepted
ITS ensures that students learn at any time and even on the go.	328	229	35	28	3.38	.78	Accepted

Key; *SD* = Strongly Disagree, *D* = Disagree, *A* = Agree, *SA* = Strongly Agree

Decision Value for Remark:*Not Accepted* =0.00-2.44, *Accepted* = 2.45-4.00

Table 2 shows the benefits derived from the usage of ITS by undergraduates in Ondo state. The table shows that the respondents agreed to all the items as follows: keep students engaged for longer time($\bar{x} = 3.14$), enables students to learn at their own pace ($\bar{x} = 3.30$), it is user assistance ($\bar{x} = 2.97$), ITS improves ICT skills ($\bar{x} = 3.38$), increases motivation ($\bar{x} = 3.30$), ITS saves cost at the long run ($\bar{x} = 2.90$), connects students to experts ($\bar{x} = 2.99$), ITS saves training materials for the future ($\bar{x} = 3.28$), it is good for time management ($\bar{x} = 3.07$), and ITS ensures that students learn at any time and even on the go ($\bar{x} = 2.29$). Based on the result from this table and mean score acceptance by the decision rule, it can be concluded that the benefits derived from the usage of ITS by undergraduates in Ondo state are: keep students engaged for longer time, enables students to learn at their own pace, it is user assistance, ITS improves ICT skills, increases motivation, ITS saves cost at the long run, connects students to experts, ITS saves training materials for the future, it is good for time management, and ITS ensures that students learn at any time and even on the go.

H01: There is no significant difference in the perceived usage of ITS for learning by undergraduates in the universities based on area of specialization.

Table 4: Summary of ANOVA Showing Difference in Perceived Usage of ITS for Learning based on Specialization

Model	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	25.207	4	6.302	.926	.448	Not Significant
Within Groups	4183.367	615	6.802			
Total	4208.574	619				

Table 3 shows the difference in perceived usage of ITS by undergraduates based on their specialization. The table shows that the mean score for students in computer science is 28.12, those in technology is 27.90, those in engineering is 28.55, those in mathematics is 28.18 while that of students in medicine is 27.94. The ANOVA results

show that there is no significant difference in the perceived usage of ITS by undergraduates for learning in the universities in Ondo state based on area of specialization ($F_{(4,615)} = .926; p > 0.05$). Hence, hypothesis 1 is not rejected.

Discussion

The results from research question one showed that undergraduates perceived the usage of the Intelligent Tutoring System (ITS) for learning in Universities positively due to its benefits. This is evident as almost all the respondents claimed the perceived usage of ITS for learning. The respondents disagree with the following: I have no problem viewing the posted information in the ITS, I am satisfied with the speed of the ITS and ITS suits all aspects of my study. The finding is consistent with several studies such as Gong et al. (2019) who claimed that ITS increases students' perception and enables ease of usage as well as teachers' eagerness to adopt the technology. In the study of Ali Talib et al. (2019) it was reported that ITS improves students learning more than traditional teaching methods.

The study also revealed in research question two that undergraduates derives from the usage of ITS for learning universities in Ondo State. This finding is consistent with that of Wijekumar et al. (2020), Zawacki-Richter et al. 2019 and Li and Wong, (2022) enumerated the benefits of using ITS for learning in the universities by undergraduates. The respondents disagree with ITS is user assistance, it improves ICT skills, it connects students to experts and it saves training materials for the future. They derived many benefits in using ITS for learning. The result from the hypothesis revealed that there is no significant difference in the perceived usage of ITS for learning by undergraduates in the universities based on area of specialization. The finding agreed with the finding of Huanhuan et al. (2023) in their study it was revealed that ITS has been applied to support learning in different subject areas such as language, Mathematics, Science, Computer Science, Medicine, History, Economics, Geometry and engineering. This was also supported by the finding of Francisco and Silva (2022) who reported on the survey of ITS for Computer Science education and software engineering education. It was revealed that computer programming was the discipline with the highest number of ITS proposals.

Conclusion

Based on the findings and review of relevant literature in this study it can be concluded that the Intelligent Tutoring System (ITS) can be used for learning in universities because it provides the opportunity to learn new things, undergraduates can download the available teaching materials in the ITS and the quality information available in ITS are correct and accurate. Also, undergraduates derived mush benefits from the usage of ITS because it kept them for a long time and enabled them to learn at their own pace.

Recommendations

- The following suggestions were made based on the following findings of this study:
- (1) Provision of ITS infrastructure should be made adequate by stakeholders in education for the undergraduates' usage in the universities.
 - (2) Universities administrators and curriculum planners should link courses to the usage of ITS in various universities.
 - (3) Workshops and training programmes` should organized for both lecturers and students to acquire the necessary skills to effectively use ITS for learning especially in courses that are not science based.

References

- Abdulkadir, K., Zeynep, P., Halil., I. A., & Goksal., B. (2018). Student perceptions on an intelligent tutoring system: A technology acceptance model perspective. *International Journal of Computer Application*. 182 (22), 31-36.
- Ahuja, N. J., Dutt., S., Choudhary, S. L., & Kumar, M. (2022). Intelligent Tutoring System in Education for Disabled learners using Human-Computer Interaction and Augmented Reality *International Journal of Human-Computer Interaction*. <https://ro.uow.edu.au/test2021>.
- Al-aqbi, A. T. Q., Falih, A. Y., Saleh, B. J., Al-juaifari, E. N. M., & Abdulhassan, E. L. (2019). The effect of intelligent tutoring systems on education. <http://www.researchgate.net/publication/336107422>.

- Baker, D. L., Polanco, M. H., Conry, J. M., Kamata, A., Otaiba, S., Ward., W., & Cole, R.(2020). Development and promise of a vocabulary Intelligent Tutoring System for second-grade Latin x English learners. *Journal of Research on Technology*. 53 (2), 223 – 247. <https://doi.org/10.1080/15391523.2020.1762519>.
- Churi, P. P., Joshi, S., Elhoseny, M., & Omrane, A. (2022). Artificial Intelligence in higher education: A practical approach (isted) CRC Press. <https://doi.org/10.1201/9781003184157>.
- Cueller – Yojas, O. A., Hincapie, M., Contero, M., & Guemes-Castorema, D. (2021). Intelligent Tutoring System: A Bibliometric Analysis and Systematic Literature Review. *Research Square*. Advance Online Publication. <https://doi.org/10.21203/rs.3.rs-673038/vi>
- Feng, S., Magana, A. J., & Kao, D. (2021). A systematic review of literature on the effectiveness of Intelligent Tutoring Systems in STEM (Paper Presentation). 2021 IEEE Frontiers in Education Conference (FIE), Lincoln, NE, USA. <http://people.cdail.mit.edu>.
- Francisco, R. F., & Silva F. (2022). Intelligent Tutoring System for Computer Science Education and the Use of Artificial Intelligence: A Literature Review. 338-345. In *Proceedings of the 14th International Conference on Computer-Supported Education(CSE SU 2022)*. 1, 338-345<https://www.scitepress.org>>
- Freedman, R., Ali, S. S., & McRoy, S. (2000). Links: what is an intelligent tutoring system?. *intelligence*, 11(3), 15-16.
- Gong, M. Xu, Y., & Yu, Y. (2019). An enhanced technology acceptance model for web-based learning. *Journal of Information System Education*, 15(4), 365.
- Jiang, Y., Almedia, M., Kai, S., Baker, R. S., Ostrow, K., Inventado, P. S., & Scupelli, P. (2020). Single template vs. multiple templates: Examining the effects of problem format on performance (paper presentation). *The 14th International Conference on Learning Science*, Nashville, Tennessee.
- Karaci, A., Akyuz, H. I., Bilgici, G., & Arici, N. (2018). Effects of Web-based Intelligent Tutoring System on Academic Achievement and Retention. *International Journal of Computer Applications*. 181(16), 35-41
- Li, K. C., & Wong B. T. M. (2021), Features and trends of personalized learning: A review of Journal Publications from 2001 to 2018. *Interactive Learning Environment*. 29 (2), 182-195. <https://doi.org/10.1080/10494820.2020.1811735>
- Mousavinasab, E., Zarifsanaiy, N., Niaka, S., Rakhshan, M., Keikha, L., & Ghazi, S. M. (2018). Intelligent Tutoring Systems: A systematic review of characteristics, applications and evaluation methods. *Interactive Learning Environments*. 5a(1), 142-163.<https://doi.org/10.1080/10494820.2018.1558257>.
- Mastrom, M., (2019). Technology acceptance model and e-learning technology, 12th International Conference on Education, Sultan Hassan al Bolkiah Institute of Education, University of Brunel Darussalam, 21-24 May 2007. 1-10.
- Wijekumar, K., Meyer, B. J., Lei, P., Beerwinkle, A. L., & Joshi, M. (2020). Supplementing teacher knowledge using web-based intelligent tutoring system for the nest structure strategy to improve content area reading comprehension with fourth-and fifth-grade struggling readers. *Dyslexia*, 26(2), 120-136. <https://doi.org/10.1002/dys.1634>.
- Yasar, A., (2020), Effects of Intelligent Tutoring Systems (ITS) on personalized learning (PL). *Creative Education*, 11(2), 953-978. <https://doi.org/10.4236/ce.2020.116069>.
- Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur; F. (2019). Systematic review of Research on Artificial Intelligence Applications in Higher Education – Where are the educators? *International Journal of Educational Technology in Higher Education*. 16 (1), 1-27. <https://doi.org/10.1186/s41239-019-0171-0>