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ARTIFICIAL INTELLIGENCE-BASED TUTORING SYSTEMS UTILIZATION FOR LEARNING: A SURVEY OF SENIOR SECONDARY STUDENTS' AWARENESS AND READINESS IN IJEBU-ODE, OGUN STATE

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ABSTRACT
As the world advances in Science and Technology in the Fourth Industrial Revolution (4IR), the application of Artificial Intelligence (AI), and Intelligent Tutoring Systems (ITS) are finding their way into educational terrains. Intelligent Tutoring Systems have been described as the instructional model of the 21st Century. Therefore, this study examined students' awareness and readiness to adopt the system for learning. Two research instruments titled "Students' Intelligent Tutoring Systems Awareness Questionnaire (SITSAQ)" (r = .76), and "Students' Intelligent Tutoring Systems Readiness Questionnaire (SITSRQ)" (r = .65), were developed using Google forms, and shared with senior secondary students on their learning platforms. Three hundred and four (304) students filled and returned the instruments. The data retrieved from the instruments were used to answer the two research questions and two hypotheses stated in the study, using Mean, Standard deviations, t-test, and One-Way ANOVA, on SPSS Version 26. The result showed that students are aware and ready to adopt Artificial Intelligence-based tutoring systems for learning in senior secondary schools. Also, the result showed that across gender, class, and subject specializations (Arts, Commercial and Sciences), there was no significant differences between senior secondary students' level of awareness and readiness to adopt Artificial Intelligence-based Tutoring Systems for learning. Based on the findings, it was recommended that there should be the design, development and implementation of Artificial Intelligence-based tutoring system for learning in secondary schools since students are aware and ready to adopt it.

Keywords: Artificial Intelligence-based tutoring systems, senior secondary students, awareness, readiness.

Introduction

Since the advent of the Covid-19 pandemic, the landscape of education has changed significantly in how instructional content are currently presented to students all over the world. While online education, online learning or e-learning is not new; however, in view of the education lockdown initiated by the Covid-19 pandemic, it has now become a norm. While the Covid-19 pandemic lasts, it is not certain if teaching and learning will return to the physical classes permanently, anymore. Meanwhile, the need to present personalised instructional content to students and also to ensure that their learning needs are met while the pandemic lasts, with little effort from the teachers, gave rise to extensive use of Information and Communication Technologies (ICTs) in

education these days. The majority of these ICT models of instruction general fall under what is collectively known as Computer-Aided Instruction (CAI).

The utilization of CAI in supplementing conventional instruction is not new. According to Okebukola (2013), CAI is an automated instructional strategy in which computers are used in presenting instructional content to students through an interactive process. Also, Audu and Agbo (2010) state that CAI is a form of an instructional strategy in which computers with predefined instructions are used to present instructional content to students. CAI has also been defined as a self-learning strategy in which computer programs that are either online or offline are used to facilitate and improve instruction (Eyo, 2018). Some of the characteristics of CAI include prompt feedback to students, a multiple-user approach, self-pacing, instruction adaptability, and random access facilities, among others (Edutech202, 2012). As the world advances in the 21st Century, there have been developments in CAI which have led to the designing of Intelligent-Computer Assisted Instructions (I-CAI). However, with the development of more sophisticated computer programmes for use in education, there is a current shift to a more sophisticated machine known as Artificial Intelligence (AI), which is now being applied in education as progress deepens in the Fourth Industrial Revolution.

Artificial Intelligence in Education

Artificial Intelligence (AI) is one of the essential driving forces of the 21st Century as it is rapidly transforming almost all human endeavours. In this wise, it would be naive to conclude that the technology will not have an impact on education given the fact that the possibilities are profound because there have been mind-blowing developments in the evolution of AI and the remarkable role it has played in human lives (Holmes, Bialik, &Fadel, 2019; Nabiyev, 2010). AI could sometimes be hard to define since it takes various forms and also because the phrase serves as an umbrella term for different procedures and technologies (Frankish, & Ramsey, 2014). Given this, it is defined based on four general approaches by Russell and Norvig (2009) as systems that act humanly, systems that think humanly, systems that act rationally or systems that think rationally. It could therefore be deduced from this definition that the main objective of AI is to understand, model and reproduce humanoid or ideal intelligent behaviour in artificial systems whereby different techniques are used.

According to Nabiyev (2010), AI is the ability of a computer-controlled device to perform tasks in a human-like manner. The human-like qualities include reasoning, meaning-making, generalization, and learning from past experiences, all of which are examples of mental processes. Some demonstrations of these mental processes in AI-based machines include the 2016 Google DeepMind'sAlphaGo which defeated one of the world's most accomplished "Go" players, Lee Se-Dol, who is a South Korean champion (Sang-Hun, 2016). As the greatest proof of AI's human-like thinking and skills, the result of this match shows that a true artificially-intelligent system can learn on its own (Adams, 2017). As the world advances, the emergence and application of Artificial Intelligence (AI) in education, in particular, has led to the application of a form of CAI but an advanced form, known as Intelligent Tutoring Systems (ITS). Intelligent Tutoring Systems are Artificial Intelligence-based computer programs that can imitate and perform the duties of a human educator. As a form of instructional strategy in the 21st Century, Artificial Intelligence-based tutoring systems are fast gaining ground as the world gradually transcends into the Fourth Industrial Revolution (4IR).

Artificial Intelligence-based Tutoring Systems

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Artificial Intelligence-based tutoring systems are computer systems or programs designed to imitate human tutors. They are mostly referred to as Intelligent Tutoring Systems (ITS). The term "Intelligent Tutoring System" (ITS) was introduced by Brown in 1982 and was first used in the research community to mean Intelligent Computer-Aided instruction (ICAI) (Brown &Sleeman, 1982). Intelligent Tutoring Systems (ITSs), according to Abidin and Baharin (2020) are computer-based instruction systems using artificial intelligence methods in presenting students with opportunities for self-directed and individualized learning through intelligent guidance and help. ITSs, an extension of Computer-Aided Instruction (CAI), are educational software used for learning without the intervention of human tutors. It consists of intelligence, feedback, and adaptive behaviour (Reva, 2000). Earlier, Brown and Sleeman (1982) stated that ITSs are computer programs that provide instruction to students in a similar manner as human tutors while also providing feedback to students.

The necessity for time and location-independent learning has portrayed ITSs as an important teaching and learning program allowing students to learn at their own pace and receive adaptive feedback on their learning progress. According to Cao, Yang, Lai and Wu (2021), the increasing reputation of ITSs portends that computer-based instruction integrated with artificial intelligence, and the design of web-based ITSs, have become prominent research areas. According to Karacı, Piri, Akyüz and Bilgici (2018), a typical ITS has three components which are (i) a domain model which is made up of instructional topics, examination questions, and the relationships among the instructional topics and questions; (ii) a student model which stores information about students' learning history, which importantly include the topics students viewed, their login and logout times, their duration of learning in the system, the answers they provided to the questions asked by the system, and their scores, and; (iii) a teaching model which employs the information stored in the student model to provide students with intelligent guidance and help where needed. Barana, Fissore and Marchisio (2018) noted that the characteristics and degrees of intelligence of one ITSs to another vary extensively, and generally, the systems are domain-independent, meaning that the teaching model can be reused in different domains. On the other hand, Raza, (2020) posits that ITSs are made up of four modules – the interface module, the domain module, the student module, and the tutor module.

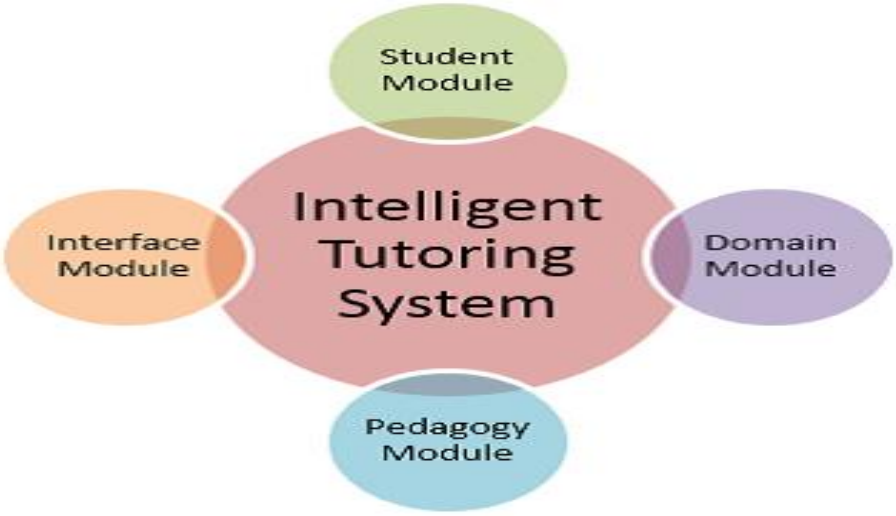


Figure 1: Intelligent Tutoring System (ITS) modules

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The interface module provides the route through which students interact with the system while the domain module is concerned with how instructional contents will be represented in the ITS. In other words, the domain module stores and represents problems, exercises and learning content of the domain. The student module is concerned with students' progress and achievement during the use of the system while also providing measuring students' learning and performance; giving guidance and providing feedback as well. The last module, which is the tutor module involves the pedagogical strategies for effective teaching in the ITS (Raza, 2020).

Studies, according to Ernest (2015), have shown that as an up-to-date mode of teaching, ITSs could be valuable supplementary aids to improving learning. Also, the need to continuously improve students' achievement has been the focus of several studies for many years (Patterson, 2005). The need to improve students' achievement created the need for researchers to develop novel methods of instruction and motivation. As students are motivated to learn, the more involved they get in the learning process. Therefore, the use of computer technologies is one strategy often utilized in education to improve achievement and motivation (Ernest, 2015). As reported by Iddrisu, *et. al.,* (2019), students find tutoring systems effective and helpful for learning. Students' awareness of CAI portents their knowledge, understanding, and skills influencing their constructions of the reality of whether CAI is useful for learning or not. Hence, the successful application of CAI in learning is strongly influenced by students' perceptions or awareness of CAI. Therefore, awareness or positive perceptions of CAI enhances the effective inculcation of CAI in learning. For instance, Adekunle (2016) reported students' positive attitudes towards the use of computers in learning, with male students having a higher positive attitude towards the use of ICT in learning than female students. ITSs are the instructional systems of the Fourth Industrial Revolution (4IR) given the fact that the systems can seamlessly adapt to the individual needs of students, and are also able to provide students with flexible instructional contents in a one-to-one learning environment with immediate feedback. Given this, ITSs development is critical to educational sustainability, and also as a solution to digital inequality.

With the advent of the Covid-19 pandemic and the possibility that it will last longer than planned, there is the need to investigate students' awareness of these systems and their readiness to use them to improve learning. In addition to these, the movement of teaching and e-learning processes to online format necessitates the need to create systems that can cater for students' learning needs with little or no effort from the teacher and the onward digitization of education calls for the need to examine students' awareness and readiness to use the systems as the world gradually enters the Fourth Industrial Revolution (4IR). This study, therefore, attempted to find out senior secondary students' awareness and readiness to utilize Artificial Intelligence-based tutoring systems across gender, class, and subject specialization.

Research Questions

1. What is the extent of senior secondary students' awareness of Artificial Intelligence-Based Tutoring Systems for learning?
2. What is the extent of senior secondary students'readiness to adopt Artificial Intelligence-Based Tutoring Systems for learning?

Hypotheses

Ho1: There is no significant difference in senior secondary students' awareness of Artificial Intelligence-Based Tutoring Systems based on:

(a) gender
(b) class
(c) subject specialization

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Ho2: There is no significant difference in senior secondary students' readiness to use Artificial Intelligence-Based Tutoring Systems based on:

(a) gender
(b) class
(c) subject specialization

Research Method

Using the descriptive survey design of the non-experimental type, the study described secondary school students' awareness and readiness to adopt Intelligent Tutoring Systems (ITSs) for learning. This investigation is also needed based on the fact that ITSs are not common in Nigerian secondary schools. The study was carried out in the Ijebu-Ode Local Government Area of Ogun State, Nigeria.

Two research instruments titled "Students' Intelligent Tutoring Systems Awareness Questionnaire (SITSAQ)" (r = .76), and "Students' Intelligent Tutoring Systems Readiness Questionnaire (SITSRQ)" (r = .65), were developed and used for data collection in the study. The "Students' Intelligent Tutoring Systems Awareness Questionnaire (SITSAQ)" contained 7 items while the "Students' Intelligent Tutoring Systems Readiness Questionnaire (SITSRQ)" contained 5 items. The questionnaire, which was designed using Google forms, based on the Likert response format of "Strongly Disagreed - SD", "Disagreed - D", "Agreed - A", and "Strongly Agreed - SA", was shared on senior secondary school online platforms for them to fill and returned online while some were also shared physically in some schools. Data collection took 5 months; from August through November, 2021. In all, three hundred and four (304) senior secondary students, made up of 270 males and 34 females, responded to the questionnaire.

The responses collected were collated and used in answering the research questions, and also to test the hypotheses raised in the study. The research questions were answered using Mean and Standard deviations while the hypotheses raised were tested using t-test and One-Way ANOVA, respectively, on SPSS Version 26.

Presentation of Results

Research question 1: What is the extent of senior secondary students' awareness of Artificial Intelligence-Based Tutoring Systems for learning?

Table 1: Mean and standard deviation on the extent to which senior secondary students are aware of Artificial Intelligence-Based Tutoring Systems for learning

Items	Mean	Std.	Remark
Software or machines that act as one-to-one teacher for students are called Intelligent Tutoring Systems (ITS).	3.08	.802	High extent
Intelligent Tutoring Systems (ITS) put students in control of their own learning.	3.11	.710	High extent
Intelligent Tutoring Systems (ITS) act as virtual teachers for students.	3.19	.773	High extent
Development of self-regulation and problem-solving skills are possible when students interact with Intelligent Tutoring Systems (ITS).	3.12	.757	High extent
Intelligent Tutoring Systems (ITS) provide students with faster, automated feedbacks of their performances.	3.23	.743	High extent
Intelligent Tutoring Systems (ITS) personalizes learning for students thereby helping to shape future learning based on present performances and needs.	3.15	.777	High extent
Intelligent Tutoring Systems (ITS) save learning time and reduce teachers' workloads.	3.29	.788	High extent
Grand Mean = 3.16			

The results in Table 1 showed that, to a high extent, senior secondary students are aware of Artificial Intelligence-based tutoring systems for learning. Individually, the result showed that the students are aware that software or machines that act as one-to-one teachers for students are

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called Intelligent Tutoring Systems (ITS) (x = 3.18), Intelligent Tutoring Systems (ITS) put students in control of their learning, (x= 3.11), Intelligent Tutoring Systems (ITS) act as virtual teachers for students (x = 3.19), development of self-regulation and problem-solving skills are possible when students interact with Intelligent Tutoring Systems (ITS) (x = 3.12), Intelligent Tutoring Systems (ITS) provide students with faster, automated feedbacks of their performances (x = 3.23), Intelligent Tutoring Systems (ITS) personalizes learning for students thereby helping to shape future learning based on present performances and needs (x = 3.15), and are also aware that Intelligent Tutoring Systems (ITS) save learning time and reduce teachers' workloads (x = 3.29).

Research question 2: What is the extent of senior secondary students' readiness to adopt Artificial Intelligence-Based Tutoring Systems for learning?

Table 2: Mean and standard deviation on the extent to which senior secondary students are ready to adopt Artificial Intelligence-Based Tutoring Systems for learning

Items	Mean	Std.	Remark
I am ready to use Intelligent Tutoring Systems software if provided with one.	3.28	.787	High extent
I am ready to use Intelligent Tutoring Systems for difficult subjects only.	2.75	.966	High extent
I am ready to use Intelligent Tutoring Systems for learning all my subjects.	3.32	.693	High extent
I am ready to use Intelligent Tutoring System because it will help me to learn at my own pace.	3.32	.689	High extent
I am ready to use Intelligent Tutoring System because it will do my teacher's works better.	3.13	.823	High extent
Grand Mean = 3.16			

The results in Table 2 showed that, to a high extent, senior secondary students are ready to adopt Artificial Intelligence-based tutoring systems for learning. Also, the result showed that the students are ready to use Intelligent Tutoring Systems software if provided with one (x = 3.28); they are ready to use Intelligent Tutoring Systems for difficult subjects only (x = 2.75), and also ready to use Intelligent Tutoring Systems for learning all my subjects (x = 3.32). In addition, the result shows that students are ready to use Intelligent Tutoring System because it will help them to learn at their own pace (x = 3.32), and also ready to use Intelligent Tutoring System because it will simplify their teacher's works (x = 3.13).

Hypothesis 1: There is no significant difference in senior secondary students' awareness of Artificial Intelligence-Based Tutoring Systems based on:

(a) gender
(b) class
(c) subject specialization

Table 3a: T-test result showing senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on gender

Variables	Gender	Mean	STD	t-cal	p-value	Remark
Awareness of Artificial Intelligence-Based Tutoring Systems	**Male**	22.10	3.501	-.741	.459	Not Sig.
	Female	22.56	2.776			

Significant at p<0.05

The results (t-cal = -.741 < *p* (.459) > 0.05), in Table 3 showed that there is no significant difference in the awareness of male and female senior secondary students on Artificial Intelligence-based Tutoring Systems for learning. According to the Table, at the .05 level

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of significance, the significant p-value was greater than the alpha value (.459 > 0.05). Therefore, the null hypothesis was not rejected. This implies that the students did not differ in their awareness of Artificial Intelligence-based Tutoring Systems for learning based on gender.

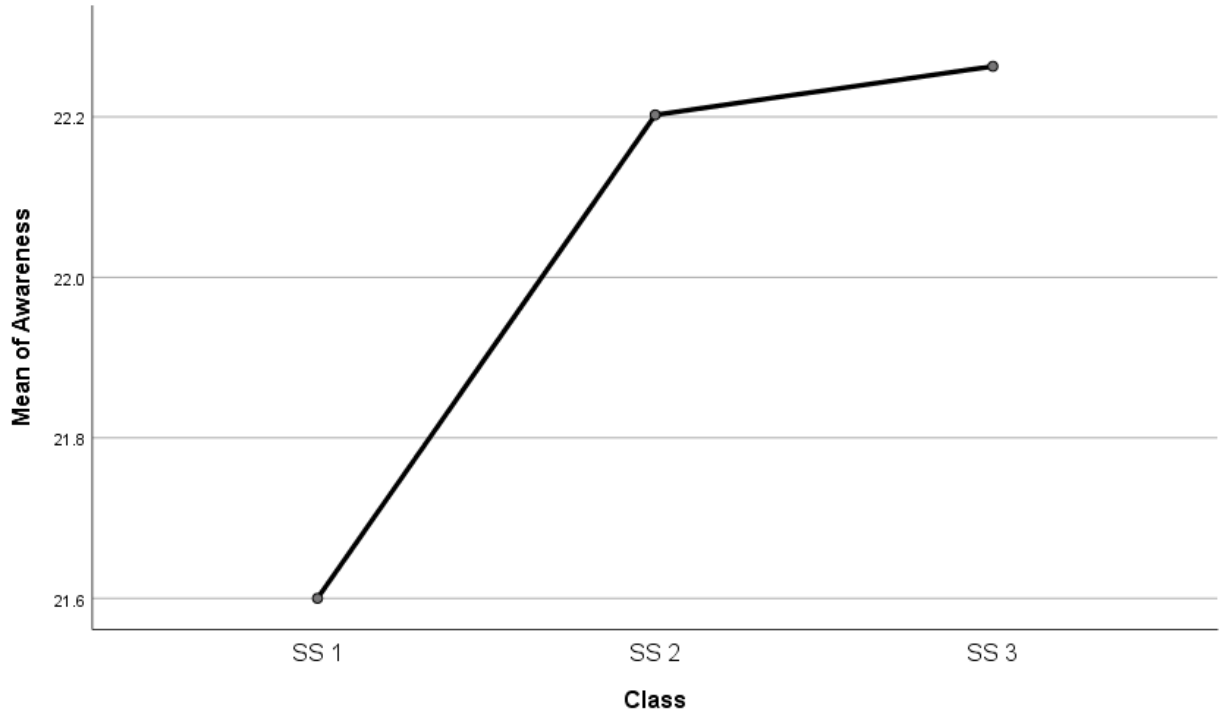
Table 3b: ANOVA showing mean rating of senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on class

Awareness based on class	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	16.071	2	8.035	.683	.506
Within Groups	3542.268	301	11.768		
Total	3558.339	303			

Significant at p<0.05

The result (F303 = .683 > *p* (.506) > 0.05) in Table 3b revealed no significant difference between the means of the classes (SS 1, SS2 and SS3) considered in the study. In other words, there is no significant difference in the awareness of senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on class. This implied that all the students did not differ in their awareness of Artificial Intelligence-based Tutoring Systems for learning in secondary schools. Given this, the null hypothesis was not rejected.

Figure 2: Mean plot showing no significant difference in senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on class



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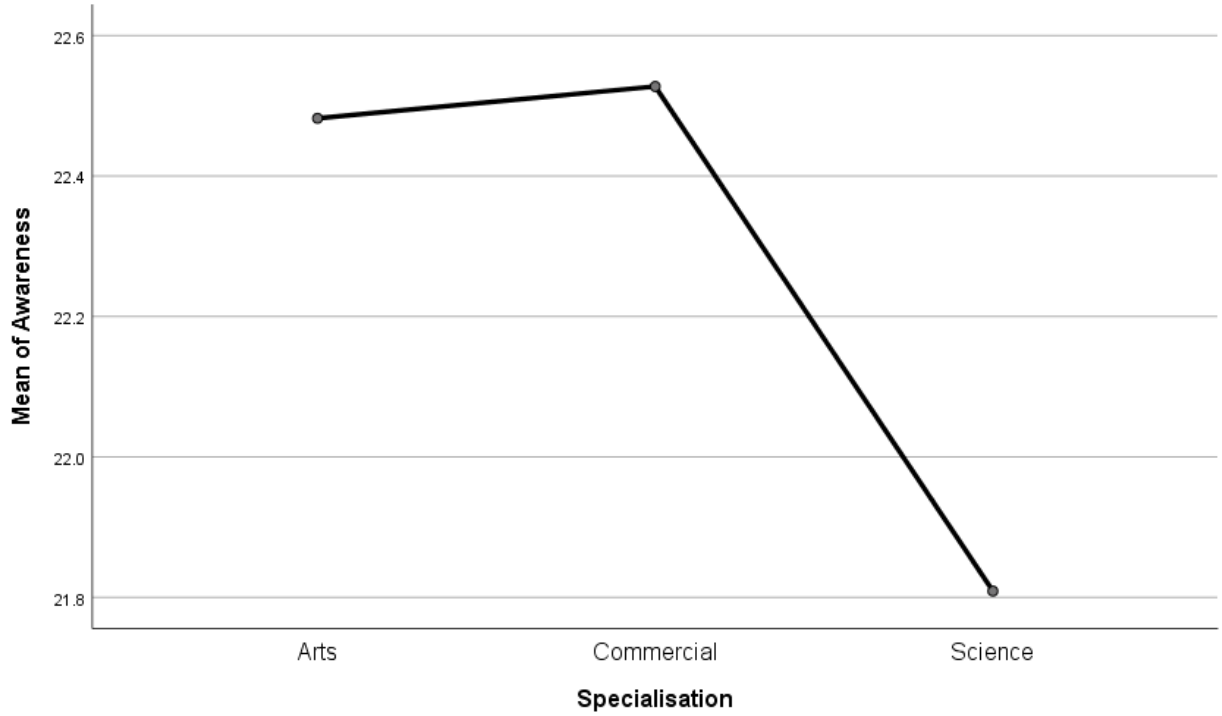
Table 3c: ANOVA showing mean rating of senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on subject specialization

Awareness based on subject specialization	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	37.408	2	18.704	1.599	.204
Within Groups	3520.931	301	11.697		
Total	3558.339	303			

Significant at p<0.05

Based on the result (F303 = 1.599 > *p* (.204) > 0.05) in Table 3c, it was concluded that there is no significant difference between the awareness of senior secondary students across the subject specializations (Arts, Commercial and Sciences) examined in the study. According to the result, at a .05 level of significance, the p-value was greater than the alpha value (.204 > 0.05). Therefore, the null hypothesis was not rejected. The result implied that the students did not differ in their level of awareness of Artificial Intelligence-based Tutoring Systems for learning in secondary schools.

Figure 3: Mean plot showing no significant difference in senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on subject specialization



Hypothesis 2: There is no significant difference in senior secondary students' readiness to adopt Artificial Intelligence-Based Tutoring Systems based on:

(a) gender
(b) class
(c) subject specialization

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Table 4a: T-test result showing senior secondary students' readiness to adoptArtificial Intelligence-based Tutoring Systems based on gender

Variables	Gender	Mean	STD	t-cal	p-value	Remark
Readiness to adopt Artificial Intelligence-Based Tutoring Systems	**Male**	15.83	2.662	.506	.613	Not Sig.
	Female	15.59	1.760			

Significant at p<0.05

The results (t-cal = .506 < *p* (.613) > 0.05) in Table 4a revealed no significant difference in the readiness of senior secondary students to adopt Artificial Intelligence-based Tutoring Systems for learning based on gender. The Table further showed that at the .05 level of significance, the p-value was greater than the alpha value (.613 > 0.05). Given this, the null hypothesis was not rejected. The result, therefore, implied that students are ready to adopt Artificial Intelligence-based Tutoring Systems for learning across gender.

Table 4b: ANOVA showing mean rating of senior secondary students' readiness to adopt Artificial Intelligence-based Tutoring Systems based on class

Readiness based on class	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.093	2	7.046	1.062	.347
Within Groups	1996.667	301	6.633		
Total	2010.760	303			

Significant at p<0.05

As shown in the result (F303 = 1.062 > *p* (.347) > 0.05) in Table 4b, there was no significant difference in senior secondary students' readiness to adopt Artificial Intelligence-based Tutoring Systems for learning based on class. Based on the result, at a .05 level of significance, the p-value was greater than the alpha value (.347 > 0.05). The result implied that the students did not differ in their level of readiness to adopt Artificial Intelligence-based Tutoring Systems in secondary schools. Based on this result, the null hypothesis was not rejected.

Figure 4: Mean plot showing no significant difference in senior secondary students' readiness to adopt Artificial Intelligence-based Tutoring Systems based on class

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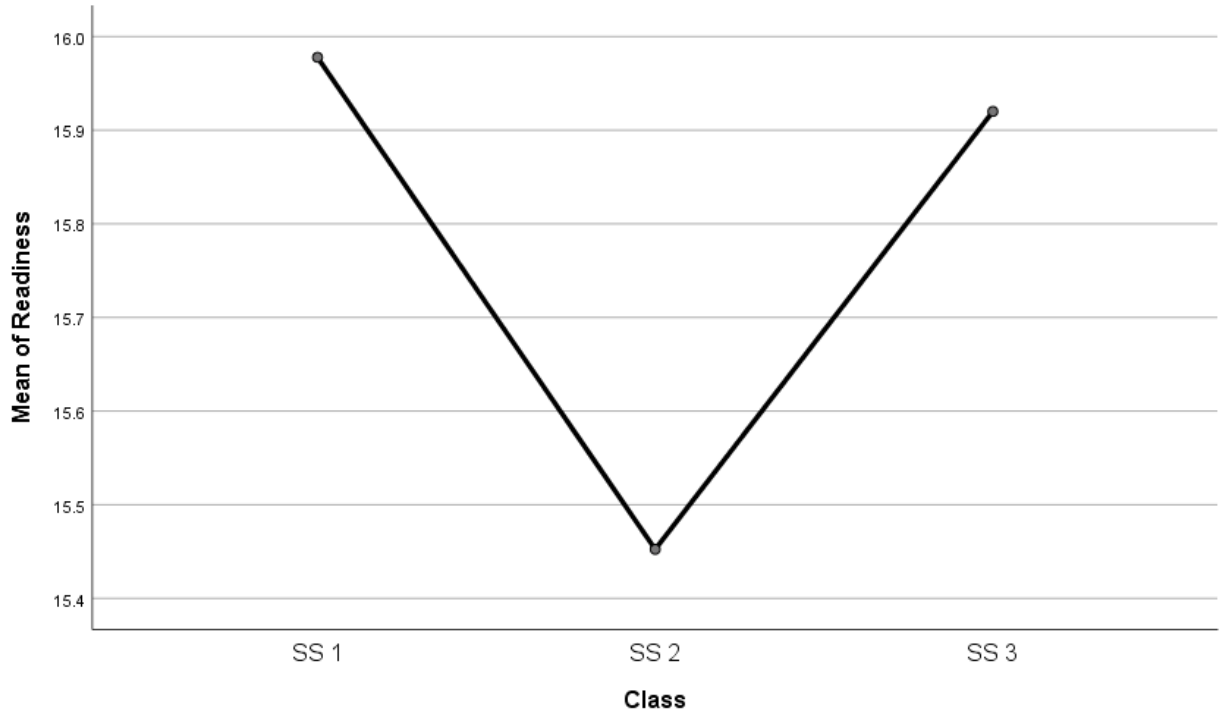


Table 4c: ANOVA showing mean rating of senior secondary students' readiness to adopt Artificial Intelligence-based Tutoring Systems based on subject specialization

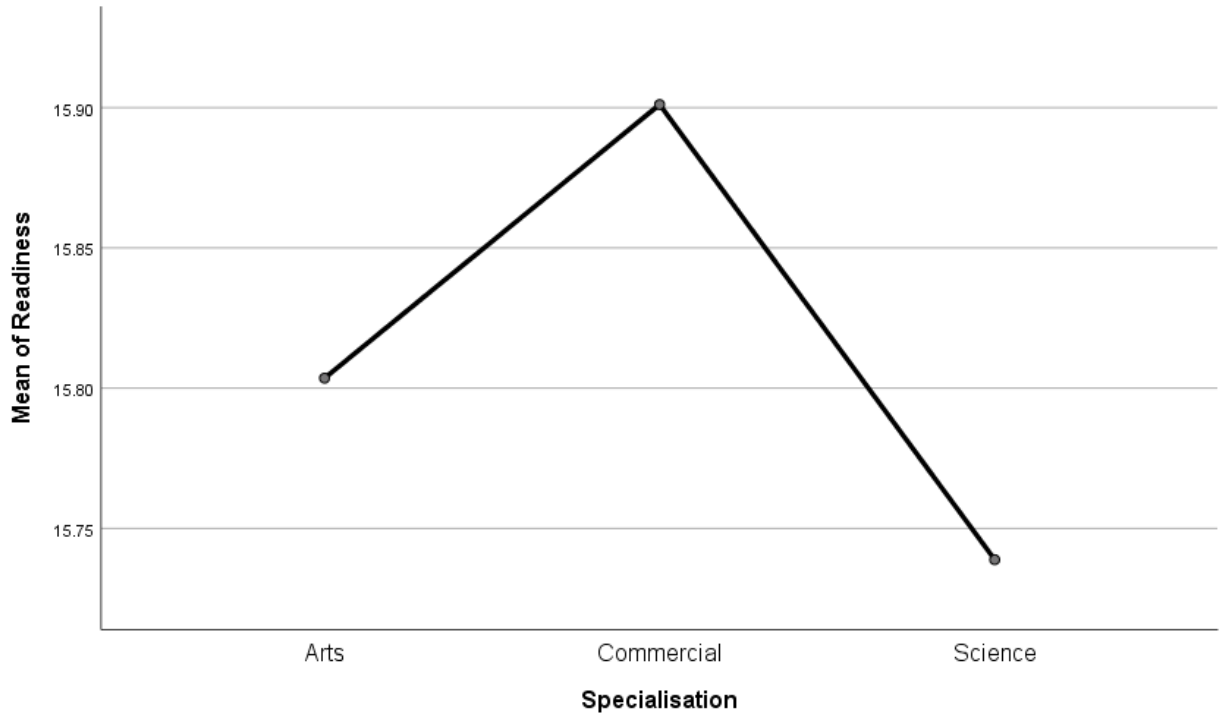
Readiness based on subject specialization	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.518	2	.759	.114	.893
Within Groups	2009.242	301	6.675		
Total	2010.760	303			

Significant at p<0.05

The results (F303 = .114 > *p* (.893) > 0.05) in Table 4c reveals showed that there was no significant difference in the readiness of senior secondary students to adopt Artificial Intelligence-based Tutoring Systems for learning across the subject of specializations (Arts, Commercial and Science). Based on the result, at a .05 level of significance, the p-value was greater than the alpha value (.893 > 0.05). Because of this, the null hypothesis was not rejected. The result, therefore, implied that the students are ready to adopt Artificial Intelligence-based Tutoring Systems for learning, as they did not differ across their subject of specializations.

Figure 5: Mean plot showing no significant difference in senior secondary students' awareness of Artificial Intelligence-based Tutoring Systems based on subject specialization

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Discussion of Findings and Conclusion

This study has been able to show that senior secondary students are aware of Artificial Intelligence-based tutoring systems for learning. In addition to this, the report has shown that senior secondary students are ready to adopt and use Artificial Intelligence-based tutoring systems for learning in secondary schools. These results are very vital for policy formulations on secondary education in Nigeria, especially as the world marches significantly into the Fourth Industrial Revolution (4IR) of the 21st Century. Also, the study found across gender, class and subject specializations, senior secondary students are aware of Artificial Intelligence-based tutoring systems for learning as the study showed that the students are aware that Intelligent Tutoring Systems (ITS) are software or machines that act as one-to-one teacher for students and that the system puts students in control of their learning, act as virtual teachers for students, and also assists students in the development of self-regulation and problem-solving skills. Concerning readiness to adopt and use Artificial Intelligence-based tutoring systems for learning, the study found that students are ready to adopt the system. The finding further showed that students are ready to adopt the system is provided with one, and also ready to adopt it for not only difficult subjects but also for all their subjects. The study also found that across gender, class, and subject specializations (Arts, Commercial and Sciences), there were no significant differences between senior secondary students' level of awareness and their readiness to adopt Artificial Intelligence-based Tutoring Systems for learning in secondary schools.

Artificial Intelligence-based Tutoring Systems can seamlessly adapt to students' individual needs and aim to achieve teacher behaviours by providing students with flexible instructional content in a one-to-one learning environment with immediate feedback. Iddrisu, *et. al.,* (2019), reported that students

find tutoring systems effective and helpful for learning, and students' awareness of CAI shows their knowledge, understanding, and skills influencing their constructions of the reality of whether CAI is useful for learning or not. This shows that the successful application of CAI in learning is strongly influenced by students' awareness of the learning system. Therefore, awareness of CAI enhances the effective inculcation of CAI in learning. Adekunle (2016) has also reported students' positive attitudes towards the use of computers in learning. Given this, ITSs development is critical to educational sustainability, and also as a solution to digital inequality. Therefore, the use of computer technologies is one strategy often utilized in education to improve achievement and motivation (Ernest, 2015). Based on the findings, it was concluded that students are aware and ready to adopt Artificial Intelligence-based tutoring systems for learning in secondary schools. Because of this, there is the need to design and develop Artificial Intelligence-based tutoring systems for implementation in education on a large scale as it is the machine of the future of learning which is almost here.

Recommendations

Concerning the findings of the study, the following recommendations are proffered:

1. There should be massive design, development and implementation of Artificial Intelligence-based tutoring systems for learning in secondary schools since students have shown a high level of awareness and readiness to adopt the system.
2. Given the above recommendation, stakeholders in education should empower programmers and software developers to go into mass production of the system on various subjects in the secondary schools for use of students.
3. Teachers and students should be trained on efficient and effective use of the system for teaching and learning in secondary schools.

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