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FACTORS INHIBITING THE INTEGRATION OF EDUCATIONAL ROBOTS IN TEACHING AND LEARNING COMPUTER EDUCATION COURSES IN UNIVERSITIES IN ENUGU STATE, NIGERIA

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Abstract
The study investigated factors inhibiting the integration of educational robots in teaching and learning computer education courses in universities in Enugu State, Nigeria. Two research questions and two null hypotheses were postulated that gave direction to the study. The study adopted descriptive survey research design. The population for the study was 100 respondents comprised of 25 lecturers and 75 students. There was no sampling because the population was small and of a manageable size. A 21-item structured questionnaire was developed by the researchers and administered to both groups of respondents. The reliability of the instrument was established using Cronbach Alpha reliability method which yielded reliability indices of 0.72 for lecturers and 0.76 for students. Data collected were analysed using mean to answer each of the research questions, while standard deviation was used to determine the closeness or otherwise of opinions of the respondents from the group mean. Independent sample t-test was used to test each of the null hypotheses at 0.05 level of significance. Based on the data analysed, the result revealed that inadequate robotics skills by lecturers, poor funding for capacity building of lecturers in robotics field, among others were factors inhibiting the integration of educational robots in teaching and learning computer education courses in universities in Enugu State, Nigeria. Thus, recommendations were made among others that compulsory robotics training should be enforced for all lecturers to enable them to be proficient in the integration of educational robots in teaching and learning.

Keywords: Robots; Educational Robots; Teaching; Learning; Computer Education; Universities

Introduction

The world is fast evolving due to technological advancement in all aspect of human endeavour. As technology advances, education also evolves in line with technological innovation to meet the demand of the students in the 21st century. Today's students grow up using all kinds of technology such as laptops, artificial intelligent gadget sand robots. Literally, a robot is a machine that looks like a human being and performs various complex tasks of a human being. A robot is a machine specifically programmed to carry out complex series of actions automatically (Eguchi, 2012). According to Haidegger (2021), a robot is a complex mechatronic system enabled with electronics, sensors, actuators, and software, executing tasks with a certain degree of autonomy. Furthermore, a robot is a computer-

controlled device that combines the technology of digital computers with the technology of servo-control of articulated chains (Kumar, 2014). Iroju, Olaleke, Afolabi, and Idowu (2021) opined that a robot is a reprogrammable, multi-functional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks. This implies that a robot must have sensors that enable it to react and adapt to changing conditions. Robots may be built to evoke human form, but most robots are task-performing machines designed with emphasis on stark functionality rather than expressive aesthetics (Benitti, 2012). Robots are classified by intended application field and the tasks they perform such as: industrial robot, medical robot, home robot, defence robot and many more. Robots have become integral component in the modern societies with great potential for being utilized in the educational sector. This implies that robots take the role of tutor, tool or peer in the learning activity (Carne, 2019). Robots that are deployed in schools for the purpose of teaching and learning are referred to as educational robots.

Educational robots are robots developed to solve real problems in educational process (Gan, 2004). Khanlari (2015) stated that educational robots are digital technological tools that help students and lecturers make learning and teaching more active and motivated. Educational robots have emerged as unique learning tools that offer hands-on activities in an attractive manner (Eguchi, 2010). Educational robots are assistive robots that support or aid users in classroom environments (Feil-Seifer & Matarić, 2011). Assistive robots are learning companions that provide academic support to facilitate learning and teaching efforts through social interactions. These robots take different forms, from small programmable robots that students can code themselves to larger robots that are designed to interact with students in a more social way. Educational robots can be divided into virtual (non-physical) robots and non-virtual (physical) robots (Pei and Nie, 2018; Berland and Wilensky,2015). Virtual robots are called software robots, which in essence are robotic source files generated through programming and encoding in a computer simulation environment. On the other hand, physical robots have physical forms; highly automatic and intelligent; can be touched and felt; and can provide a higher-level experience of interaction. Physical robots appear often as an assistant teaching tool, a smart teacher and/or students' learning partner. Educational robots have the characteristics of flexibility, digitization, repeatability, humanization and interactivity (Chang, Lee, Po-Yao, Chin-Yeh, & Gwo-Dong, 2010). Some of the educational robots available are: LEGO Mindstorms, VEX Robotics, Ozobot, Sphero, NAO, OWI 535, Makeblockm Bot, Robo Wunderkind and many more. These robots are designed to help students learn more interactively and engagingly while also providing teachers with new tools to enhance their teaching methods. Educational robots create active and cooperative learning environment for teaching and learning. It plays important role in the acquisition and retention of knowledge and skills. Educational robots improve learning experience of the students through the creation and implementation of activities (Atmatzidou and Demetriadis, 2016). Studies have shown that educational robots encourage interactive learning; as well as engage students in their learning activities (Wei, Hung, Lee & Chen, 2011; Highfield, 2010; Chen, Quadir & Teng, 2011). In many cases, educational robots assist teachers, or even act as an avatar (a movable icon representing a teacher) for students learning remotely. Furthermore, educational robots help teachers to increase students' participation, improve students'

learning and academic performance. Some educational robots are equipped with artificial intelligence (AI) that allows them to adapt and respond to students' needs in real-time. Furthermore, educational robots make learning more engaging and interactive; encourages hands-on learning; and help students develop important skills (such as coding, programming, and problem-solving) that are in high demand in today's job market. Through play, educational robots help students' develop basic cognitive skills of mathematical/computational thinking. In other words, educational robots help develop the mental process use to solve problems of various kinds through an orderly sequence of actions.

However, it is worrisome that the Nigerian education system is lagging behind in robotics technology. Despite the prevalent nature of technology in virtually every aspect of human endeavour, educational robots have not been adequately integrated in teaching and learning in the Nigerian education system. Hence, the researchers perceived that there were factors inhibiting the integration of educational robots in teaching and learning computer education courses in universities that constrain the implementation and utilization of these robots in teaching and learning.

Statement of the Problem

In the western world, the services of physical educational robots were employed as assistant teaching tool or co-instructors for teaching and learning in their classrooms. But, there are limited evidence of adopting educational robots in teaching and learning in the Nigerian universities probably because of insufficient funds to purchase the educational robot kits, inadequate skill to manipulate the robotic kits or because of fear of robots taking over the entire teaching position in classroom setting. Owing to this, the passive teaching method remained predominate in the Nigerian educational system. This implies that the use of robot to support or rather assist in the teaching and learning has yet to commence. Hence, this study attempts to fill this gap by conducting a comprehensive investigation to identify the factors that inhibit the integration of educational robots in teaching and learning of computer education courses in universities in Enugu state, Nigeria.

Purpose of the Study

The main purpose of this study is to find out factors inhibiting the integration of educational robots in teaching and learning computer education courses in universities in Enugu State, Nigeria. Specifically, this study will determine the:

1. Lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities.
2. Student-based factors inhibiting the integration of educational robots in learning computer education courses in universities.

Research Questions

The following research questions were formulated to guide the research study:

1. What are the lecturers-based factors inhibiting the integration of educational robots in teaching computer education courses in universities?
2. What are the students-based factors inhibiting the integration of educational robots in learning computer education courses in universities?

Hypotheses

Following the research questions, two null hypotheses were formulated that guided the study and were tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean responses of male and female on lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities.

$H0_2$: There is no significant difference between male and female respondents on student-based factors inhibiting the integration of educational robots in learning computer education courses in universities.

Methodology

The study adopted descriptive survey research design. The study was carried out in the department of computer and robotics education, university of Nigeria, Nsukka and computer education department, Enugu State University of Science and Technology during the 2021/2022 academic session. The choice of this area was based on the fact that educational robots were not used in teaching and learning computer education courses in the two universities. The population for the study is 100 respondents comprised of 17 lecturers and 30 first-year students from University of Nigeria Nsukka; and 8 lecturers and 45 first-year students from Enugu State University of Science and Technology respectively. There was no sampling because the population was small and of a manageable size. The instrument for data collection was a structured questionnaire titled "Factors Inhibiting Integration of Educational Robots Questionnaire" (FIIERQ), developed by the researchers from literature for both lecturers and students. FIIERQ is a 21-item questionnaire that has a 4-point rating scale with weight values from 4 to 1 point respectively (Strongly Agree, SA = 4; Agree, A = 3; Disagree, D = 2; and Strongly Disagree, SD = 1). FIIERQ was subjected to face validity by three experts from the Department of Computer and Robotics Education, University of Nigeria, Nsukka. The experts were requested to review the suitability, conformity, content, and language of the instrument for data collection. Observations and suggestions made by the experts were used to improve the quality of the instruments. The reliability of the instrument was established using Cronbach Alpha reliability method. A total of 38 respondents (13lecturers and 25 students) from Nnamdi Azikiwe University (NAU) Awka, Anambra State, which was outside the study area, though shared similar geographical characteristics with the zone under the study, was used for the trial testing. The reliability test yielded an Alpha value (reliability indices) of 0.72 for the lecturers and 0.76 for the students, indicating high reliability. The instrument was administered by the researchers with the help of two (2) research assistants through personal contacts; and the consent of the respondents was voluntarily given. The data collected for the study were analysed using mean to answer each of the research questions, and standard deviation to determine the closeness or otherwise of the opinions of the respondents from group mean. Any item with a mean value of 2.50 and above was agreed; while items with mean values less than 2.50 were disagreed for each of the item questionnaire. Moreover, null hypotheses formulated for the study were tested using independent sample t-test at 0.05 level of significance. If the significance is less than 0.05, then, the null hypothesis should be rejected otherwise the null hypothesis should be accepted.

Results

Research question one: What are the lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities?

Table 1: Mean and Standard Deviation on the Lecturer-Based Factors Inhibiting the Integration of Educational Robots in Teaching Computer Education Courses in Universities.

S/N	Item	N	$\bar{X}$	SD	Decision
1	Poor attitude(inability to embrace innovation)	25	3.80	0.50	Agree
2	Poor funding for capacity building of lecturers in robotics field	25	3.52	0.82	Agree
3	Limited accessibility of robotics tools by lecturers	25	3.76	0.52	Agree
4	Incompetent robotics skills by lecturers	25	3.78	0.42	Agree
5	Poor attitude to innovation	25	3.76	0.60	Agree
6	Non possession of robotic kits	25	3.72	0.54	Agree
7	Ill-equipped robotics lab for teaching robotics education	25	3.74	0.54	Agree
8	Lecturers resistance to change	25	3.60	0.76	Agree
9	Inadequate training on robotics discipline	25	3.48	0.87	Agree
10	Poor funding for procurement and maintenance of innovative robotic kits	25	3.39	0.94	Agree
11	Inability to sponsor lecturers for capacity building on robotics education	25	3.92	0.29	Agree
12	Fear of job displacement by robots	25	3.75	0.58	Agree
	Cluster Details		**3.69**	**0.62**	**Agree**

Key: N = Number of Respondents, $\bar{X}$ = Mean, SD = Standard Deviation

Table 1 shows that all the items have mean scores above 2.50. The respondents accepted all the items as lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities. The standard deviation of all the items ranged from 0.42-0.94 showed that the respondents were close in their responses to the items. The cluster mean of 3.69 is an indication that the respondents agree that all the items were lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities.

Research questions two: What are the student-based factors inhibiting the integration of educational robots in learning computer education courses in universities?

Table 2: Mean and Standard Deviation on Student-Based Factors Inhibiting the Integration of Educational Robots in Learning Computer Education Courses in Universities.

S/N	Item	N	$\bar{X}$	SD	Decision
13	Non availability/poorly equipped robotics laboratories	**75**	3.67	0.58	Agree
14	Programming in robotics is a difficult task for students	75	3.75	0.55	Agree
15	Poor access to robotics tools	75	3.77	0.43	Agree
16	Negative attitude towards as a discipline	75	3.45	0.86	Agree
17	Fear of writing robotics programs/codes	75	3.68	0.58	Agree
18	Non possession of robotic kits	75	3.59	0.60	Agree
19	Poor access to robotics laboratories for practical purposes	75	3.58	0.73	Agree
20	Nonchalant attitudes towards online self-learning in robotics disciplines	75	3.67	0.64	Agree
21	Programming in robotics is difficult task for students	75	3.26	0.87	Agree
	Cluster Details		**3.60**	**0.65**	**Agree**

Key: N = Number of Respondents, $\bar{X}$ = Mean, SD = Standard Deviation

Table 2 shows that all the items have mean scores above 2.50. The respondents accepted all the items as student-based factors inhibiting the integration of educational robots in learning computer education. The standard deviation of all the items ranged from 0.43-0.87 showed that the respondents were close in their responses to the items. The cluster mean of 3.60 is an affirmation that the respondents agree that all the items were student-based factors inhibiting the integration of educational robots in learning computer education courses in universities.

Null Hypothesis 1

Table 3: There is no significant difference in the mean responses of male and female on lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities.

Gender	N	$\bar{X}$	SD	F	Sig.	T	df	Sig. (2-tailed)	Remark
Male	13	3.80	0.45	20.21	0.25	1.33	23	0.31	Significant
Female	12	3.52	0.67						

Key: N=Number of Respondents, $\bar{X}$ =Mean, SD=Standard Deviation, Significant at 0.05

The result of the analysis in table 3 show that Levene's of F(23) = 20.21, P = 0.25, t(23) = 1.33, P = 0.31 was significant at 0.05 alpha level. This indicates that gender is statistically significant difference on lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities. Hence, the null hypothesis was rejected.

Null Hypothesis 2

Table 4: There is no significant difference between male and female respondents on student-based factors inhibiting the integration of educational robots in learning computer education courses in universities.

Gender	**N**	$\bar{X}$	**SD**	**F**	**Sig.**	T	**df**	**Sig. (2-tailed)**	**Remark**
Male	45	3.60	0.64	1.88	0.50	0.36	73	0.55	Significant
Female	30	3.56	0.65						

Key: N=Number of Respondents, $\bar{X}$ =Mean, SD=Standard Deviation, Significant at 0.05

The result of the analysis in table 4 show that Levene's of F(73) = 1.88, P = 0.50, t(73) = 0.36, P = 0.55 was significant at 0.05 alpha level. This indicates that gender is statistically significant difference on student-based factors inhibiting the integration of educational robots in learning computer education courses in universities. Hence, the null hypothesis was rejected.

Discussion of findings

The data presents the lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities. The findings revealed that a major lecturer-based factor was incompetent robotic skills by lecturers. Lecturers do not have robotic skills and knowledge needed to fully understand as well as reprogramme educational robots. The findings were in line with that of Khan, Hasan, and clement (2012) which revealed that lecturers incompetent skill is one of the main inhibiting factors in teaching computer education courses both in developed and developing countries. Further analyses revealed that the mean difference between the male and the female respondents is 0.28. This implies that there is close association on the opinion of male and female respondents on lecturer-based factors inhibiting the integration of educational robots in teaching computer education courses in universities which resulted in statistically significant difference.

The data presents the student-based factors inhibiting the integration of educational robots in learning computer education courses in universities. The findings revealed that one of the inhibiting factors faced by students is programming. This is because programming is a difficult task for students. Programming of robots is highly task demanding from students. The findings of the study were in conformity with the findings of Bliskstein (2013) who stated that difficulty in robotics programming is one of the main hindrances in learning computer education courses. Further analyses revealed that the mean difference between the male and the female students is 0.04. This is an indication that there is a close relationship between the male and the female respondents on student-based factors inhibiting the integration of educational robots in learning computer education courses in universities that resulted in statistically significant difference.

Conclusion

In conclusion, based on the findings of the study, the researchers concluded that educational robots have not been properly integrated in universities due to many inhibiting factors such as: inadequate robotics kits, incompetent robotics skills by lecturers, poor for funding from government, inadequate training on robotics, and many more. It was also concluded by the researchers that both lecturer-based factors and student-based factors inhibiting the integration of educational robots in teaching and learning computer education courses in universities were statistically significant difference.

Recommendations

1. Government should intensify effort in increasing the funding of universities in line with UNESCO standard of 26% allocation of national budget in education.
2. Compulsory training on robotics should be enforced for all computer education lecturers to enable them to be proficient in the integration of educational robots for teaching in the universities.

Suggestions for Further Studies

1. The study can be carried out in other geopolitical zones of the country to determine the factors inhibiting the integration of educational robots in teaching and learning Computer Education courses in universities
2. The use of educational robots in teaching and learning in secondary schools' student in Enugu state.
3. A study should be carried out on the factors inhibiting the integration of educational robots for instructional delivery
4. A study should carry out on the strategies in integration of educational robots in teaching and learning Computer Education courses in universities in Nigeria
5. A study should be carried out on the influence of educational robots in teaching in Enugu.

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