



Impact of Teaching Computer Robotics Programming Using Hybrid Learning in Public Universities in Enugu State, Nigeria

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Abstract

This study focused on the effect of hybrid learning in teaching and learning robotics programming at the public Universities in Enugu State. Specifically, this study sought to determine: The effect of hybrid learning and lecture method on students' academic achievement in robotics programming education, the effect of hybrid learning and lecture method on students' interest in robotics education. Two research questions and one null hypothesis guided the study. The population for the study was 47 second-year students of Department Computer Science Education, University of Nigeria, Nsukka and Enugu state university of science and technology. Robotics Programming Education Achievement Test (RPAT) and Robotics Education Interest Scale (REIS) were the instruments used for data collection. The REAT consists of 35 multiple choice items with 4 options while REIS was a 15-item interest scale. Data collected were analyzed using mean and standard deviation while ANCOVA was used to test the four null hypotheses at a significance level of 0.05. The findings revealed the following: effect of hybrid learning on students' achievement in robotics programming education is higher than the effect of lecture method, mean scores of hybrid learning on students' interest in robotics programming education are higher than the mean score of lecture method, and among others. Recommendations were made which includes: the technology used for the online learning must shift content and instruction to students' control in at least some way for it to qualify as Department learning from the student's perspective, rather than just the use of digital tools from the classroom teacher's perspective and among others.

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Introduction

In an era where technology is rapidly transforming every aspect of our lives, computer robotics programming stands at the forefront of innovation and automation. This field involves the design, development, and implementation of computer programs that control and manage robotic systems (Alam, 2022). The author asserts that robotics programming application includes industrial automation to healthcare, robotics programming has far-reaching applications that promise to revolutionize the way we live and work (Shim, Kwon & Lee, 2016). Miller and Nourbakhsh (2016) continued that Robotics programming has its roots in the mid-20th century when the first programmable robots were developed. Since then, advancements in computer science and engineering have led to the development of more sophisticated and versatile robotic systems. According to Yolcu and Demirer, (2023) there are component of computer robotics programming such as algorithms and data structures, control system, Artificial Intelligence (AI) and machine learning, sensors and actuators, simulation and testing. Several programming languages are commonly used in robotics programming, each with its strengths and applications such as Python, C++, Java, MATLAB (Chen & De Luca, 2016).

Therefore, application of computer robotics programming such as industrial automation robots are used to automate repetitive and dangerous tasks in manufacturing, improving efficiency and safety (De Luca, Li, Mian, & Chen, 2018). The authors continued that there are various challenges associated with teaching and learning of computer robotics programming such as Complexity, Robotics programming involves integrating multiple components, including hardware, software, and sensors. Ensuring that all these elements work together seamlessly can be challenging. Real-Time Processing, robots often need to perform tasks in real-time, requiring efficient algorithms and fast processing capabilities. Achieving real-time performance can be difficult, especially in resource-constrained environments. Programmers must carefully design and test their systems to prevent failures and accidents. Teaching computer robotics programming is a crucial and rapidly evolving area of education. As technology continues to advance, the demand for skilled professionals in robotics and programming grows. Teaching computer robotics programming, including methodologies, tools, challenges, and future trends (Monteiro, et al 2019).

Methodologies for teaching robotics programming. Different methodologies can be

employed to teach robotics programming effectively: Traditional classroom learning, Project-Based Learning (PBL), Flipped, Peer facilitated approach (Basil, Nwokoye & Biedomo, 2021; Omeh et al 2024). Blended learning this approach combines online instruction with face-to-face interactions, providing flexibility and support. Olelewe and Agumuo (2017) explained that hybrid learning, also known as blended learning, and is an educational approach that combines traditional face-to-face classroom instruction with online learning experiences. This innovative model leverages the strengths of both in-person and digital education to create a more flexible, personalized, and effective learning environment. As technology continues to evolve, hybrid learning has gained prominence as a viable solution to address the diverse needs of students and educators in the 21st century. Face-to-face instruction, this component involves traditional classroom teaching, where students and teachers interact in person. It includes lectures, discussions, hands-on activities, and other forms of direct instruction. Online Learning this component leverages digital platforms and resources to deliver educational content. It includes video lectures, interactive simulations, online assessments, and collaborative tools. Hybrid learning allows students to learn at their own pace, accessing online materials and resources as needed. This flexibility enables personalized learning experiences (Raes, Detienne, Windey & Depaeppe, 2020).

Hybrid learning offers numerous advantages for both students and educators Flexibility and Convenience. Scheduling: Hybrid learning allows students to access course materials and complete assignments at their own convenience. This flexibility is particularly beneficial for working professionals and non-traditional students. Challenges such as student's interest and academic achievement needs to be addressed. Academic achievement refers to the degree of success in achieving instructional and educational goals (Omeh & Olelewe, 2021). It is usually measured by students' grade-point average (GPA), cumulative grade-point average, or most times measured from the cluster of academic achievement tests, homework, projects and assessments. Student achievement in robotics programming is therefore important in determining the level of progress made in terms of change in learners' behaviour (e.g. problem identification, abstraction, algorithm, and coding) (Ajaykumar, Steele & Huang, 2021). Academic achievement is one of the major factors considered by employers

during staff recruitment, especially for fresh graduates.

Furthermore, gender is the range of physical, biological, mental and behavioural characteristics about and differentiating between the feminine and masculine (Su, Yang & Zhong, 2023). The importance of examining academic achievement concerning gender is based primarily on the socio-cultural differences between girls and boys. Gender differences in achievement have been examined in several studies for example (Okanlawon, Fakokunde, Yusuf, Abanikannda & Oyelade, 2017). Gender difference is yet to be established in computer robotic programming as a course of study about the use of innovative pedagogical approaches. The growing interest in robotics programming among students is a testament to the dynamic and evolving nature of education (McGill, 2012). By offering engaging, interactive, and relevant learning experiences, robotics programming captures the imagination of students and equips them with essential skills for the future. As educators and institutions continue to promote robotics education, they can inspire the next generation of innovators, engineers, and problem-solvers, paving the way for a brighter and more technologically advanced future.

Purpose of the study

The main purpose of this study was to determine the effect of hybrid learning in teaching and learning robotics education in Enugu State. Specifically, this study determined:

- i. The effect of hybrid learning method and lecture method on students' academic achievement in robotics education.
- ii. The effect of gender on students' interest in the use of hybrid learning method to teach robotics education.

Hypotheses

The following null hypotheses will be tested at 0.05 level of probability:

- Ho 1:** There is no significant difference in the mean achievement scores of students taught robotics education using hybrid learning method and those taught using the lecture method.

Methodology

Design of the study

The design of the study was a quasi-experimental research design. A quasi-experimental design is an experiment where randomization of the subject of experimental and control groups is not possible (Nworgu, 2006). The design is considered

appropriate for the study because intact classes were used instead of randomly composed samples. The use of intact classes is to ensure the non-alteration of lecture time. The design is represented thus: $E_G = O_1 \times O_2, C_G = O_1 - O_2$, where E_G stands for the experimental group, C_G stands for the control group, O_1 stands for pre-test observation, O_2 stands for posttest observation, \times stands for treatments using hybrid learning, $-$ stands for the use of lecture method.

Area of the study

This study was carried out in the University of Nigeria, Nsukka, Enugu State and Enugu state university of science and Technology. This area was chosen because it is the public University in Enugu State that teaches computer robotics programming.

Population for the study

The population for the study was 47 students. 25 from department of Computer and Robotics Education University of Nigeria, Nsukka, Enugu State, while 22 from Enugu state university of science and Technology and this formed the sample size which is made up of 20 males and 27 females of second-year students. The experimental group was made up of 10 males and 12 females while the control group was made up of 9 males and 18 females.

Sample and sampling techniques

Total sampling technique was used because the population was manageable.

The instrument for data collection

The instrument for data collection for this study consists of Robotics Programming Achievement Test (RPAT) and Robotics Education Interest Scale (REIS). The RPAT which was used to determine the academic achievement of students was developed based on the test blueprint table. The RPAT consists of 35 multiple choice items with 5 options. The questions were developed by the researcher based on robotics education curriculum. The REIS was also developed by the researcher, containing 15 items interest scale. This instrument was designed to assess students' interest in the use of hybrid learning to teach robotics education. It was based on a four-point rating scale of Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The researcher prepared four (4) sets of lesson plans for the teaching of the module set out for the study. These lesson plans were prepared from the units in the test blueprint. Each set

contains two (2) lesson plans. Two sets of the lesson plans were prepared based on hybrid learning method (HLM), while the other two sets were written based on the lecture method (LM) approach of teaching robotics education. The hybrid learning method (HLM) lesson plan was used to teach the experimental group, while the control group was taught with lecture method (LM) lesson plan. The Pre-Robotics Education Achievement Test (PRE-REAT) and the Pre-Robotics Education Interest Scale (PRE-REIS) were administered to the students in the two groups before the commencement of the experiment and no feedback on the test was given to the students. Students' scores were recorded and kept aside for use after the treatment by the researcher. At the end of the experiment, a Post-Test of the Robotics programming Education Achievement Test (POST-RPAT) and the Post Robotics Education Interest Scale (POST-REIS) were administered on both groups. The result of the pre-test and post-test were recorded separately.

Validation of the instrument

The instrument was subjected to face-validity by three experts, two from the Department of Industrial Technical Education, and one from Measurement and Evaluation Department, University of Nigeria, Nsukka, Enugu State. The test blueprint was face validated and the achievement was subjected to face and content validation by the same experts mentioned above. The REIS was subjected to face validation by the same validates. The validation exercise was conducted in the following manner: copies of the title of the study, the purpose of the study, research questions, hypotheses, the test-blue print, and the achievement test were sent to the above experts. They were requested to read through the instrument, vet the items for clarity, relevance, proper coverage and also to identify and correct wrongly spelt words, ambiguous statement and make suggestions of missing items. The suggestions were utilized to produce the final version of the questionnaire for the study.

Reliability of the instrument

The trial test for determining the coefficient of stability of the "RPAT" was carried out using estimate or temporal stability (Test Re-Test). The instrument was administered by the researcher on an equivalent sample of second-year students of the Computer Science Department, University of Calabar, Calabar, Cross River State. The objectives answer sheets were marked by the researcher and scores kept. After two weeks, the RPAT was re-

administered to the same sample. The objective questions were also marked by the researcher and scores obtained from the first and second test administered were correlated. The reliability coefficient of the RPAT was found to be 0.86 using Pearson product-moment correlation coefficient since the test items (REAT) were of multiple choice type. Cronbach Alpha was used to determine the internal consistency of "REIS" items. The interest scale was administered on an equivalent sample of second-year students in the University of Calabar, Calabar, Cross River State. The reliability coefficient of REIS was found to be 0.83. The REAT was scored out of 20 marks (2 marks each) while REIS was rated based on a 4-point scale.

Experimental procedure

Training of teachers for the conduct of the study. The regular robotics education lecturers of the selected schools that teach robotics education were given one-week training. The lecturers were given a detail explanation on the use of hybrid learning method. The training was organized for both the experimental and control group. The training exercise was based on the purpose of the study, the topics to be taught and the general conduct of the study.

Treatment procedure

The conduct of the study took place during the normal school periods. The normal time table of the schools used for the study was followed. The regular robotics education lecturers were used. The group that was given treatment, that is the hybrid learning method served as an experimental group while the group that was taught with conventional method served as the control group. On the first day, before the commencement of the lesson, the two instruments RPAT and REIS were administered as a pre-test to both the experimental and control groups after which proper teaching started by using the prepared lesson plan. The hybrid learning lesson plans incorporated some instructional strategies (organizing and transforming, rehearsing and memorizing, keeping a record, seeking social assistance, seeking information, self-evaluation) that enabled the students actively construct knowledge about a situation to develop strategies to proceed within the situation, and able to use a previous understanding of any issue and the newly acquired knowledge to respond to an issue, develop skills, conduct, analyze and communicate findings.

At the end of the treatment, a post-test was administered on both groups with the RPAT and

REIS. The scores obtained from the groups were compared to determine if there was any significant difference in the performance of the two groups. The data collected was used for further analysis; the scores were collected and kept under the care of the researcher.

Control of extraneous variables

To control some extraneous variables that may distort results and lead to false findings and wrong conclusion, the researcher adopted the following steps: Teacher Variable: to ensure that errors coming from teacher variables will not interfere with the findings of the study, the researcher organized a one-week training exercise for the regular robotics education lecturers of the groups that were selected for the study. The training helped in establishing a common instructional standard among the robotics education lecturers. The topics for the study were treated in details during co-ordination. Regular supervision was made by the researcher during the period of the experiment to ensure that the

lecturers did not deviate from the agreed pattern of instruction. Subject Bias: the use of intact classes removed the possibility of the students knowing whether they are in the experimental or control group.

Method of data analysis

The data collected were used to analyze research questions on Pre and Post REAT. Other research questions on REIS were answered based on the response options of: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA). Analysis of covariance (ANCOVA) was also used to take care of equivalence in the group since intact classes were used for the study. In testing the hypotheses of significant difference, any item whose P-value is greater than 0.05 was regarded as not significant while, any item whose P-value is less than 0.05 was regarded as significant.

Table 1: Mean and standard deviation of pretest and post-test scores of the effect of the hybrid learning method and lecture method on students’ academic achievement in robotics education.

Variable	N	Pretest		Posttest		Mean gain
		Mean	SD	Mean	SD	
Methods of Teaching						
Hybrid Learning method	25	7.79	1.88	16.43	1.45	8.64
Lecture Method	22	5.89	1.96	12.22	1.48	6.33

Key: N-Number SD-Standard deviation

Table 1 show that the group taught Robotics programming using hybrid learning method had a pretest mean score of 7.79 with a standard deviation of 1.88 and a posttest mean score of 16.43 with a standard deviation of 1.45. The difference between the pretest and posttest mean was 8.64. The group taught robotics programming using the lecture method had a pretest mean score of 5.89 with a standard deviation of 1.96, and posttest means a score of 12.22 with a standard deviation of 1.48. The

difference between the pretest and posttest mean was 6.33. However, for each of the groups, the posttest mean was greater than the pretest means with the group taught using hybrid learning method having a higher mean gain. This is an indication that hybrid learning method has more effect on students’ academic achievement in robotics programming education than the lecture method. The effect is that students performed better when they were taught with the hybrid learning method.

Table 2: Mean and standard deviation of pretest and posttest scores of the effect of gender on students’ mean interest score in the use of hybrid learning method to teach robotics education.

Variable	N	Pretest		Posttest		Mean gain
		Mean	SD	Mean	SD	
Gender						
Male	30	25.60	2.01	31.00	1.49	5.40
Female	37	20.62	2.06	24.38	1.50	3.76

Key: N-Number SD-Standard deviation

Table 2 show the effect of gender on students’ mean interest score in the use of hybrid learning method to teach robotics programming education. Results showed that the male students had a pretest mean interest score of 25.60 with a standard deviation of 2.01 and a posttest mean interest score of 31.00 with a standard deviation of 1.49. The difference between the pretest and posttest mean score for the male students was 5.40. The female students taught robotics education using hybrid learning method had a pretest mean interest score of

20.62 with a standard deviation of 2.06 and a posttest mean interest score of 24.38 with a standard deviation of 1.50. The difference between the pretest and posttest mean score for the female students was 3.76. However, for each of the groups, the posttest mean was greater than the pretest means with the male students having a higher mean interest score. This is an indication that gender affects students’ interest in the use of hybrid learning method to teach robotics education.

Table 3: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught robotics education using hybrid learning method and those taught using the lecture method.

Source	Type III Squares	Sum of df	Mean Square	F	Sig.
Corrected Model	228.793 ^a	3	76.264	18.355	.000
Intercept	157.125	1	157.125	37.816	.000
Pretestscore	5.760	1	5.760	1.386	.254
Groups	33.632	1	33.632	8.094	.010
Gender	17.987	1	17.987	4.329	.051
Group * Gender	.000	0	.	.	.
Error	78.946	19	4.155		
Total	3914.000	23			
Corrected Total	307.739	22			

Table 3 shows that there was a significant difference in the mean achievement scores of students taught robotics programming education using hybrid learning method and those taught using the lecture method. The result shows that concerning the group taught robotics education using hybrid learning method and those taught using lecture method, an F-ratio of 8.094 was obtained with an associated probability value of 0.01. Since the associated probability value of 0.01 was less than 0.05 set as the level of significance, the null hypothesis (H_{01}) which stated that there is no significant difference in the mean achievement scores of students taught robotics

education using hybrid learning method and those taught using lecture method was rejected. Thus, the inference drawn therefore was that there is a significant difference in the mean achievement scores of students taught robotics programming education using hybrid learning method and those taught using lecture method; with those taught using hybrid learning method having a higher mean gain. This shows that hybrid learning method has more effect on students’ academic achievement in robotics education than the lecture method.

Discussion of the findings

The data presented in table 1 provided an answer to research question one, findings revealed that the main effect of hybrid learning method on students' achievement in robotics education is higher than the main effect of the conventional technique, at the same time, analysis of covariance was used to test the first hypothesis at the calculated F-value of 8.09, the significance of 0.01 and confidence level of 0.05; there was a statistically significant difference between the main effect of hybrid learning method on students' achievement in robotics education confirming that the difference between the main effect of the hybrid learning method and lecture method was statistically significant. These findings imply that hybrid learning method (recording lectures on videotapes or CDs and post it online through YouTube, WhatsApp and among others) is more effective than conventional or lecture method in enhancing students' achievement in robotics education. The finding that hybrid learning method has a positive effect on students' academic achievement is similar to the findings of (Walsh, 2014).

The data presented in table 2 provided an answer to research question two. Findings revealed that mean scores of hybrid learning method on students' interest in robotics education are higher than the mean score of the lecture method. Analysis of covariance presented in table 6 confirmed that the difference between the main effects of the hybrid learning method and conventional lecture method in students' interest inventory was significant. The significant difference is attributed to the treatment given to the experimental groups assigned to hybrid learning method. The findings indicated that hybrid learning method is more effective in stimulating students' interest in robotics education than the conventional lecture method. Baker, (2011) asserted that the degree of understanding by students depended on several interacting variables such as learning materials, students' interest, school environment, and teaching techniques. Therefore, he emphasized that teachers should endeavour to adapt instructional techniques that are capable of stimulating students' interest.

The data presented in table 4 also provided an answer to research question four. Findings revealed that gender does not affect students' interest in robotics education using the hybrid learning method. The analysis of covariance was used to test the fourth hypothesis at the calculated F-value 3.72, the significance of 0.06 and confidence level of 0.05; there was no significant difference in the mean interest scores of male and female students taught robotics education using hybrid learning method, which

implies that hybrid learning method is more effective in stimulating students' interest in robotics education regardless of gender.

Conclusion

In hybrid learning programs, students do some of their learning via the Internet. This does not mean using any digital tool, such as an online graphing calculator or Google Doc perspective learning means a bigger instructional shift from a face-to-face teacher to web-based content and instruction or media-based. By understanding hybrid learning as an instructional delivery model that gives students some element of control over their learning and by leveraging the opportunity of personalization that hybrid learning can provide at scale, educators can start to address challenges and opportunities in their schools that will enable them to move the practice of hybrid learning method forward.

Recommendations

Based on the findings, the following recommendations were made:

1. The technology used for online learning must shift content and instruction to students' control in at least some way for it to qualify as hybrid learning from the student's perspective, rather than just the use of digital tools from the classroom teacher's perspective.
2. To prevent lack of coordination, most hybrid learning programs should use a computer-based data system to track each student's progress and try to match the modality - whether it is online, one-on-one, or small group - to the appropriate level and topic.
3. Ministry of education should create a conducive and enabling environment to encourage teachers and students by providing basic infrastructures/facilities that will enable one, irrespective of his/her financial status, acquire and apply computer knowledge and skills

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