

# Evaluation of a Developed Intelligent Tutor System for Learning Robotic Programming Course in Tertiary Institutions South East, Nigeria

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**Abstract** This study is on evaluation of a developed Intelligent Tutor system for learning Robotic programming course in Tertiary Institutions South East, Nigeria. 2 research questions guided the study and 1 hypothesis were formulated. This developed ITS followed Research and Development (R&D) design based on the theoretical foundation of Iterative life cycle model. The population of the study is 120 students and three schools were used. 120 students also formed the population that was used to evaluate the ITS. The total sampling techniques was used while the reliabilities of instruments were tested with cronbach-alpha coefficient. Result gotten is 0.89. mean answered the research questions and Anova tested the hypothesis that guided the study. Furthermore, the findings on hypothesis tested show the no significance differences in the responses of second year students of tertiary institutions selected for the study on their learning experiences using the developed Intelligent Tutor System. It was recommended that the developed tutor should be adopted by teachers in computing disciplines for effective use in classroom teaching. Teachers should engage students in practical use of the developed ITS in teaching Robotics programming courses for increased learner motivation and performance.

**Keywords** Programming Robotics Programming, Intelligent Tutor System, Learning, Evaluation

## 1. Introduction

Programming is the act of writing computer program, which are sequence of instruction written using computer programming languages to perform a specified tasks by the computer [1]. Yatim [2] stated that programming is developed to communicate information to computer. The author further buttressed that programming is used to develop program to handle the behavior of the machine. Programming is seen as a platform that showcase creativity, especially in problem-solving, entertainments, developing new video game, graphics and animation to showcase new business idea or to resolve problems [3]. Programming in Nigerian tertiary institutions is geared towards impacting students with the knowledge and skills of problem solving. [3]. Programming is one of the major courses taught to students in computing disciplines in Nigerian Tertiary Institution and has become parts of Computer Education [3]. The teaching of programming has become a necessary

tool in producing students who will be able to use programming codes to solve real life problems. In the same vein, [4] said that in the teaching of programming in Nigerian tertiary institution, students will be introduced to the introduction programming, they will be exposed to analyse problem, make use of technique to represent the issue and approve the solutions. The author further stated that students are meant to find solution to the problem by making use of programming languages. The learners will test the program to verify errors to ensure that the result is right in line with the requirement [4]. However, the problem identified in teaching programming has to do with the student population [5]. The inability of lecturers to effectively teach programming has led to difficulty in understanding the core concept of programming thereby making programming look very complex. [5], [6]. However, [6] stated that, programming is big task that is difficult to learn. Hence, the process of designing and building executable instructions which directs the mechanical device on how to perform a particular task is an aspect of robotics programming.

## 2. Robotics Programming

Robotics programming is a process of designing an executable instruction that tells mechanical device and electronic system known together as a robot what task to perform [7]. Mehmet [8] stated that Robotics programming is use to perform autonomous task. Many software and frameworks have been proposed to make programming robot easier. Sewall [9] stated that it is obvious that, there is a great future for Robotics programming even in the creation of learning environment for students. Robotics Programming in the context of this study is a programmed command for directing the motions of the robot so that it can perform duties without human help. Robotics programing is a new course that needs an alternative teaching method that will make robotics programming easy for students to learn. The new phase/advantages about using ITS in robotics programming is that it helps students study subject by series of lessons, questions on each lesson taken and given instructions with feedbacks. The ITS in robotics programming crates a profile for students and also estimate the students' level of skills / knowledge [12], [15]. Intelligent tutor system in robotics programming is a system that provide feedback to Computer Robotics education students, usually without requiring a human teacher. Hence, the developed ITS for-learning Robotic programming course in tertiary institutions South East Nigerian will provide one-on-one private training and tutoring in Robotic programming course it will also provide personalized learning

## 3. Learning

Learning is seen as a means of getting, modifying

behaviors. [10]. Kimble [11] stated that learning develops socially accepted behaviors and also there is an equal chance of building negatives side of human behavior. The author further stated that learning is a process which occupies an important role in molding the structure of our personality and behaviors. Kingsley [12] stated that learning necessitates to meet some personal needs as it is a purposeful and goal oriented. The conventional method of learning has been used extensive and have progressed very slowly and might be ineffective for addressing various knowledge styles and levels of training [13]. Personalized learning seeks to increase student's learning by channeling instructional environment such as; how, when, where and what student learn to address individuals need, interest and skill of each students [14]. Therefore, personalized learning is seen as a dynamic learning opportunity that provide student with contents that address their personal learning need based on their interest, parental inputs, and teachers' observations as well as assessments data, as the most important elements. Application developer and experts have been exploring Smartphones, tablet and intelligent tutor system applications as a software package for personalized learning [15]. Learning systems and solutions take account of attributes, such as learning effectiveness, learning efficiency, and learner engagement. Evaluating developed Robotics Programming course intelligent tutor system has focus on evaluating the correctness of recommendations subject content of the Robotics Programming course intelligent tutor system and students' personalized response on their experience on the use of this Robotics Programming course intelligent tutor system which is the objective methods. While comparing students' personalized response on their experience on the use of Robotics Programming course tutor system is accurate and simple to analyse, it means the students' performance during learning is never significantly difference to the duration the next user will carry out learning. Students' experience with the software is positively interrelated with having a positive students' experience [16] ending in potential bias. In this tutor, students are presented with instruction on how to take the quiz problem, and a number of radio buttons which one of them has the correct answer for this problem. For example, once the student is ready to start to answer the questions, instructions will be presented and a start button will be clicked. A total of 10 seconds meant for the quiz and the remaining time will be shown. If a student wishes to visit the previous question as a result of doubt, previous question button will be pressed. At the end of the quiz, student will press submit button to Robotics Programming course Tutor, the Robotics Programming course Tutor then ask student to confirm the submission. The "Hint" is invisible when students are attending to the problem this is because we just need to encourage students think more about the solution of the problem. "Hint" will be visible when students must have submitted, which shows the questions, the correct answers to each of them and the total

score.

## 4. Intelligent Tutor System

Intelligent tutor system (ITS) gives many benefits as a human instructor to large number of students [17]. Lee [18] asserted that ITS are software that are able to interpret complex students' response and also learn while working, they are capable of distinguishing where and why a student understanding has gone amiss and also give it hint to help student's understanding of the materials. Liu [19] explained that Intelligent tutor system can as well deliver real time data to instructor and developer to enhance their style of teaching. According to [19], [20] intelligent tutor system is also a computer programs which access learner's mindset to provide self-learning. Intelligent Tutor System is also a computer software designed to **help** a human instructor's skills behaviors and guidance [21]. This system presents educational resources in a flexible and personalized way [22]. Because educational institution cannot give a human tutor to all the students, intelligent tutor system is an alternative platform that gives students personalized guild [23]. [23] further stated that ITS developed are advanced, it allows students to enhance their understanding by finishing task as part of the lecture interactive environment. Intelligent tutor system can transform teaching strategy; gives explanations, practical exercise, examples and demonstrations where needed [24]. Intelligent tutor system is more advanced and allows students improving their skills by completing task as part of the lecture hall interactive environment [19], [12], [24]. Intelligent tutor system, is opposed to other educational technologies, is to get each student response in order to evaluate his/her knowledge and networking skill [23], [24]. Intelligent tutor system is also a software designed to be same to teacher's behaviour in teaching. ITS also helps students study subject by series of lessons, questions on each lesson taken and given instructions with feedbacks. The ITS crates a profile for students and also estimate the students' level of skills / knowledge [12], [15]. In this study intelligent tutor system is a system that provide feedback to Computer Robotics education students, usually without requiring a human teacher. Hence, the developed ITS for-learning Robotic programming course in tertiary institutions South East Nigerian will provide one-on-one private training and tutoring in Robotic programming course it will also provide personalized learning.

### 4.1. Domain of Intelligent Tutor System

The developed ITS contains 4 components which are: user interface, teaching model, student model, domain model.

Domain module or expert knowledge is an Intelligent Tutor System which have the skills, content and the lesson [25]. Domain model is a technique to encode domain knowledge, such as rules, procedures concepts and

procedures, facilitating their use in computer system. Author also stated that the domain model serves as a source of expert knowledge and it also serves as a standard for evaluating students performance. The domain model according to [27], deals with "what to teach [28] also stated that document and material needed to teach learners are in the domain module.

### Student Model

For a new student to use intelligent tutor system, the students must have a profile in the ITS. The student's profile will have the details /information of the student such as session, the date the student logged into the ITS. Student score, overall score, students' names, number and difficult numbers during the lesson [25]. Scores represents the student scores for the level. The students' model also known as learning model is a component of ITS which gives attentions to student's in the process of learning. According to Yue [25], students' model is a technique used to understand the students which includes their behaviour, emotions and knowledge level. It provides a computer-interpretable representation to the system. Student module contains knowledge and also motivate state happening at the course of learning [26]. Mokbel [29] stated that student model saves informations about learners and their actions.

### 4.2. Teaching model

The teaching or instructional or tutoring model inputs the domain and student models and choose learning techniques, on what the software will do next. Teaching model provides an intelligent representation of educational material such as desirable detail levels, degree of backward knowledge, assessment of the system on the levels of student's acquaintance with the matter being currently taught [29]. The system knows when the learners deviate from the rules of the models and provide timely feedback to the learner, which results in a brief period of time to reach proficient with the targeted skills.

### 4.3. User Interface Model

Users interface model is an interactive user front end of an Intelligent Tutor System which include information required to communicate with the students with text, pictures, audios and videos [29]. According to Yue [25] user interface model works as a presentational tier that blends service together in order to communicate and interact with the users. [26] stated that user interface model of ITS is the part that explain learners' ideas through speech, text and pictures. User interface module promotes ease of use of the software, incorporates dialogues, and ensures that the dialogue is adaptive and also ensures that the dialog possesses an effective screen design with varieties of interaction styles. The schematic diagram of this developed ITS is presented in Figure1.

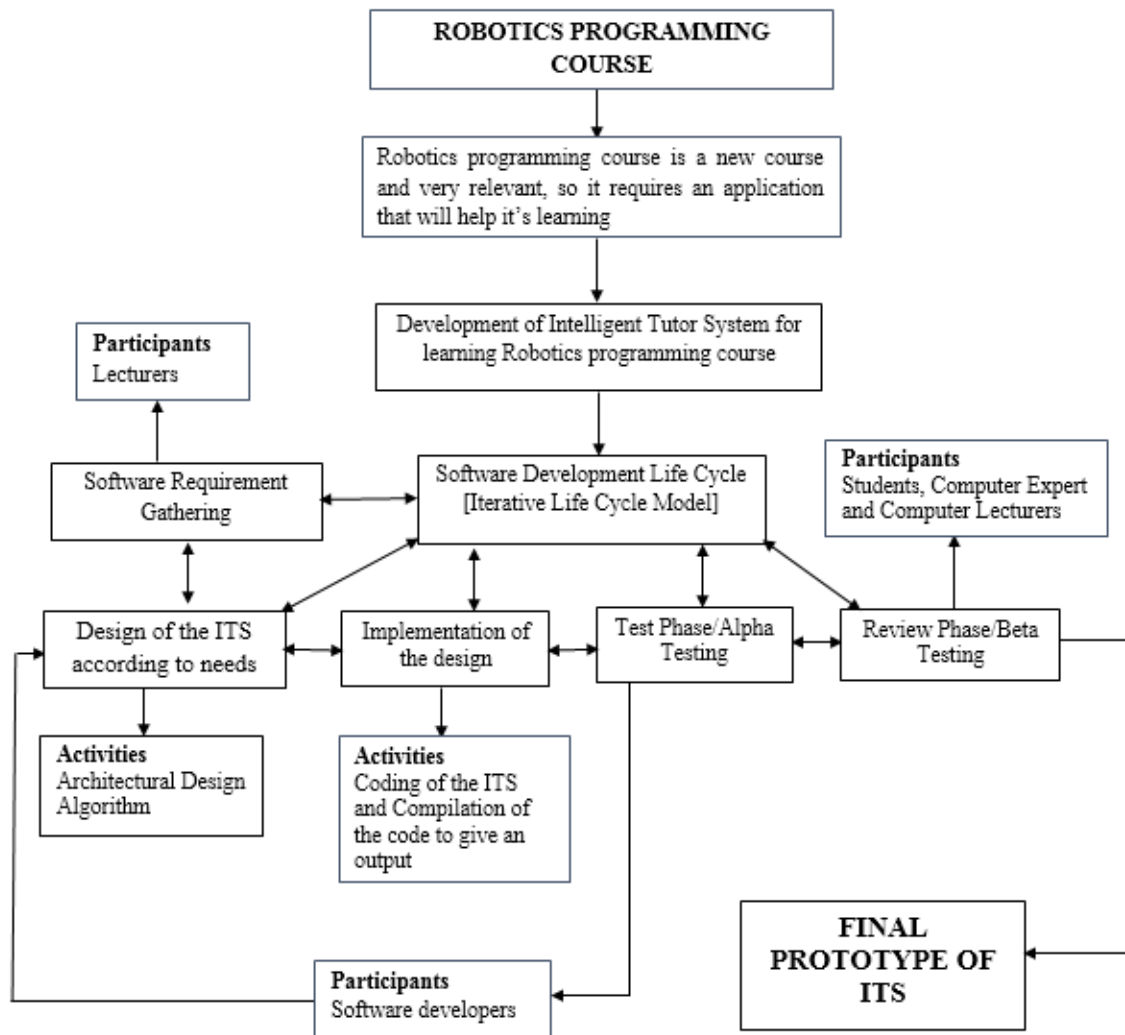


Figure 1. Schematic diagram of a Robotic programming course Intelligent Tutor System

## 5. Evaluation

Evaluation is evaluating of design, integrating the results of the initiative for decision-making and learning. *Evaluation is knowing the gain and the effect; evaluation is an outcome of the process.* **Student profile have the details about the student and it enables them to use ITS; student should have an account such as session, ITS date that it was used. Students: name, number, score, over-all score. Student will login to its environment. There is course content in the ITS. The students now select the contents to learn and write the quiz base on what they learnt and the students can't go the next content without passing the first content. The result of the student is gotten and used to evaluate the student performance on the use of the ITS for learning Robotics Programming Course.** It is important that we state what students' needs to learn, and how it will be evaluated. It is also important to know the students' levels on previous knowledge and recognize that students have diverse learning styles and preferences [21]

### 5.1. Statement of the Problem

Robotics programming is a new course done by students of Robotics and Computer Education owing to the global shift in the way teaching and learning is conducted in the 21<sup>st</sup> century. With personalized learning, student now learn wherever they are and what ever device they have access to. Robotics programming is not all about using developed Robotics devices, rather it is majorly about solving problems, unfortunately the course Robotics programming is a new course and lecturers do not want students to face difficulties in transforming abstract problems into a workable solution which has negatively affected students' motivation in learning other programming courses. The difficulties students face in transforming abstract problems into a workable solution has resulted into having many graduates in computing disciplines who cannot use a programming language to develop a software that can be used to solve a problem and as such, many graduates in computing disciplines are not able to get jobs into the software industries where a high level of programming

skills is required. In Nigeria, the opportunity to learn programming outside the university is very expensive and not affordable to the common students. The above problems have become a thing of concern, and an immediate solution needs to be done so as to enhance the tutoring as well as learning Robotics programming in Tertiary Institutions. However, advancement in technology has led to the development of intelligent tutor system to teach complex tasks. Developed countries and some universities in Nigeria have been using the tutor and these tutors offer more personalized learning, provides immediate feedback and customized to meet the learning pace of each student. Although, Intelligent Tutor System has not been developed for teaching Robotics programming in Nigeria using Computer and Robotics Education curriculum, its need is becoming imperative. The increasing demand for skilled programmers in Robotics programming makes it imperative for researchers in education to develop a more effective way of teaching Robotics programming as a new course and other programming courses to Nigerian students. Hence, this has led the researcher to evaluate the developed Intelligent Tutor System as a means of solving problems will be encounter in learning Robotics programming course in Tertiary Institution South East Nigeria.

## 5.2. Purpose of the study

The major aim of this research is to evaluate a developed Intelligent Tutor System for learning Robotic programming course in South East Tertiary Institutions. Particularly, study seeks to determine the:

1. lecturer review on Subject Content on the developed Intelligent Tutor System (RPITS)
2. Student Response on the use of developed Robotic Programming course Intelligent Tutor System (RPITS)

## 5.3. Research Questions

1. What are the lecturers review on the Subject Content of the developed Intelligent Tutor System (RPITS)?
2. What are the Students Response on the use of developed Robotic Programming course Intelligent Tutor System (RPITS)?

## 5.4. Hypothesis

**Ho<sub>1</sub>:** There was no significance differences in the responses of 2<sup>nd</sup> Year students of nwafor orizu college of education nsugbe, Alvan Ikoku's Colleges of Education and University of Nigeria; Nsukka on their learning experience using the developed intelligent tutor system.

## 5.5. Methodology

This study "Evaluation of a developed intelligent tutor

system for leaning robotic programming course in tertiary institution South East, Nigeria" was done in three tertiary institutions in South East, Nigeria, Tertiary Institutions are Nwafor Orizu College of Education Nsugbe, Alvan Ikoku's Colleges of Education and University of Nigeria; Nsukka. 120 students also formed the population that was used to evaluate the ITS. The total sampling techniques was adopted because the population size is manageable so the author studied all. Reliability of the instrument were tested using cronbach-alpha co-efficient. The result gotten was 0.89. 120 students answered the student personalized questionnaire based on their experience on the use of the ITS while 20 lecturers evaluated the subject content of the ITS. Data gathered was analyzed using statistical package for social science. statistical package for social science. Mean answered the reasearch questions, the rule of decision for research questions is based on the cut-off point of 3.0 on a 5.0-point Likert scale. Items with cutoff point below 4.5 in research question one was named as Excellent, 3.5 is very good anything less than 3.5 is poor. Meanwhile, hypothesis formulated for this study was tested at 0.05 significance level with (ANOVA) Analyses of Variance. ANOVA deals with two or more groups so it is appropriate for this study. Significant "sig (2-tailed)" level less than or equal to the stated .05 significance level were not accepted but significance "sig (2-tailed)" level is greater than .05 significance level, the ITS was upheld. SPSS is a widely used program for *statistical analysis in social science*. It is also used by education researchers and health researchers. SPSS bridge the gap between data science and data understanding. It analyzes scientific data related with social science

## 6. Results

### Research question 1

1. What are the lecturers' review on the Subject Content of the developed Intelligent Tutor System (RPITS)?

The data for answering this research question were presented in three tables based on result of the subject content of the Intelligent Tutor System

Table 1 showed the results of the subject content validation during the on the lecturer's review on the Subject Content of the developed Intelligent Tutor System for learning robotics programming. The table revealed that the eight items considered for the on the Subject Content of the Intelligent Tutor System ranged from Very Good to Excellent. The mean scores of the items ranged between 4.13 to 4.94. The overall rating of ITS in subject content validation is Very Good with a mean score of 4.31. All the items on subject content of the developed ITS for learning Robotics Programming is above the cutoff point so all the items are accepted as the robotics programming subject contents. The alpha coefficient can be gotten using

Cronbach Alpha coefficient from Statistical Package for social science.

**Table 1.** Results on the lecturer's review on Subject Content on the developed Intelligent Tutor System (RPITS)

S/No	Items	$\bar{X}$	Std. Deviation	Remarks
1	Content organization and presentation	4.26	0.78	Very Good
2	The use of English, grammar and appropriateness of word	4.13	0.50	Very Good
3	Learning task organization.	4.27	0.72	Very Good
4	Clarity in explaining concepts	3.84	0.68	Very Good
5	Appropriateness of images to course content	4.31	0.60	Very Good
6	Addition of videos to course content	4.13	0.34	Very Good
7	Addition of animations to content	4.63	0.50	Excellent
8	Inclusion of test quiz to content	4.06	0.25	Very Good
	Overall rating	4.31	0.51	Very Good

Key: Mean=  $\bar{X}$ , SD: Standard Deviation

### Research Question 2

- What are the Students Response on the use of developed Robotic Programming Intelligent Tutor System (RPITS)?

Table 2 showed the Students Personalized response on the use of developed Robotics Programming System. All the 10 items have mean scores between 4.24 to 4.44 which means all the items are ranged as very good. The overall rating of RPITS in students personalized response is very good with an overall mean score of 4.32. All the items on students personalized experience on the developed ITS for learning Robotics Programming is above the cutoff point so the students experience were rated excellent. The alpha

coefficient can be gotten using Cronbach Alpha coefficient from Statistical Package for social science

**Table 2.** Result on Students Personalized response on use in d Robotics Programming System.

S/No	Items	$\bar{X}$	Std. Deviation	Remarks
1	Flexibility on the use of RPITS	4.30	0.61	Very Good
2	Motivation on learning Robotic Programming through the RPITS	4.34	0.63	Very Good
3	Adequate organization of the contents of RPITS	4.26	0.63	Very Good
4	Understanding of the teachings and illustrations of RPITS	4.32	0.65	Very Good
5	Easy learning and understanding of robotics programming through RPITS	4.32	0.55	Very Good
6	User friendliness of the RPITS	4.26	0.53	Very Good
7	Color and Graphic quality of the RPITS	4.28	0.67	Very Good
8	Simplicity of the videos in the learning process of Robotic Programming	4.24	0.66	Very Good
9	Adequacy of response time	4.44	0.56	Very Good
10	Helpfulness and Reliability of RPITS in learning Robotic programming	3.99	0.67	Very Good
	TotalMS	3.99	0.54	Very Good

Key: Mean=  $\bar{X}$ , SD= Standard Deviation

### Hypothesis

**Ho<sub>1</sub>:** There was no significance differences in the responses of 2<sup>nd</sup> Year students of Nwafor Orizu College of Education Nsugbe, Alvan Ikoku's Colleges of Education and University of Nigeria; Nsukka on their learning experience using the developed intelligent tutor system.

The data generated from the hypothesis testing is shown in Table 3.

**Table 3.** Analysis of Variance (ANOVA) of students' response on their learning experiences using the developed Intelligent Tutor System for learning Robotic programming course.

	Sum of Squares	Df	Mean-Squares	F value	Sig-Value	Remark
Between Group	0.489	3	0.163	1.167	0.336	Not significant
Within Groups	5.025	36	0.140			
Total	5.514	39				

Key: Degree of Freedom=DF

Table 3 shows the F-calculated values on the responses of second year students of Nwafor college of Education Nsugbe, Alvan Ikoku's colleges of Education Imo and University of Nigeria; Nsukka. F-calculated is 1.17 with a significant of F at 0.336 which is greater than .05 significance level. Therefore, hypothesis is upheld. The finding presented in Table three implies that the no significance differences in the responses of second year student of Nwafor Orizu Colleges of Education Nsugbe, Alvan Ikoku's Colleges of Education and University of Nigeria; Nsukka on their learning experiences using the developed Intelligent Tutor System

## 7. Discussion of the Findings

The finding on Table 1 and 2 showed the result of the ITS by the lecturers and students in subject content questionnaire and student personalized questionnaire. Teachers review in subject content questionnaire shows that ITS is in line with the design. Rating of the students showed that their learning experiences on the use of ITS in-learning Robotics programming was rated as very good/Excellent. This is in line with the opinion of [30] who noted that ITS content and communication with students are the educational important of the ITS & the feature that differentiates ITS from traditional medias e.g. television. Findings from hypothesis presented in the Analysis of Variance (ANOVA) in 3<sup>rd</sup> table showed the no significance difference in the mean responses of second year students of Alvan Ikoku's Colleges of Education; Nwafor Orizu Colleges of Education Nsugbe and University of Nigeria; Nsukka. This finding agrees to VanLehn [31] which said that humans tutor, step-based tutor, & sub step-base tutor provides enough feedbacks to get student to self-generate corrects solution for problem the Author stated that the feedbacks in classroom using ITS helps students check the skills/knowledge. the instructor examines and provides ITS for student to use when solving a problem. Findings agrees with literature saying that teachers to adopt educational applications of artificial intelligence and machine learning technologies and other computer simulated tutors for teaching and learning of complex and practical skills, and have shown great potential to catalyze and support effective learning, by determining the nature of the scheme of the individual learners, and then attempting to provide the type of problem, analogies, and explanation that will be best for the learner in developing learners heuristic skills to solve non-trivial problem.

## 8. Conclusions

This study is on Evaluation of a developed Intelligent Tutor system for learning Robotic programming course South East, Nigeria institutions. The developed ITS was used to obtain students learning experiences through the

students personalized response validation while using the developed ITS for-learning Robotics programming course. The finding from the study showed that students were motivated, there was flexibility, there was easy understanding and learning of Robotics programming course through the developed ITS.

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