Assessment of an Intelligent Tutor System for Learning Robotics Programming Courses in Tertiary Institutions in Nigeria

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Abstract: This study is on assessment of an intelligent tutor system for learning Robotics programming courses in Nigeria Tertiary Institutions. The study purpose was to evaluate the developed intelligent tutor system for learning Robotics programming courses in tertiary institutions, two specific objectives and 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 ITS package was developed as web based using HTML, CSS, JavaScript and PHP. The population of the study is 120 students and three schools were used. The 120 students also formed the population that was used to evaluate the ITS. The total sampling techniques was used while the reliabilities of instrumensts were tested with Cronbach-alpha coefficient. Result gotten is 0.89 mean answered research questions and tested the hypothesis that guided the study. Furthermore, the findings on hypothesis tested shows 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 and teachers should engage students in practical use of the developed ITS in teaching Robotics programmming courses for increased learner motivation and performance.

INTRODUCTION

Programming is the act of writing computer programs which are sequence of instructions written using computer programming language to perform a specified task by the computer. Yatim[1] 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 a platform to showcase creativity, especially in problem-solving, entertainment, developing new video games, graphics and animations to showcase new business ideas or to resolve a particular problem[2]. Programming in Nigerian tertiary institutions is geared towards impacting students with the knowledge and skills of problem solving[2].

Programming is one of the major courses taught to students in computing disciplines in Nigerian Tertiary Institution and has become parts of Computer Education[2]. 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 vain, Ismail *et al*.[3] said that in the teaching of programming in Nigerian tertiary institution, students will be introduced to the introduction programming, they will be exposed to analyze problems, make use of techniques to represent the issues, solution and approve the solution. The researcher further stated that students are meant to find solution to the problem 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[3].

However, the problem identified in teaching programming has to do with the student population[4]. 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. However, Olalekan 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.

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. Mehmet stated that Robotics programming is use to perform autonomous task. Many software and frameworks have been proposed to make programming robot easier. Sewall[5], 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. Robotic programing a new course that needs an alternative teaching method that will make robotics programming easy for students in learning learning can be seen as a way of getting, modifying existing behaviors[6]. Kimble[7] stated that learning develops socially accepted behaviors and also there is an equal chance of building negatives side of human behavior. The reseacher further stated that learning is a process which occupies an important role in molding the structure of our personality and behaviors. Kingsley[8] stated that learning necessitates to meet some personal needs as it is a purposeful and goal oriented. The conventional method of learning have been used extensive and have progressed very slowly and might be ineffective for addressing various knowledge styles and levels of training[9]. Personalized learning seeks to accelerate student learning by tailoring the instructional environment such as what when how and where students learn to address the individual needs, skills and interests of each student[10]. Therefore, personalized learning is a dynamic learning opportunity that provides students with content that addresses their personal learning needs based on their interests, parental input and teacher observation as well as assessment data which is the most important element. Many application developers and education experts have been exploring Smartphone, tablet and intelligent tutor system applications as a software package for personalized learning[11].

Learning systems and solutions take account of attributes such as learning effectiveness, learning efficiency and learner engagement. All of these stands as parameters to play in forming a proper insight into the learning experience and its usefulness. Evaluating robotics programming course intelligent tutor system has largely focused on evaluating the correctness of recommendation 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 student's personalized response on their experience on the use of Robotics programming course tutor system is statistically accurate and simple to analyze, it means that the student's performance during the experiment is not significantly different to another time user might carry out the experiment. The student's experience with the software is positively interrelated with having a positive student's experience[12], resulting in potential bias. In this study, methods of evaluation of the systems themselves include how users find the system's reliability, security, efficiency.

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 sec 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.

Intelligent Tutor System (ITS) delivers numerous of the benefits of a human instructor to very large numbers of students McLoughlin[13]. Lee[14] asserted that ITS are software capable of interpreting complex student responses and also learn as they work, they are able to distinguish where and why a student's understanding has gone amiss and also give it hints to aid the student's understanding of the material. Ma et al.[15] explained that Intelligent tutor system can also deliver realtime data to instructors and developers looking to enhance their teaching style. According to Ma et al.[15], intelligent tutor system is a computer program that access learner's mindset to provide self-learning. Intelligent tutor system is a computer software designed to simulate a human instructor's skills behavior and guidance[16]. This system presents educational resources in a exible and personalized way. Because educational institutions cannot allocate a human tutor to all students, intelligent tutoring system is a useful alternative platform to give any student personalized guild [17]. Almurshidi and Naser further stated that ITS are more advanced, allowing students to enhance their understanding by finishing tasks as part of the interactive lecture environment. Intelligent tutor system can transform teaching strategies; give explanations, examples, demonstrations and practical exercises where needed[18].

Intelligent tutor system is more advanced and allows students to improve their skills by completing tasks as part of the interactive lecture hall environment. Intelligent tutor system as opposed to other educational technologies, is to assess each student's response in order to assess his/her knowledge and networking skills[17]. Intelligent tutor system is a software designed to be same to teacher's behavior in teaching. ITS can also help student study subjects by series of lessons, questions on each lesson and given instructions with feedback. The ITS makes a profile for students and estimate the student level of skills/knowlegde. The system can change its tutoring behavior in real-time. 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 development of ITS for-learning Robotics programming courses in Nigerian tertiary institutions will provide one-on-one private training and tutoring in Robotics programming courses it will also provide personalized learning. The developed ITS

contains 4 component 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[18] domain modeling is a technique to encode domain knowledge such as concepts, rules and procedures, facilitating their use in computer systems. The researcher 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 Roy and Basu, deals with "what to teach". Bhattacharya, etc. also stated that document and material needed to teach learners are in the domain module.

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 name, number, score, overall score and difficult number during each lesson[19]. Score represents the student's score for the level. The student 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[19], student modeling is a technique used to understand students including their knowledge level and their behaviors and their emotions; it provides a computer-interpretable representations to the system. The student module contains the knowledge, motivate state happening at the course of learning. Gross et al.[20], stated that student model stores information about learners and their actions.

The teaching or instructional or tutoring model inputs the domain and student models and choose learning techniques on what the software will do next[20]. Gross et al.[20] also stated that the teaching model implements feedback principles and provides example-based feedback in order to help students reflect on their solutions, find mistakes and give explanations on how to solve a given problem. The teaching model provides an intelligent representation of educational material such as degree of backward knowledge, desirable detail level, assessments of the system on the level of student's acquaintance with the matter being currently taught[20]. The system recognizes when the learner has deviated from the production rules of the model and provides timely feedback for the learner which results in a shorter period of time to reach proficiency with the targeted skills.

The user interface model is the interacting front end of the intelligent tutor system which include information required to communicate with the students with text, pictures, audios and videos[20]. According to Yue[19] user interface model works as a presentational tier that blends services together in order to interact and communicate

with the user. Robert *et al.*[21] 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.

Assessment 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. Students 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 to 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 define what the students need to learn and also how this will be evaluated. It is also essential to know the student's level of previous knowledge and recognize that students have diverse learning styles and preferences[22].

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 21st 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 student's 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 develop an intelligent tutor system as a means of solving problems will be encounter in the teaching and learning of Robotics programming in Tertiary Institution Nigeria.

Purpose of the study: The major purpose of this study is to assess the intelligent tutor system for learning robotics programming course in tertiary institutions. Particularly, study seeks to determine the

- Lecturer review on subject content on the developed Intelligent Tutor System (RPITS)
- Student response on the use of developed Robotic Programming Intelligent Tutor System (RPITS)

Research questions:
- What are the lecturers review on the subject content of the developed Intelligent Tutor System (RPITS)?
- What are the Students Response on the use of developed Robotic Programming Intelligent Tutor System (RPITS)?

Hypothesis
- H_{O1}: there was no significance differences in the responses of 2nd Year students of Nwafor Orizu College of Education Nsugbe, AlvanIkoku College of Education and University of Nigeria Nsukkaon their learning experience using the developed intelligent tutor system

MATERIALS AND METHODS

This study "Evaluation of intelligent tutor system for leaning robotics programming course in Nigeria tertiary institutions". Study was done in three Nigeria tertiary

institutions, The Institutions are Nwa for Orizu College of Education Nsugbe, AlvanIkoku College of Education and University of Nigeria Nsukka. The 120 students also formed the population that was used to evaluate the ITS. The total sampling techniques was adopted. Reliability of the instrument were tested using Cronbach-alpha co-effiecient. The result gotten was 0.89. 120 students answered the student personalized questionaire based on their experience on the use of the ITS while 20 lecturers evaluated the subject content of the ITS. Data gathered was analyzed suing statistical package for social science. Mean answered the research 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 <3.5 is poor.

Meanwhile, hypothesis formulated for the study was tested at 0.05 significance level with (ANOVA) Analyses of Variance Significance "sig (2-tailed)" level less than or equal to the stated 0.05 significance level were not accepted but significance "sig (2-tailed)" level is <0.05 significance level, the ITS was upheld.

RESULTS AND DISCUSSION

Research question one:
- 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 result of the subject content validation during the on the lecturer's review on the subject content of the developed intelligent tutor system. 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 4.13-4.94. The overall rating of ITS in subject content validation is very good with a mean score of 4.31.

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 4.24-4.44 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.

Hypothesis:
H_{OI}: there was no significance differences in the responses of 2nd Year students of Nwafor Orizu College of Education Nsugbe, AlvanIkoku College 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 1: Results on the lecturer's review on subject content on the developed Intelligent Tutor System (RPITS)

Items	$\bar{X}$	SD	Remarks
Content organization and presentation	4.26	0.78	Very good
The use of English, grammar and appropriateness of word	4.13	0.50	Very good
Learning task organization	4.27	0.72	Very good
Clarity in explaining concepts	3.84	0.68	Very good
Appropriateness of images to course content	4.31	0.60	Very good
Addition of videos to course content	4.13	0.34	Very good
Addition of animations to content	4.63	0.50	Excellent
Inclusion of test quiz to content	4.06	0.25	Very good
Overall rating	4.31	0.51	Very good

Table 2: Result on students personalized response on use in d robotics programming system

Items	$\bar{X}$	SD	Remarks
Flexibility on the use of RPITS	4.30	0.61	Very good
Motivation on learning Robotic Programming through the RPITS	4.34	0.63	Very good
Adequate organization of the contents of RPITS	4.26	0.63	Very good
Understanding of the teachings and illustrations of RPITS	4.32	0.65	Very good
Easy learning and understanding of robotics programming through RPITS	4.32	0.55	Very good
User friendliness of the RPITS	4.26	0.53	Very good
Color and graphic quality of the RPITS	4.28	0.67	Very good
Simplicity of the videos in the learning process of robotic programming	4.24	0.66	Very good
Adequacy of response time	4.44	0.56	Very good
Helpfulness and reliability of RPITS in learning robotic programming	3.99	0.67	Very good
Total MS	3.99	0.54	Very good

Table 3: Analysis of Variance (ANOVA) of student's response on their learning experiences using the developed intelligent tutor system for learning robotic programming

Groups	Sum of square	df	Mean-square	f-value	Sig-value	Remark
Between	0.489	3	0.163	1.167	0.336	Not significant
Within	5.025	36	0.140			
Total	5.514	39				

Table 3 shows the F-calculated values on the responses of second year students of Nwafor college of Education Nsugbe, University of Nigeria, Nsukka and Alvanikoku College of Education Owerri. F-calculated is 1.167 with a significance of f at 0.336 which is >0.05 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 College of Education Nsugbe, Alvan Ikoku College of Education and University of Nigeria Nsukka on their learning experiences using the developed intelligent tutor system.

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. This is in line with the opinion by Vannucci and Colla[23] who noted that ITS contents and communication with the students are the point of educational ITS and the features that differentiate them from traditional media such as television.

Findings from the hypotheses presented in the Analysis of Variance (ANOVA) in Table 3 showed that there was no significant difference in the mean responses of second year students of Nwa for Orizu College of Education Nsugbe, Alvan Ikoku College of Education and University of Nigeria Nsukka. This finding agrees with VanLehn[24] that human tutors, step-based tutors and sub step-based tutors all provide enough scaffolding and feedback to get students to self-generate correct solutions for most problems the researcher stated that the feedback 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 schemes of the individual learner and then attempting to provide the types of problems, analogies and explanations that will best fit with the learner in developing the learners heuristics skills to solve non-trivial problems.

CONCLUSION

This study is on assessment of an intelligent tutor system for learning robotics programming courses in Nigeria tertiary. 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. The finding from the study showed that students were motivated, there was flexibility, there was easy understanding and learning of Robotics programming through the developed ITS.

RECOMMENDATIONS

Intelligent tutor should be adopted by the Federal Ministry of Education for teaching computer programming courses in Nigerian tertiary institutions. The developed intelligent tutor should be adopted Universities and other curriculum development agencies the use of interactive and simulated tutors for teaching computer programming in Nigerian schools. Curriculum development agencies should set up curriculum review committee that will use the module contents of the intelligent tutor for modification of existing computer programming curriculum contents in Nigerian schools. Software companies should adopt the developed intelligent tutor in this study for the training and retraining of their staff in order to equip them with current knowledge and skills of programming in Robotics.

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