Adoption of Expert Systems in Nigerian Tertiary Institutions; Benefits, Issues and Challenges

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***Abstract*— *In a rapidly evolving world, there arises a need for inclusion of ICT and its associated technologies in the bid to conform to global practices and adapt to changing times with the sole aim of reaping the benefits that accompanies positive change. The benefits associated with the use of computers in education are tremendous, be it e-learning, computer aided education, computer-based education or expert systems in the form of intelligent tutorial systems. The study highlighted the benefits, issues and challenges confronting the adoption of expert systems in tertiary education in Nigerian. The study adopted two methods, an experimental approach and a descriptive methodology. The result of the research showed a significant positive difference in the academic performance of the students when an educational expert system was introduced in their teaching and learning process. Major benefits of adoption of educational expert systems in teaching and learning in Nigerian tertiary educational system included reduced dependence on human resources, and around the clock availability of the system. Challenges identified from the study amongst others included high cost of implementing expert systems, lack of basic support infrastructures, lack of technical knowledge and unwillingness to adopt change. The study finally highlighted the issues confronting adoption of expert systems in education to include among others, inability of the system to sustain dialogue with users, inability to impact deep learning and inability to adapt to different emotional situations of its users.*

***Keywords*— Intelligent tutorial systems, Expert Systems, Tertiary Educational Systems, Issues, Benefits, Challenges.**

I INTRODUCTION

Expert systems are computer software that attempt to behave like a human expert on a particular subject area. It uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted [1]. Expert systems involve the study and design of systems or computer systems that represents, behaves and reasons with expert knowledge in some specialist subject with the view to solving problems or giving advice in areas where human expertise is falling short [2]. The systems are centralized on the use of knowledge base (collection of reliable expertly gathered facts, pertain ng a particular subject area which can be formally represented in form of cases, frames, patterns, rules and semantic networks) [3]. In education, expert systems have been used in the form of intelligent tutorial systems; these systems assist students in their learning by using adaptive techniques to personalize with the environment, prior knowledge of the student and student's ability to learn. Computer tutoring according to [8], is a late development in the long history of tutoring in education. Whereas human tutoring has been used in schools for 2,500 years—or for as long as schools have existed—computer tutoring is largely a product of the past half century. The first computer tutoring systems to be used in school classrooms (e.g., R. C. Atkinson, 1968; Suppes & Morningstar, 1969) showed the influence of the programmed instruction movement of the time: They presented instruction in short segments or frames, asked questions frequently during instruction, and provided immediate feedback on answers (Crowder, 1959; Skinner, 1958). A different type of computer tutoring system appeared in research laboratories and According to [4], expert systems are beneficial as a teaching tool, because it is equipped with the unique feature that allows users to ask questions on "how", "why" and "what" format. When used in the classroom environment, surely expert systems will give many benefits to students as it prepares the answers without referring to the teacher. Expert systems in addition to providing logical reasons towards a given answer, provides excellent alternatives to private tutorial. According to [7], Expert systems in education otherwise called intelligent tutoring systems, or ITS, are computer programs that model students' psychological states as well as their prior knowledge to personalize instruction for them. As students interact with them, the programs collect

data about how the students approach each problem, when they are likely to get frustrated, and so on. The system evolves in response to the people who use it, to improve the lessons and assessments it presents.

The broad aim of the study was to determine the benefits as well as issues and challenges confronting the adoption of expert systems in teaching and learning in Nigerian tertiary institutions. The specific objectives however include:

- To carry out an experiment to determine the effects of adoption of expert system on students and teachers in tertiary institutions in Nigeria.
- To carry out a survey in other to identify the benefits, issues as well as challenges facing the adoption of expert systems in tertiary institutions in Nigeria. In the course of this research, efforts were geared towards providing answers to the following research questions:
- Is there a significant difference in the academic achievements of students who use the educational expert system?
- What are the benefits of the adoption of educational expert systems?
- What issues and challenges confront the adoption of expert systems in teaching and learning in Nigerian tertiary institutions?

II RELATED WORK

"Any skill that a computer can teach is going to be done by a computer in the workplace, and that's something people don't think about enough," said Christopher Dede, an education and technology professor at the Harvard Graduate School of Education. For that reason, he said, teachers can use computer programs not simply to replace pieces of their instruction, but to model for students how to work with technology professionally. "It changes the skills people need to be employed. AI changes teaching, yes, but more important than that, AI changes the goals and purposes of teaching," Dede said.

[1] states that the use of expert systems as a tool in the teaching and learning process in the Nigerian educational system is very much desirable as it will facilitate the teaching and learning process. In developed countries, they further stated that expert systems are very useful in teaching courses such as engineering, mathematics, earth science and distance tutorial lessons. Expert systems have been adopted in advanced country in teaching, military training and even in special needs education. [9] has summarized common beliefs about the effectiveness of different types of tutoring. According to [9], CAI tutors are generally believed to boost examination scores by 0.3 standard deviations over usual levels, or from the 50th to the 62nd percentile. ITSs are thought to be more effective, raising test performance by about 1 standard deviation, or from the 50th to the 84th percentile.

[7] submitted that "In the intelligent tutorial system, you have a conversation, and the tutor-machine knows an awful lot about your background in the course and can build on that in a way you can't in a regular classroom," said J.D. Fletcher, a researcher with the Institute of Defense Analyses and a primary developer of the U.S. Navy's Digital Tutor ITS, which is used to train Navy staff for technical jobs in the force, such as troubleshooting systems on a ship. "Some of your kids will take one day what it takes others four days to learn. In a traditional classroom, the fast students are left twiddling their thumbs. ... If you have [an ITS] engaging in a conversation with you, the tutor can just keep piling on the questions to you that are progressively more difficult." Such tutoring systems have had mixed effectiveness over the years, but more recent programs have shown significant promise.

A 2014 meta-analysis of several different ITS, discovered that they were as effective in helping students in learning, as a person leading one-to-one or small-group instruction, and more effective than full-sized teacher-led classes, workbooks or textbooks, or traditional computer-based instruction [7]. A separate evaluation of the Navy's intelligent- tutoring system found those who used it outperformed those using standard technical training—not just on other tests, but also on practical troubleshooting exercises. Navy staff who had been trained using the tutoring program also attempted more challenging problems and tasks than students who had been trained in other ways [7].

Nigeria cannot afford to be left behind in the adoption of computer aided instruction in teaching and learning. Expert systems have a lot of benefits especially to the students, trainers and educational institutions [1].

III METHODOLOGY

Two methods were adopted in the study;

Case Study Approach: A field and case study was carried out at Imo State University, Owerri. In this study, data were collected in other to determine the benefits, issues and challenges facing the adoption of educational expert systems in teaching and learning in Nigeria tertiary institutions.

Experimental Approach: This method was adopted to help determine the academic achievement of the students when an intelligent tutorial system (expert system) was adopted in Nigerian tertiary institutions.

A POPULATION OF THE STUDY

Population of the study comprised of 100 level students' in Nigerian universities.

B SAMPLE SIZE/SAMPLING TECHNIQUES

Fifty 100 level students from the school of sciences, Imo state university Owerri were purposively sampled.

C DATA COLLECTION

1. Primary data was collected using:

a. A 10-point test question: This question paper enabled the researcher to test the students and collect scores in other to ascertain the academic achievement rates of the students when expert systems were adopted in teaching and learning.

b. Structured Questionnaires: The questionnaires were designed to enable the researcher identify the benefits, issues and challenges facing adoption of expert systems in teaching and learning. A modified four-point-Likert was used in rating the questionnaires responses.

Secondary data were collected from reviews of related literature.

D METHOD OF DATA ANALYSIS

Test scores of the experimental and control groups were analyzed using Analysis of Variance(ANOVA), R programming for statistical analysis was the package used to run the analysis. Questionnaire responses were analyzed using descriptive statistics (frequency distributions and percentages).

E EXPERIMENTAL PROCEDURE

The fifty (50) sampled first year students from the school of sciences were divided into two groups of twenty-five (25) students each. The two groups were labeled groups A and B. Group A were the experimental group while group B were the control group.

Both groups were merged and taught Differentiation and Integration, a topic in mathematics. At the end of the lecture, a test was administered to the students and their scores recorded (pre-test). The groups A and B were split; the student's in group A were given access to the mathematical expert system (intelligent tutorial system) that was programmed to teach Differentiation and Integration, installed to their systems; while the control group (group B) were given tutorial CDs on the same subject area to study with. The experiment lasted for 7 days, at the end of which a second test was administered to the groups (post-test) and scored recorded. The test scores were subjected to Analysis of Variance, where the means of the experimental and control groups test scores were compared to identify significant differences in the performance of the two groups. The results of the analysis are seen below.

Between experimental group... pre-and post

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Test	1	225.2	225.18	48.59	9.05e-09 ***
Residuals	47	217.8	4.63		

Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05
'.' 0.1 ' ' 1

Between control group..... pre-and post

	Df	Sum Sq	Mean Sq	F value	Pr(>F) L
Test	1	22.82	22.82	3.841	0.056
Residuals	47	279.19	5.94		

Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05
'.' 0.1 ' ' 1

The p value is the one highlighted in yellow.

There was a significant difference between the means of the Experimental groups, as seen by Pvalue of 0.00000000905, represented in the scientific notation 9.05e-09, which is highly significant. This shows that there is a very high significance in the pretest and post test scores of the experimental group. The result denotes that use of expert systems significantly improved the performance and achievement rate of the students in the experimental group.

The means of the control groups had a pvalue of 0.056 which is on the borderline. This means that there was a near-significant difference. Though there was an improvement in test scores after using tutorial CDs to study the topic, the improvement wasn't significant.

On interview, the students in the control group stated that the tutorial CDs didn't provide them with the dynamism and fluid synergy the required. They could not receive feedback nor ask questions and receive answers. To further illustrate the, mean columns and sum of scores bars were implored to further buttress the point.

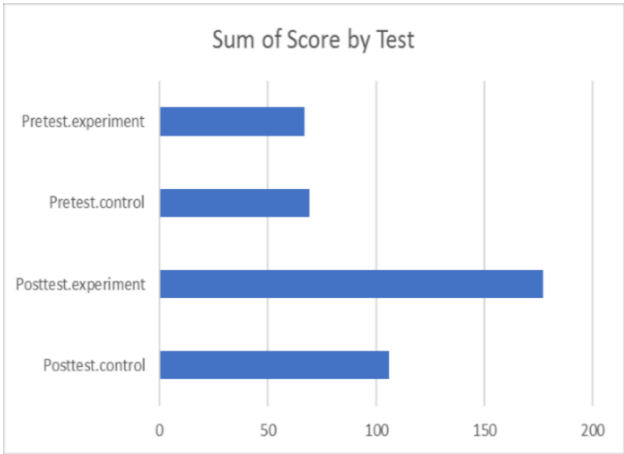

Figure 1. Mean Columns comparing the means of each group.
Source; Field data,2016

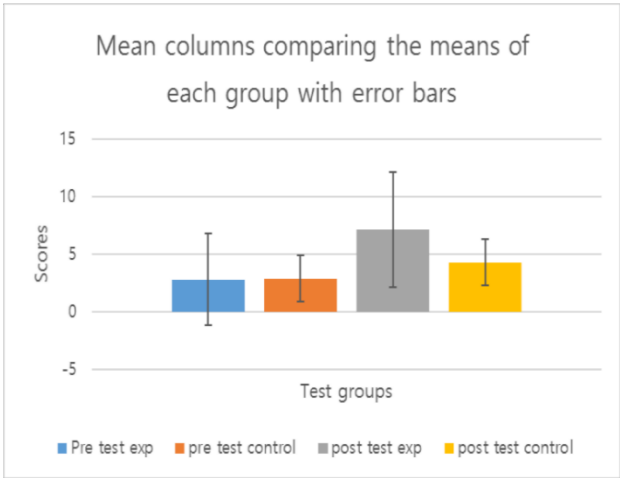

Figure 2: Sum of Score bar
Source: Field data, 2016.

The mean columns and sum of score bars both show no significant difference in performance of students in both groups during PreTest. But after treatment had been administered (in this case Introduction of expert systems for the experimental group and use of tutorial CDs by the control group), it is observed from both charts that there is a significant difference in performance rate of the two groups as it is seen that the experimental group performed significantly better than the control group hence having higher achievement rate.

IV RESULTS OF DESCRIPTIVE SURVEY

n = 25 (number of sampled students in experimental group)

Table 3: Benefits of Adopting Expert Systems in Education

S/N	BENEFITS	FREQUENCY	PERCENTAGE (%)
1.	All-round availability	25	100
2.	Reduces students' dependence on human resources	22	88
3.	Provision of immediate feedback	25	100
4.	Ensures on-demand hints	21	84
5.	Supports mastering and learning	20	80
6.	Improves students achievement rate	19	76
7.	Enables instructors to create personalized programs and modules for learners	18	72

Source: Field Data, Nov. 2016

Respondents in Table 3 identified several benefits in adopting educational expert systems in Nigerian tertiary institutions.
These benefits include around the clock availability (100%),
providing immediate feedback to users (100%), reduction of
dependence on human resources (88%), ensures on-demand hints (84%), supporting mastering and learning in users (80%), improves students' performance and achievement rates (76%) and finally, enables creation of individualized programs and modules for learners (72%).

Table 4: Challenges confronting the adoption of expert systems in Educations

S/N	CHALLENGES	FREQUENCY	PERCENTAGE (%)
1.	Poor awareness of the technology	19	76
2.	Reluctance to embrace new technology	24	96
3.	High cost of purchasing software	22	88
4.	Poor support infrastructure	25	100
5.	Lack of technical know-how	21	84
6.	It is very difficult to justify to management and administrative staff why adoption of expert systems is beneficial to teaching and learning.	25	100

Source: Field Data, Nov. 2016

Table 4 above shows that challenges facing the adoption of expert systems in Education in Nigeria Universities include: poor support infrastructures (100%) like power supply, hardware, software, and internet access. Other challenges identified include: difficulty in convincing management to implement expert systems (100%), reluctance of both learners and educators to embrace new technologies (96%), high cost of implementing the expert system (88%), lack of technical knowledge of how to use the system effectively (84%) and finally, lack of awareness of the concept and technology of educational expert system (76%).

Table 5: Issues/Pitfalls of adopting expert systems in Education

S/N	ISSUES	FREQUENCY	PERCENTAGE (%)
1.	Failure to achieve deep learning in users	23	92
2.	Inability to interpret and adapt to different emotional conditions	20	80
3.	Can be time consuming using the system	15	60
4.	Inability to initiate and sustain dialog and feedback	25	100
5.	Difficulty in accessing the effectiveness of the expert system	19	76

Source: Field Data, Nov. 2016

Result from Table 5 above shows that 100% of the respondents identified inability to initiate and sustain dialog and feedback as the major issue they had with using the expert system. Other issues identified include failure to achieve deep learning in users (92%), inability to interpret and adapt to different emotional conditions (80%), difficulty in accessing the effectiveness of the expert system (76%) and finally, time consumption (60%).

V CONCLUSION AND RECOMMENDATIONS

The study showed that adoption of expert systems in teaching and learning brought about significant and improved performance translating to high achievement rate amongst the sampled students. This implies that if promoted, adoption of expert systems in teaching and learning in Nigerian tertiary institutions would lead to improvement in the academic performance of the Students. It was observed from the study that adoption of expert systems in teaching and learning otherwise called intelligent tutorial systems had an edge over regular tutorial CDs as the later lacked the ability to give feedback a to the learner hence could not act like a human expert in this regard. Results from the study identified the benefits of adopting intelligent tutorial systems in teaching and learning in Nigerian universities to include; around the clock availability of the expert system,

provision of feedback to its users, reduction on dependence on human resources, improvement in academic performance of its users amongst others. However, the study identified certain challenges facing adoption of expert systems in tertiary education in Nigeria to include; poor support infra structures, unwillingness of both facilitators and learners to adopt new technologies, lack of technical knowledge of the technology, high cost of implementing expert systems in educational settings amongst others.

The research finally identified issues confronting the adoption of the expert systems in tertiary education in Nigeria to include; the inability of the system to sustain prolonged dialogue and feedback, inability to ensure deep learning in its users, the system is not able to adapt to different emotional situations amongst other issues identified. The study supports the research of [7] and [9] who agree that adoption of expert systems (intelligent tutorial systems) yield better result and improved academic achievement in its users.

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