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Intelligent Tutor for Teaching Service Station Mechanics in Technical Colleges in Lagos State

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Abstract:- This study developed and validated Intelligent Tutor for Teaching Service Station Mechanics in Technical Colleges. Research and Development (R&D) design was adopted. The population for study was 1977 which comprised 1095 forecourt managers, 521 software developers, 39 MVMW teachers and 322 MVMW students. Sample of 295 was used for the study. Data was collected using validated questionnaire and multi-stage sampling was used based on the phases adopted for the study. Data was analyses employed percentage, mean and analysis of covariance. Findings revealed that the software design specifications were compatible with operating system, system bit, memory space, internet services and content organization. Practical skill test score showed that using Intelligent Tutor for teaching is better approach to conventional teaching method. Therefore, Intelligent Tutor should be used for teaching Service Station Mechanics in Technical Colleges.

Keywords:- *Artificial intelligence, Intelligent Tutor and Service Station (SS), Software Development.*

I. INTRODUCTION

Service station is a facility that offers the services of both a filling station and a repair garage where periodic maintenance of vehicles can be carried out. Service stations usually have a forecourt where customers can carry out basic auto services like battery charging, wheel balancing and alignment services, oil changing, sales of automobile parts, vulcanizing and other routine services. The Nigerian Board on Technical Education (NBTE) noted that service station mechanics (SSM) was designed to produce a forecourt service mechanic who understands routine service and have ability to carry out forecourt servicing and sales. Forecourt service mechanics are strategic players in the automobile industry considering their rate of patronage from car owners. In Nigeria, most filling stations have forecourt service mechanics to help customers easily carry out routine maintenance or buy needed parts while they come to buy fuel. Eames (2010) noted that filling station managers also use display of mastery of the forecourt mechanics as a strategy for bringing customers to their filling stations. Students in specialty area of Motor Vehicle Mechanics Works (MVMW) in Technical Colleges offer Service Station Mechanics (SSM) as a module.

Service Station Mechanics is offered as a module in the Technical Colleges so that at completion of the module, the students are equipped with knowledge and skills needed to work as a forecourt service mechanic. At completion of SSM module, students are expected to be versatile in performing basic routine issues involving the automobile. However, in Lagos State, most Technical College graduates of Motor Vehicle Mechanics Works (MVMW) after being exposed to SSM module are unable to effectively work as forecourt mechanics. According to Udogu (2015), despite the well stated objectives of SSM, the dominance still remains in the hands of informally trained mechanics. Jika (2010) hinged lack of skill of Technical Colleges MVMW graduates to use of obsolete technologies in schools. Agbata (2010) noted that if nothing is done to improve the quality of skill training given to students in technical training institutions, the craftsmen needed to work on today's cars may be imported just as the cars are imported.

Traditional diagnoses of visual and aural inspection of vehicle systems are no longer sufficient for diagnosing faults on the vehicle. Chakraborty et al (2012) are of the opinion that emerging technologies in automotive domain are driven by embedded systems and software solutions making it imperative for service technicians to have functional understanding of how these embedded systems control the operation of the vehicle in order to be able to work effectively on them which calls for change in method of teaching Service Station Mechanics in Technical Colleges. Most institutions are gradually embracing emerging technology such as intelligent tutor in teaching.

Ziaaddini & Tahmasb (2014) noted that Intelligent Tutor (IT) is a branch of artificial intelligence (AI) concerned with the use of computers in performing tasks that are normally considered to require human knowledge, perception, reasoning and cognitive abilities. The automobile industry is already using AI in the various sectors of the industry ranging from manufacturing to maintenance of the automobile. Artificial Intelligence has two broad categorizations, which are expert systems and intelligent tutor systems. For instance, automobile diagnosis software are expert systems, able to perform the task of a professional mechanic in fault diagnosis while Intelligent Tutor Systems (ITS) on the other hand are software designed to provide instruction and feedback with a human teacher. As AI continues to find relevance in the automobile industry, computer-based technologies like

the use of intelligent tutor system need to be applied in the classroom for training of skilled men for the industry.

Nesbit et al (2014) described an intelligent tutor as a computer program which modes learners' psychological states to provide individualized instruction. Graesser et al (2014) described an intelligent tutor as a computer system that performs functions of human teacher. Considerable progress has been made in different countries of the world to make use of intelligent tutor for supporting students' learning and as such, should not be left to chance in Nigeria. Development of Intelligent Tutor for teaching and learning of SSM is based on a software. Software development life cycle organizes the development activities of software. It provides a framework for monitoring and controlling the software development project. Mohd-Fairuz (2005) stated that the software development cycle entails the entirety of the different phases. There are several models of software development cycle such as waterfall, spiral, rapid prototyping and incremental development model that could be adopted in developing a tutor. In this study, the waterfall life cycle model was used in developing the intelligent tutor. Palmquist et al (2013) noted that waterfall method is a sequence, with feedback, of analysis, design and production activities, followed by testing and maintenance. Each stage produces something on which the next stage starts with and develops. The waterfall model can be summarily described as having three phases, which are software design specification, design and development as well as testing and validation. This study therefore, developed an intelligent tutor for teaching Service Station Mechanics and validated the tutor's ability to enhance the practical skill of the students in SSM.

II. METHODOLOGY

The current study seeks to address the question whether SSM using Intelligent Tutor teaching module would add considerable value to students as opposed to the traditional SSM teaching module. Hence, software specifications compatible for development of intelligent tutor for teaching service station mechanics were designed, using Lagos State as a pilot location. Lagos State being the former federal capital and the commercial nerve centre of Nigeria was found suitable for the study as a result of large number of filling stations that required the services of trained forecourt mechanics and availability of well-equipped technical colleges.

A. Sample

Out of a total population of 1977 samples, comprising 1095 forecourt managers, 521 software developer, 39 MVMW teachers and 322 MVMW students, 295 samples were randomly selected for the study. Using a multi staged sampling technique, 198 of the sample were used in phase I and 97 were used in phase IV. Thereafter, the difference in performance amongst those taught with intelligent tutor and conventional methods was assessed using samples from two technical colleges for testing the intelligent tutor on student's skills in SSM.

B. Instrumentation

Questionnaires were used for data collection in different phases of the multi stage approach, namely; Software Design Specification Questionnaire (SDSQ), Alpha Testing Experiential Evaluation Questionnaire (ATEEQ), Subject Content Validation Questionnaire (SCVQ), Computer Expert Validation Questionnaire (CEVQ), Personalized Response Validation Questionnaire (SPRVQ), Service Station Mechanics Skill Test (SSMST) and lesson plans (8 different lesson plans) for the two groups were all used for data collection.

III. RESULTS AND DISCUSSION

S/N	Items compatibility	Percentage	Decision	
1	Compatibility with operating system	54.94	Compatible	
2	Compatibility with system bit	86.00	Compatible	
3	Compatibility with memory space	52.78	Compatible	
4	Compatible with internet services	79.78	Compatible	
5	Organization of content	62.75	Compatible	

Table 1:- Software Design Specification

Table 1 shows the compatibility mode of the intelligent tutor teaching service station. The compatibility modes above 50% signified compatible while compatibility mode below 50% is not compatible. Therefore, the intelligent tutor is compatible with the operating system, system bit, memory space, internet services and organization of content.

S/N	Items	Mean	SD	Decision	Cronbach alpha
1	ATEEQ	3.38	0.91	Good	0.72
2	SCVQ	3.84	0.78	Very good	0.76
3	CEVQ	3.56	1.08	Very good	0.83
4	ETEVQ	3.47	0.40	Good	0.73
5	SPRVQ	3.46	0.25	Good	0.91
					Cohen kappa's coefficient
6	SSMT	3.63	0.48	Excellent	0.78

Table 2:- Reliability Responses

The data in table 2 presents the reliability responses of the different data sources. It shows that the instruments are good to be used in subject content validation in the study with standard deviation showing the level of closeness of the respondents to the Mean value. Also, the Cronbach alpha and Cohen Kappa's coefficients value show that the instruments are sufficiently reliable.

Teaching Method	No	Pre-test $\bar{x}$	Std. Dev	Post-test $\bar{x}$	Std. Dev	Mean Gain $\bar{x}$
Intelligent Tutor	46	9.15	2.61	76.53	9.83	67.38
Conventional Method	51	9.45	2.5	55.70	8.34	46.25

Table 3:- Practical scores of students in SSM using method of teaching

Table 3 shows the scores of the students in service station mechanics skill tests based on the modes of instruction. The students taught service station mechanics using the Intelligent Tutor pre-test mean score was 9.15 and the post-test score was 76.53 with mean gain of 67.38. While, the students taught with conventional methods had a pre-test score 9.45, post-test score 55.70 and mean gain 46.25. From the result presented on the table, the group taught using the Intelligent tutor performed better in service station mechanics skill test.

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	3491.662[a]	3	1163.887	32.509	.000	.432
Intercept	7182.571	1	7182.571	200.622	.000	.610
Pretest	28.444	1	28.444	.794	.374	.006
Intelligent tutor*conventional	3395.271	2	1697.635	47.418	.041	.726
Error	4582.603	128	35.802			
Total	101781.000	132				
Corrected Total	8074.265	131				

Table 4:- Analysis of Covariance (ANCOVA) of Students' skill performance in Service Station Mechanics.

Table 4 shows the F-calculated values for differences in academic achievement of students taught using intelligent tutor and conventional methods in SSM. The F-calculated value for treatment gave 47.42 with F = 0.04 at 0.05 significant level. The null hypothesis is rejected showing that there is significant difference in the academic achievement of students taught using intelligent tutor and those taught with conventional method.

Table 1 shows the compatibility of the software design of Intelligent Tutor for teaching Service Station Mechanics. This agrees with the findings of Jennings (2007) which shows that windows operating system is most dominant operating system in Nigerian schools. It is most advisable for tutor design because of its compatibility with the operating system available in Nigerian schools. Also, its compatibility with 1GB RAM with the hard drive (HDD) 120GB according to Olatokun (2006) correlates with the National Information Technology Agency specifications. This makes the tutor support and conforms to internet networking, (local area network -LAN) and mail host) specifications and it enables students share knowledge within the class and serves as feedback mechanism for teachers. However, Woolf and Poli (2010) noted that tutors should not be presented the same way textbooks which are ineffective, but rather it should be interactive and preferably modular. Cheng et al (2010), used a computer based tutor to teach assembling of automobile engines and found it effective in helping students acquire engine assembly skills. This is in line with the result in table 3 which revealed the effectiveness of intelligent tutor in enhancing students' practical skills in SSM.

The students that were taught with intelligent tutor performed better compared to those taught with conventional methods. This result was further cushioned by the outcome of the hypothesis which showed a significant difference between the intelligent tutor and conventional method. However, this study contradicts the study of Hennessy et al (2006) who found out that replacing "on the car" hands – on exercise with computer based tutor is inappropriate. Nonetheless, they concluded that computer

based tutor serves as an effective mechanism that helps learners prepare and have better understanding of the processes involved in car repairs.

IV. CONCLUSION

The Intelligent Tutor was developed based on the specifications collected in the needs assessment for teaching of Service Station Mechanics (SSM). The developed tutor was subjected to various validation processes and the results from the validation indicated that the IT conforms with design specification from needs assessments. The finding from the study showed that student's practical skills in Service Station Mechanics were enhanced by the Intelligent Tutor.

From the findings, it is recommendations that:

- Curriculum for Technical Colleges should include the use of Intelligent Tutors for teaching of skills based modules.
- Awareness should be created for teachers in Technical Colleges to enlighten them on how technology can be embedded in teaching.
- Government and non–governmental organizations should partner with the technical colleges to improve computer based tutor development for teaching vocational subjects.
- The development of intelligent tutors for teaching vocational subjects should be incorporated as part of course of study in tertiary institutions where Vocational and Technical Education courses are offered.

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