An Android Mobile Intelligent Tutoring System(MITS) for Teaching English Grammar

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By

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Mobile devices are presently the most commonly used devices, especially by the youth. With its convenience and portability, several applications are already developed, and more are still in the development stage, to fit to every personal need of its users. With this, a Mobile Intelligent Tutoring System (MITS) has been designed, developed, and deployed to teach English Grammar to grade school and junior high school students. MITS was designed using the "rewards and punishment" pedagogical approach in teaching and learning. Motivational prompts like "Good Job!", "Congratulations!" and rewards like certificates are used to give positive feedback for correct actions. Repetition is used for "punishment" or as an intervention when a student commits mistakes and/or errors.

Fourteen (14) grade 7, 8 and 9 students from a private school in the City participated (with adult consent, i.e. parents and/or teacher) in the deployment experiment conducted by the researchers. Among the major findings of the experiment are: MITS was to result to a positive learning gain from the student users. Learning gain was computed from pre-test and post-test scores also taken in the MITS learning environment. Usability tests were also performed using a 5-point Likert scale (1-Very easy/Very Pleasing and 5 – Very difficult/Not pleasing). For ease of use and user friendliness, MITS was given a mean rating of 1.79. In terms of content (and its level of difficulty), MITS got a mean rating of 1.93. For the graphic design and aesthetics, MITS got a mean rating of 2.07. The usability tests revealed results with tendencies for good performance and design of MITS, coupled with the resulting learning gain (36%) from the students participating in the experiment, this research project can be considered as a success.

General Terms: Intelligent Tutoring System (ITS), Android Studio, Mobile Intelligent Tutoring System (MITS), Native Application, Web-Based App

Additional Key Words and Phrases: Bloom's Taxonomy, model-tracing tutors, Poor Man's Eye Tracker (PMET), Domain Module, Student Module, Expert Module, Communication Module, Human-Computer Interaction

1. INTRODUCTION

1.1 Background of the Study

An Intelligent Tutoring System (ITS) is a "computer software designed to simulate a human tutor's behavior and guidance"[1]. An ITS provides exercises and checks if the answer given was right or wrong. Furthermore, it also gives feedback and explanations if the answers are incorrect. Aside from these, the system can also provide several specific hints to help the student in answering and understanding the question. These features makes an ITS a more suitable tool in monitoring a large group of students.

Mobile devices have been playing a huge part in our everyday lives. These devices can now do a lot of things, ranging from simple actions such as sending each other text messages, to complex tasks such as socializing using existing applications. Because of their convenience, many applications have been developed to address entertainment issues, but most of all, for practical needs. Mobile technology can be integrated with other technology to respond to our needs.

As a country that uses English as their second language, Filipinos still encounter problems in writing in English such as essays, letters, or speeches. Although Filipinos know the meaning of several English words and can understand the context of this language, they still have difficulties when it's time for them to write. Most of the time, their grammar is wrong which makes them incomprehensible.

With this motivation, a mobile intelligent tutoring system (MITS) has been designed, developed, and deployed by the researchers to investigate the possible contributions of a mobile ITS to teaching and learning English most especially for the youth. MITS design uses the interplay of

pedagogies, content and technology to optimize the benefits that a mobile ITS can give to education in this country, most especially for its youth.

1.2 Problem Statement

Can a mobile intelligent tutoring system help augment conventional schooling in teaching and learning English grammar?

The specific problems that this study answers are as follows:

(1) How can students (and/or non-native English speakers) learn the English grammar?
(2) What are the components of a Mobile Intelligent Tutoring System?
(3) How can we implement Intelligent Tutoring System in a mobile environment?
(4) How can we implement Adaptive Learning in an Intelligent Tutoring System to address the diverse and specific needs of each user / learner to ensure learning gain and with the system/software?
(5) What is the framework/platform to be used in creating Mobile Intelligent Tutoring System?

1.3 Objectives

This study aimed to design and develop a mobile ITS that can help students improve their English grammar.

The specific objectives of the study were as follows:

1 Determine how students can learn English grammar.
2 Determine the components of a Mobile Intelligent Tutoring System.
3 Determine the proper ways on implementing Intelligent Tutoring System on a mobile environment to consider the requirements in terms of content, technology and appropriate pedagogy.
4 Determine ways to implement Adaptive Learning, specifically the implementation of a "rewards and punishment" framework, to a Mobile Intelligent Tutoring System to address the diverse and specific needs of each user to ensure learning gain.
5 Determine the appropriate platform to be used in developing a Mobile Intelligent Tutoring System.

1.4 Significance of the Study

Non-native speakers of English find some relative difficulty to learn the language without constant study and practice. However, even with practice, the Filipino youth still commit grammatical errors when conversing and writing in English. This is considered as one of the more noted problems for those who have English as their second language [2].

Mobile devices are the most widely-used electronic device, with 73% out of the 37,00 respondents agreeing [3], these makes the mobile environment the most suitable environment for creating a system or an application to be used by an intended great number of users. Therefore, implementing a

system in mobile devices, specifically, an Android device, that can help the users in improving their grammar is what makes this study significant.

With many existing web-based English tutoring systems, MITS provides an extra advantage that mobility offers.

MITS is designed and implemented with the interplay of context, technology and pedagogy. I.e., English grammar topics were chosen from the curriculum of the Department of Education, rewards and punishment in terms of motivation and reinforcement were implemented and mobile and data resources were tapped to make MITS reach a greater audience.

1.5 Scope and Limitations

The focus of this study is to help students improve their English grammar through the use of MITS. MITS has been developed using Anroid Studio, hence will only be deployed in Android devices. The target audience of MITS is composed of grade 7,8 and 9 students as the chosen subject area is commonly found in the curriculum of these year levels. However, those who have difficulty in basic English grammar and the topics included in MITS may also be part of the intended users.

2. REVIEW OF RELATED LITERATURE

2.1 Intelligent Tutoring System (ITS)

"An intelligent tutoring system is a computer software designed to simulate a human tutor's behavior and guidance" [1]. The ITS provides exercises for the students to answer. If the student is having difficulties in answering an exercise, the system can provide hints to help the student understand the question better. The system records the answers, both correct and incorrect, to know whether the student have mastered the concept or not. If the student provided an incorrect answer, the system will give a feedback explaining concept behind the question. Furthermore, the system will also suggest exercises of the same category for the student to be able to master the concept. However, most of these ITSs are web-based and only a few students who can first-handedly connect to the internet can use them [7].

ITSs have been shown to increase and improve student understanding and assessment scores, making it an effective tool in the student's learning process. Although the human mentors cannot be replaced by the ITSs, ITSs can work with a large number of students simultaneously and can handle them individually. In addition, it is available and can be accessed whenever the student want and needs to (e.g. a night before an exam), which the human mentors cannot do.

2.2 Model-tracing Tutors

Model-tracing tutors is one of the three classifications of an ITS [11]. In model-tracing, the expert model is used to trace the actions of the student. It checks all steps the student had taken and offers feedback while the student is solving a problem. The model-tracing tutor also checks if the step that the student took matches the correct answer, and identifies the error of the answer matches a production rule that represents an incorrect step, or fails to match anything.

2.3 Adaptive Learning and Artificial Intelligence in Intelligent Tutoring Systems

Adaptive learning means adjusting the difficulty of the instructions that is being executed to compensate on the learner's primary knowledge. It also helps in personalizing the instructions

being presented to improve or help the student excel in his performance. The instructions that will be given to the learner is targeted to the needs of the individual student. There are many advantage using adaptive learning, it can reduce course drop-out rate, improve student outcomes, or speed of achieving those outcomes [19].

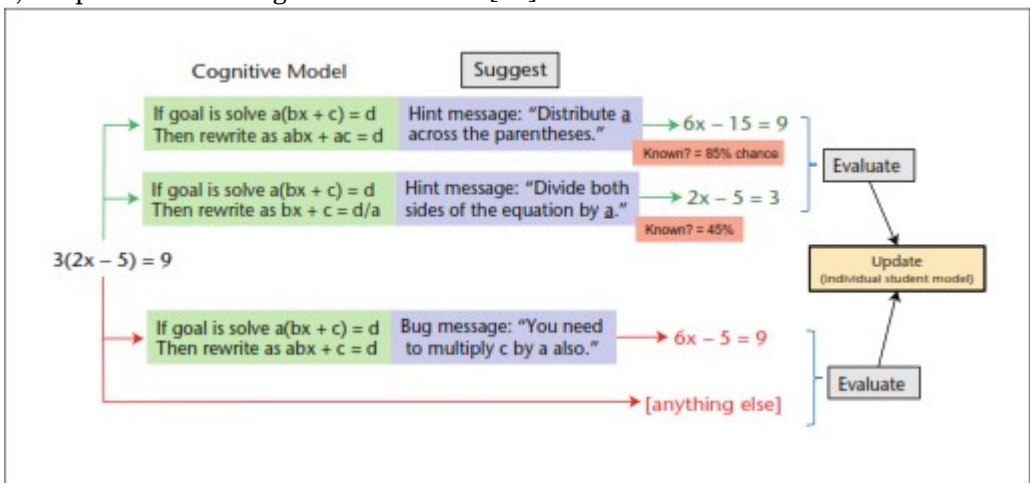

Fig. 1. Example of the use of Production Rules [20]

2.4.1.

2.4 Human Computer Interaction and Intelligent Tutoring Systems

Human Computer Interaction (HCI) is defined as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [16]. It can also be described as the place where the human user and the computer communicate, which is usually the user interface [17]. The flow of information from the user towards the computer, and vice versa, is called the loop of interaction. This includes the following:

(1) Task Environment
(2) Machine Environment
(3) Areas of the Interface
(4) Input Flow
(5) Output
(6) Feedback

2.5 Mobile Learning

Among all electronic devices, it was found that the mobile phones are the most frequently used, followed by PDAs and other handheld devices [8]. Mobile learning (M-Learning) is a new discipline in the field of education and educational technology. Many researchers are now trying to develop and expand this kind of application in the area of education. M-Learning means educational applications in a variety of mobile technology. It is designed to produce an "anytime, anywhere learning experience.

2.6 Bloom's Taxonomy of Learning

Bloom's Taxonomy is often when designing learning processes. It is a model of classifying thinking according to six levels of complexity [5].

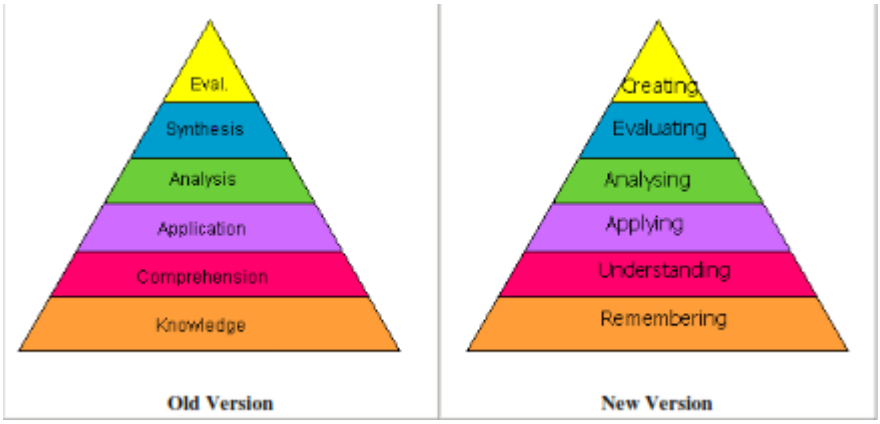

Fig. 2. The original and revised version of Bloom's Taxonomy [5]

Figure 1 shows the previous and revised form of the Taxonomy. The terminologies are changed from noun to verb to reflect a more active form of thinking and a more accurate version of Bloom's Taxonomy.

The new terms are defined as:

- ***Remembering:*** *retrieving, recognizing, and recalling relevant knowledge from long-term memory*
- ***Understanding:*** *constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining*
- ***Applying:*** *carrying out or using a procedure through executing*
- ***Analyzing:*** *breaking material into constituent part, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing*
- ***Evaluating:*** *making judgments based on criteria and standards through checking and critiquing*
- ***Creating:*** *reorganizing elements into a new pattern through generating, planning, or producing*

Bloom's Taxonomy will be used for the content design and pedagogical structure of the proposed MITS. It will be the basis for the structure and the flow of the tutoring system.

2.7 Related Works

Few institutions have already developed an ITS. Some of the developed ITSs are:

- *Cognitive Tutor*
- *Genetics Cognitive Tutor*
- *Andes Physics Tutor*
- *Writing Pal*
- *ASSISTments*
- *Knewton*
- *Circuit Tutor*

2.7.1 Circuit Tutor

Circuit Tutor is web-based mobile intelligent tutoring system that teaches/tutors the principles of basic circuit, specifically, Ohm's Law. Before the lesson proper, a pre-test is given for the student to answer after registering on the app. After which, the score will be displayed along with the correct answers to the questions. After the pre assessment, the concepts will be provided for the user to learn. After that, quizzes can be taken by the student, whenever he is ready, where hints will be provided by the system upon student request. The answers will be processed and scores will be interpreted by the system. The student is free to review the lessons and take the quizzes again.

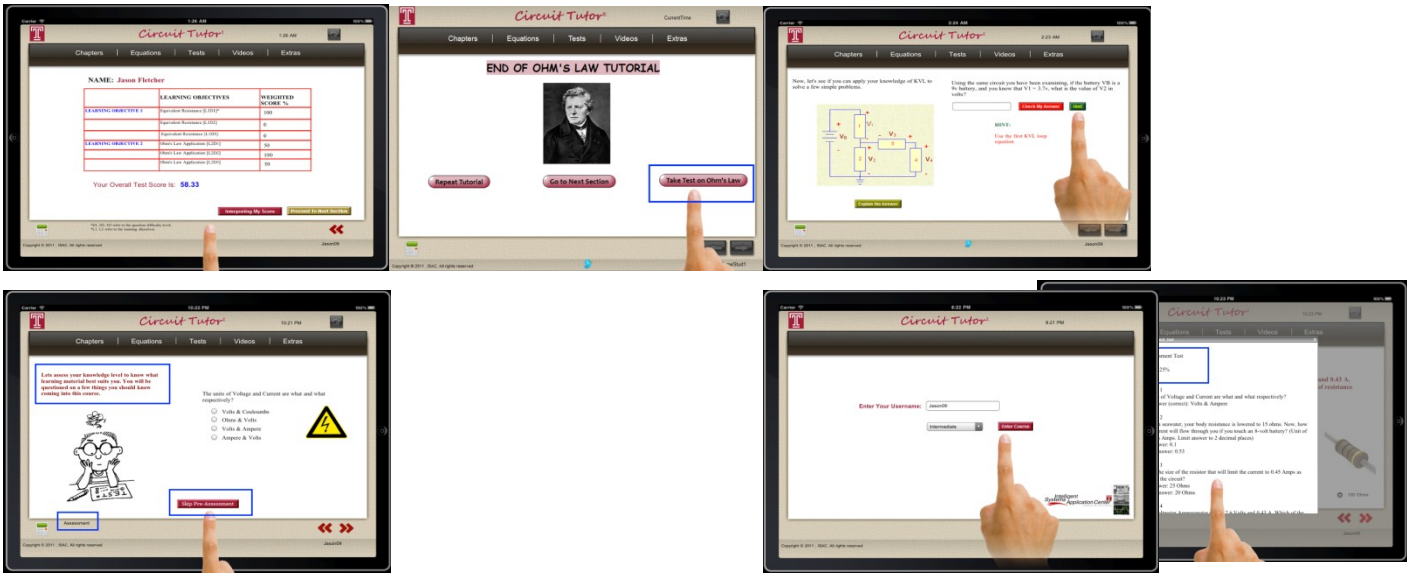

Fig. 3. Screenshots of Circuit Tutor [6]

The screenshots of the Circuit Tutor are presented in Figure 2. From upper left to upper right, are the screens of the following: detailed score report, end of the lesson menu, and hints on the exercise. On the lower left to lower right are the screens for pre-assessment, scores of the pre-assessment, and the user registration.

2.8 Theoretical Framework

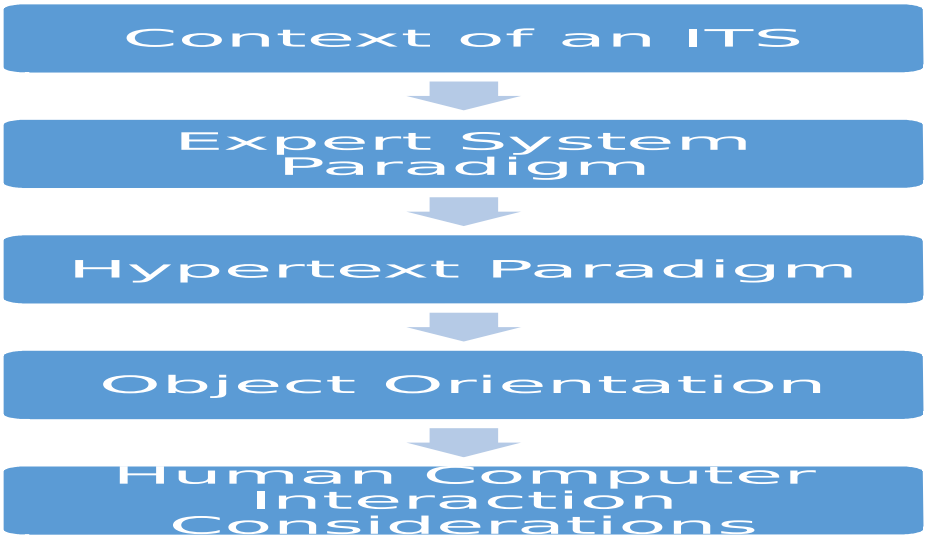

Fig. 4. Theoretical Framework for Developing an ITS [9]

Kinshuk et al. [9] proposed a framework that is concerned with producing ITSs to be used by a large number of students as well as the reusability of the process. This was based on the context of an ITS, the expert system paradigm, the hypertext paradigm, object orientation, and human computer interaction considerations. On the context of an ITS, the various contexts of an ITS is recognized, specially the role of the teacher as an implementor, and the nature of the discipline. The expert system paradigm provides a separation of knowledge and processing of that knowledge. The hypertext paradigm allows the teacher to link appropriate intelligent tutoring applets to create a larger tutoring system. On the object orientation, the tutoring applets are designed to create a good match between the structuring of knowledge and the object oriented programming paradigm. Lastly, the system should maintain simple and interactive interface.