An Intelligent Tutoring System To Maintain The Students' Motivation

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ABSTRACT:

Recently, many educational institutions around the world has transformed to online education specially during the COVID-19 pandemic. This fast and in many cases unplanned transformation leads to the needs for more researches to find solutions for the problems of this rapid transformation. As it's the best economic options during this pandemic, this study focused on creating a web-based (asynchronous system) intelligent tutoring system (ITS) to support the teachers in the C programming language course. Nonetheless, the suggested system takes into consideration one of the biggest challenges for asynchronous system which is how to maintain the students' motivation for the entire learning process. Therefore, the current study suggested the use of an interactive ITS as a solution for this challenge. The created system C-ITS used a set of motivational state rules and tactics to assess and maintain the motivation of the students. Finally, after using the system by the students and the teachers for two weeks, we conducted an evaluation study to evaluate the quality of the system design, the usability, the functionality, the compatibility. The result of the evaluation study showed that C-ITS system acceptable from both the students and the teachers.

1. INTRODUCTION

Recently, due to COVID-19 pandemic, most educational institution has transformed to online education. Because of this rapid transformation, many issues raised such as the effectiveness of the online education, the integrity of the online exams, the students' motivation and engagement during the online education (Bruscato and Baptista, 2021a). Thus, there is a need for more research to solve those different issues. According to Bruscato and Baptista (2021a), generally the students and teachers had a bad conception about the online education. However, online education seems to be the safest solution for the educational institution during the COVID-19 pandemic (Bruscato and Baptista, 2021b). Delivering the online education can be done using one or both of the two communication methods; the synchronous method or the asynchronous method (Hrastinski, 2008). Using the synchronous method, the teacher and the students can interact directly on the real time, examples of this method are video conferences and real time chats. While, using the asynchronous method students can get the knowledge anywhere and anytime; at their pace, examples of this method are web-based learning, email, and forums. As mentioned by Bruscato and Baptista (2021b), both synchronous and asynchronous online education has the same effect on the educational process. However, as they concluded, the asynchronous online education is more effective from an economical perspective than the synchronous.

According to many research, students' motivation is one of the most important factors of the successes of the educational process (e.g., Weiner, 1985; Ames, 1992; Ramaha, Basha, Ismail, Umer, 2015; Steinmayr, Weidinger, Schwinger, and Spinath, 2019). Nonetheless, one of the major problems of the asynchronous online education is how to maintain students' motivation for the entire learning process. Since, in contrast with synchronous online education, the level of interaction between the teacher and the students considers trivial using the asynchronous online education. Within the traditional classroom and synchronous online education the teacher communicate simultaneously with the students, hence he/she can assist the students' motivation and interact with them to maintain their motivation. Therefore, the asynchronous online educational systems need to interact with the students to maintain their motivation (Keller and Suzuki, 2004; Ramaha, Karaş, Gül, Bozkurt, and Yayvan, 2021; Hartnett, 2016). To maintain the motivation of the students', the asynchronous online educational system needs to execute two functions: (1) detect students' motivational state, (2) respond to the students' motivational state to maintain it. Therefore, in this study, we are creating an Intelligent Tutoring System (ITS) to learn C programming language (named C-ITS) for the Karabuk university students with the ability to maintain the students' motivation for the whole learning process.

2. MATERIAL AND METHODS

2.1 C-ITS Architecture

By reviewing the related works, we have found some interesting architectures for interactive intelligent tutoring systems. One of these architectures suggested by Bokhari and Ahmad (2013), in their study, they suggested a four tire architecture for an Interactive Multi-Agent Based Learning System (I-MBLS). Another architecture suggested by Grivokostopoulou, Perikos, and Hatzilygeroudis (2017) for an Artificial Intelligence Teaching System (AITS) that assessing the students' answers. Also, Ramaha (2021) suggested another interesting Interactive Web-Based Tutoring System (IWTS) architecture. However, in our study, we adopted the suggested architecture by Ramaha and Karas (2021) as it is suitable for our study. Figure 1 shows the architecture of the C-ITS system, this architecture focus on the relationship between the students and the system components.

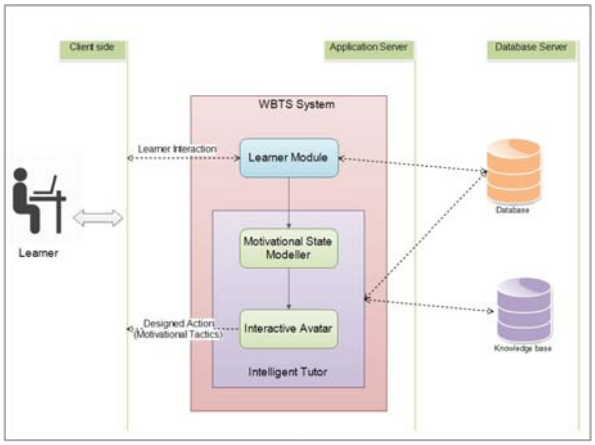

Figure 1. C-ITS Architecture (adopted from Ramaha (2021)).

C-ITS architecture has three sides:

1. Client side: as our system a web-based ITS, this side contains a website that represents the interface for interaction between the students and the system.
2. Application Server: the main components of the system located on this side. This component responsible for managing the requests between the client side and the database server, analysing the collected data, and take the decisions.
3. Database Server: database and the knowledge base are located on this side. There are two types of the rules in the knowledge base: motivational state rules and motivational tactics rules.

C-ITS system has three main components to interact with the students and maintain their motivation:

1. Learner Module: this module responsible for gathering the data generated from the interaction between the students and the system. The gathered data include the students' motivational state and cognitive data. Motivational state data includes the taken time for the exercise answer, the mouse movements, the received helps or feedback, the result of the exercise, and the time from login to start answering the exercise (hesitation). The cognitive data include the success or failure doing the exercise, giving up the exercise, and asking for help. All these gathered information will be sent to the "Motivational State Modeller" and a copy will be saved in the database for future use.
2. Motivational State Modeller: the job of this modeller is analyzing and evaluating the motivational state and cognitive data that come from the learner module. To do this job the this modeller needs a set of motivational state rules, we adopted these rules from Ramaha (2017), these rules stored in the Knowledge base. The result of this analysing will be passed to the interactive avatar and a copy will be stored in the database.
3. Interactive Avatar: After receiving the motivational state of the student the interactive avatar will take the decision about the needed motivational tactics' rules for maintaining the student motivation and when to apply these tactics. These motivational tactics' rules also stored in the knowledge base and adopted from Ramaha (2017).

2.2 The Interactive Avatar

Figure 2 shows the structure of the interactive avatar, the interactive avatar communicates with the students and trying to maintain their motivation. This avatar uses a set of motivational tactics' rules to decide the way to interact with the students.

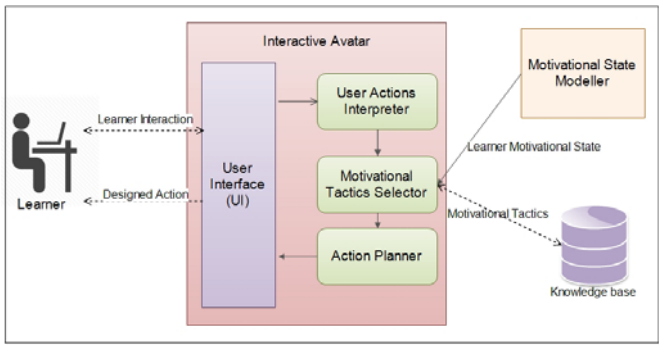

Figure 2. The Interactive Avatar structure (adopted from Ramaha (2021)).

The interactive avatar has three components:

1. User Action Interpreter: this component responsible for interpreting the students' action, such as give up the task, doing the task successfully, failed to finish the task, and ask for help.
2. Motivational Tactics' Selector: it's decided which motivational tactics should be applied depending on the interpreted student's action and the student's motivational state that comes from the motivational state modeller.
3. Action Planner: this planner takes the actions and interact with the students depending on the selected motivational tactics' rule.

Examples of the actions that could be taken by the action planner (Ramaha, 2017):

- Praise the learner's effort.
- Require more effort from the learner.
- Ask the learner to continue with the task.
- Provide the learner with help.
- Provide the learner with performance feedback to reward his/her performance.
- Provide the learner with a same/more/less difficult task.

2.3 User Interface

C-ITS system have a set of web pages as a user interface. There are two main categories of users for the system: students and teachers. The following set of interface for the teacher that allow him/her to manage the lessons and the exercise. The teacher should also give some information that will help the system to analyse the student's actions and motivational state such as: the level of the exercise difficulty, the minimum and maximum time. Depending on this information the system can analyse the student's motivational state and apply the appropriate motivational tactics to maintain his/her motivation.

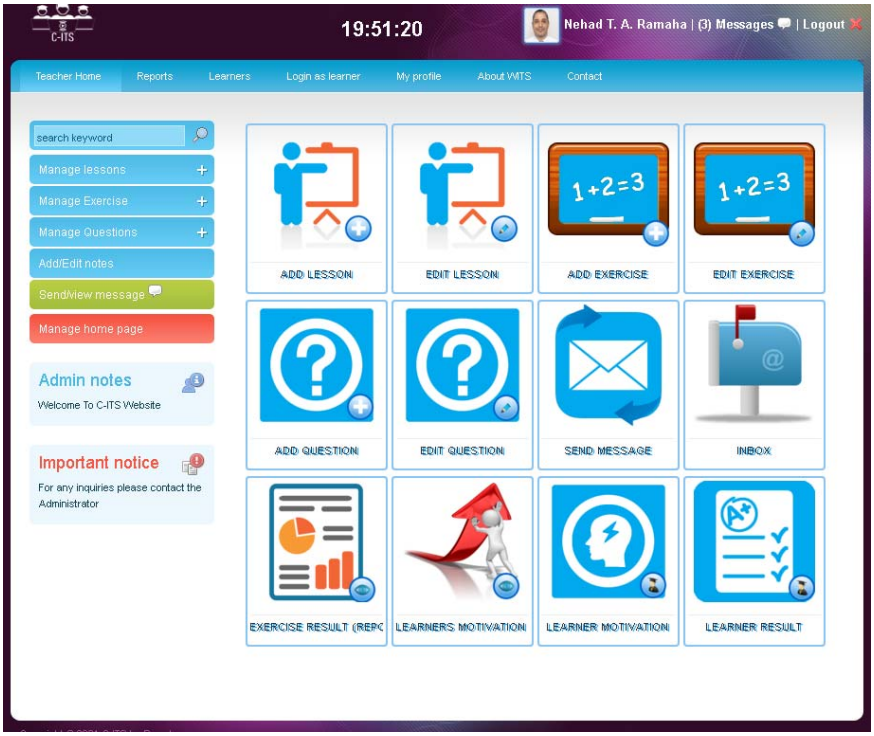

Figure 3. C-ITS Teacher Home Page

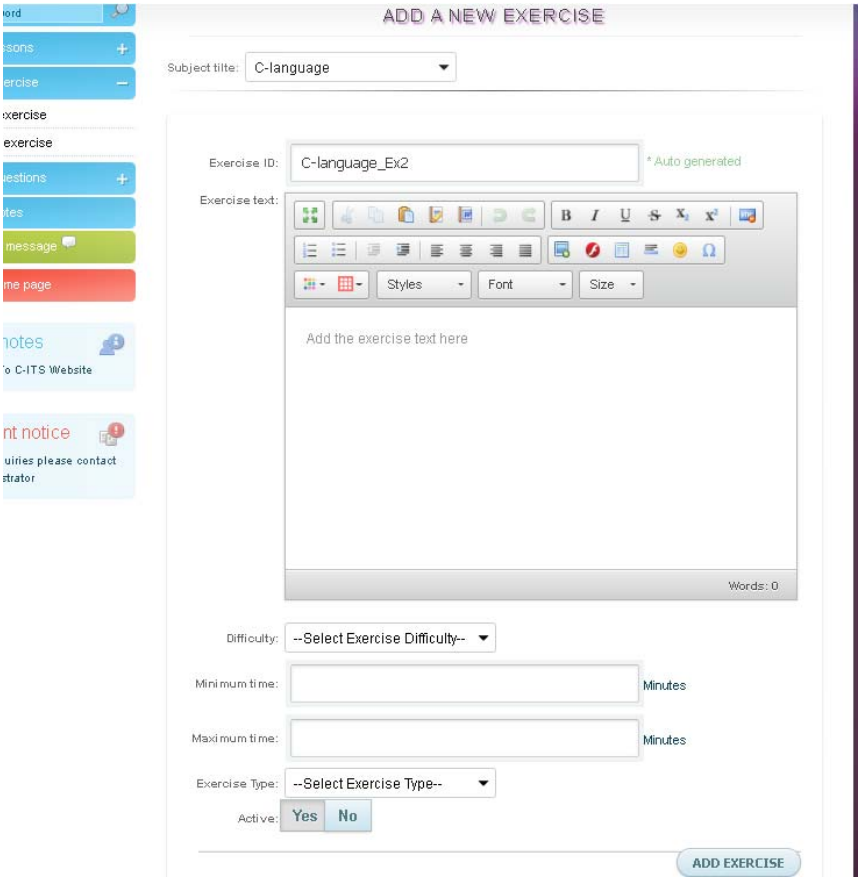

Figure 4. C-ITS Add Exercise Page

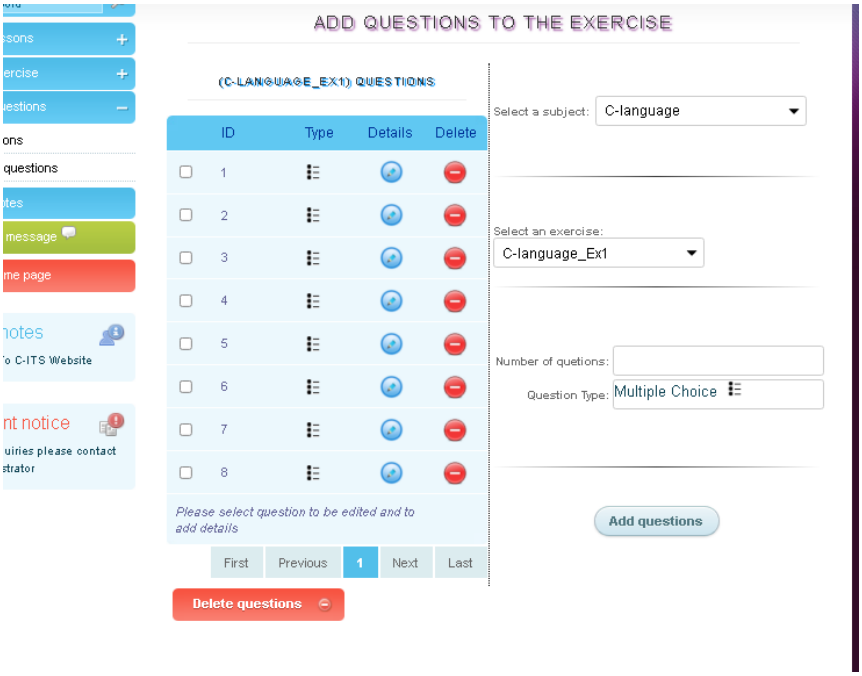

Figure 5. C-ITS Add Question

The following set of figures show some of the interaction between the student and the C-ITS system.

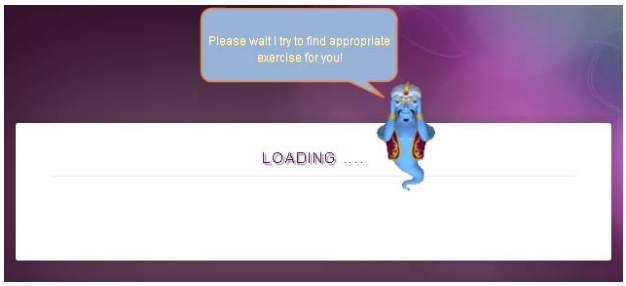

Figure 6. Select Appropriate Exercise for the student

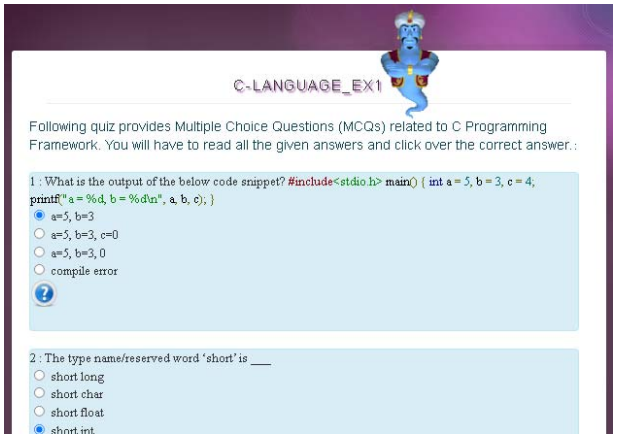

Figure 7. Exercise page

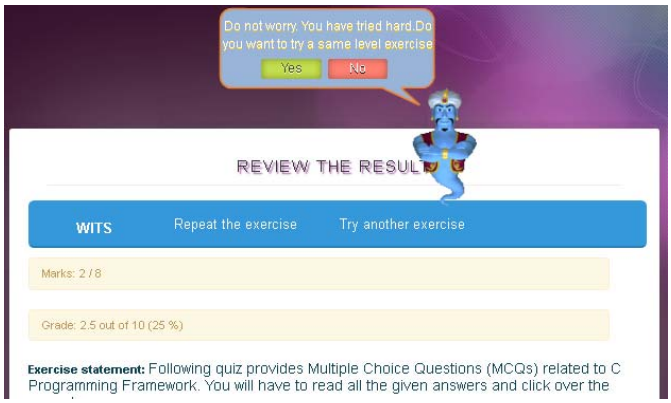

Figure 8. Exercise result feedback

3. EVALUATION

In order to evaluate our C-ITS system, the system was used by 4 teachers and 300 students for two weeks. Thereafter, the students and the teachers responded to a questionnaire about the quality of the system design, usability, functionality, and compatibility. Figure 9 shows the result of this evaluation study. This evaluation study is a part from an ongoing study , the second part of this evaluation will focus on answering the question: dose the C-ITS system maintains the students' motivation?

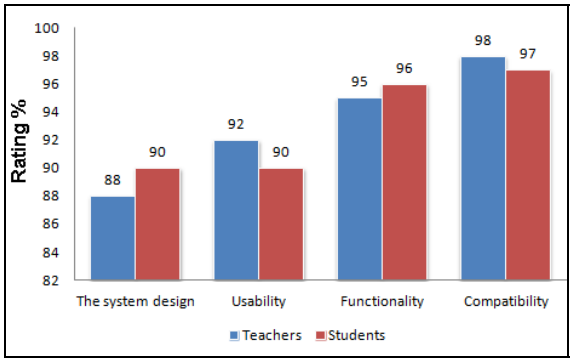

Figure 9. The evaluation result

4. CONCLUSION AND FUTURE WORK

During the COVID-19 pandemic most educational institutions around the world has transformed to online education. Therefore, more research needed to solve the problems of this rapid transformation. Being one of the best economic options, this study focused on creating an asynchronous online system (web-based) to support the teachers in the C programming language course. However, one of the biggest challenges for this type of systems is how to maintain the students' motivation, this study suggested the use of an interactive ITS as a solution to maintain the students' motivation. The created system C-ITS used a set of motivational state rules and tactics to detect and maintain the students' motivation. After using the system for two weeks we evaluated the system in term of the quality of the system design, the usability, the functionality, the compatibility. The evaluation results showed that the system was acceptable from both the students and the teachers. However, we are looking to complete an experimental study to evaluate the system in term of maintaining the students' motivation.

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