Human Computer Interaction in the AIAL system

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Abstract. The Artificial Intelligence Assisted Learning application has been created to help Mathematics students at primary school level and assist their teachers. The application generates classwork and homework worksheets based on each student's ability level, corrects the worksheet, and gives immediate feedback to both the student and teacher. A crucial Human Computer Interaction concept implemented in the AIAL system is usability since the target audience is primary students and teachers who may have a basic proficiency in IT skills. Through the use of clearly partitioned sections, for classwork, homework, results and trophies, and intuitive controls, the application is easy to use and has a very low learning curve. Gamification and reinforcement elements were included in this application to further increase student engagement and enjoyment levels. The AIAL application can also be used for continuous assessment purposes. In the testing phase, it was noted that students enjoyed using the app.

Keywords: Artificial Intelligence (AI), Human Computer Interaction (HCI), Artificial Intelligence Assisted Learning (AIAL)

1 Introduction

Human Computer Interaction (HCI) can be defined as "a sociotechnological discipline whose goal is to bring the power of computers and communications systems to people in ways and forms that are both accessible and useful in our working, learning, communicating, and recreational lives" (Wtec.org, 2018). The Artificial Intelligence Assisted Learning (AIAL) application has been created to help Mathematics students and assist teachers in primary schools. HCI ideas have been implemented in the AIAL app in order to make the app more accessible and helpful to users.

2 Usability of the AIAL application

2.1 App Partitioning

An important HCI concept which was implemented in the AIAL system is usability and ease of use. This is an essential feature since this app is designed for primary school students and their teachers, who may have only a basic proficiency level of IT.

One way in which usability was implemented is through clearly differentiated parts of the application.

In the application there are different sections for classwork, homework, results and trophies. Therefore the user can easily navigate through the application. This is an essential feature to ensure that no unnecessary time is spent searching for the worksheet given by the teacher and the student only spends time working on the material of the given worksheet.

It is for this reason that the sections for classwork, homework, the student's user profile that contains trophies and work due have been programmed in a way to ensure that the student can easily find the work or information he/she is looking for.
The 'work due' section is composed of worksheets, mainly for homework purposes. These worksheets are found in separate sections, sorted by date, to help the child remember and keep up to date with the work that is due for that particular Mathematics topic.

In addition, the structured application aims to provide this app with a low learning curve for both teachers and students to be able to independently access all the features being offered in the app and master using it in a relatively short time.

2.2 User Controls

A user friendly interface for both students and teachers has been implemented in the Artificial Intelligence Assisted Learning (AIAL) application. By implementing intuitive and easy to learn controls to use the app, the app will assist learning in classrooms. Rather than using a mouse and a keyboard, the students just interact directly with the tablet through tap and/or drag motions for the numbers, operators or words. The student can also write/draw using either their finger or a stylus in the workings section as if it was rough paper. Similarly, when the teacher inputs a topic and sample question into the AIAL system, they use a drag and drop block style, similar to a visual programming language. The AIAL system then understands the input given and generates personalized classwork and homework depending on the level of the student that is recorded in the student's user profile. Every time a student completes work (classwork, homework or tests), the AIAL system updates the student's profile on the app. The student profiles of all the students in the class can be accessed by the teacher in order to provide the teacher with ready-made analytics and also indicate to the teacher which questions have been misunderstood and which students are struggling with a particular topic.

3 Human Learning

Another area which has been studied as part of HCI research is human learning and understanding. From previous literature it was learnt that continuous assessment is a

better tool to aid student learning in comparison to final exams (Rezaei, A. R. 2015; Kornell, N. 2009). Moreover, when students have fun during the lesson, they are more concentrated and learn more.

3.1 Student Enjoyability Levels

During the testing phase of the AIAL application, it was evident that most students enjoyed using the app as they were very immersed in the content and were competing to see who could obtain the highest score by answering most questions correctly in the worksheet. Moreover, it was also noted that students were very eager to show the teachers the trophies they had unlocked. These trophies reflect the work completed and the student's performance in this aforementioned task.

In the AIAL system, the use of continuous assessment occurs through the use of periodic tests which are generated by the system. Moreover, the interactive application will enable students to remain interested in the classwork/homework they are performing and reduce boredom, which in turn promotes learning (Holmes, N. 2015) This AIAL app can be used periodically as an additional tool in classrooms to provide an engaging and stimulating classwork activity in conjunction with other pen and pencil exercise worksheets given out by the teacher.

3.2 Gamification and Engagement

The use of a timer was also employed to increase the gamification in the app. This timer adapts according to the user level and the time increases and decreases accordingly. The time increases gradually if the system realizes that the user is running out of time as the answer box is repeatedly left empty when the timer reaches 0. On the other hand, if the student is never running out of time (timer does not reach 0) and answers a high proportion of the questions correctly, the time given to the student to answer the question will be decreased, thereby making the task more challenging to complete. A minimum and maximum time limit is set to ensure that the time is not decreased to such a low value that the student is unable to answer the question in time while also keeping the timer as a competition /game feature to ensure that the student is being challenged when answering the question and to ensure they do not get distracted and forget to answer the question. Students also have the option of switching off the timer should they require more time to answer the questions (than the maximum time) or do not like working under pressure/ timed.

The colours used in the AIAL app were also specifically chosen to increase student engagement and personalize the app to each user. The screen flashes red when the time is running out to inform the user and remind them about the timer. Moreover, in the working section the user can change the colour of the pen. This allows the student to work out the problem in their preferred colour. The working space allows the students to work out the questions 'by hand' and not mentally. In this way, the student is able to solve the problem using any method that they have previously learnt.

3.3 Reinforcement

A further important aspect in student learning, especially in primary students, is that of reinforcement. Positive reinforcement is given to the students when they achieve a pre-set goal set by the teacher. An example of a goal is completing all the homework given in the week. If the student reaches this goal, a trophy will be given to the student which he/she will be able to view on their personal user profile. Viewing the trophies and seeing an ever-increasing number on their profile could act as an incentive and increase motivation in the students. This also helps students to respect deadlines without adding extra pressure. On the other hand, the AIAL system also provides constructive feedback to the student. This occurs immediately after the students complete a classwork/homework worksheet. The AIAL system corrects the personalized worksheet and shows the students which problems are correct and also which problems were wrongly answered. The student may then opt to either rework the worksheet or else view the answers with the solutions to the problems they got incorrect. This allows the students to recognize their mistakes and allows them to focus on understanding the process behind the solutions to the problems they answered incorrectly.

The application also involves two-way communication between the AIAL system and the student by acting as a tutor if the student encounters any difficulties. The system can offer assistance by showing other similar or related problems to the student, depending on where in the problem the student has misunderstood or is struggling with the problem. This can be done by the system analyzing the student's partial answer/s to try to get an understanding on what the student has already understood and where he/she actually needs help.

4 Conclusions

In conclusion, various Human Computer Interface techniques were used throughout the development of the Artificial Intelligence Assisted Learning (AIAL) app to ensure that the user was kept as a top priority throughout.

A user friendly interface for both students and teachers was implemented in the AIAL application. By implementing intuitive and easy to learn controls to use the app, the app has a low learning curve and students are able to focus all their attention on working out the material of the given worksheet rather than on navigating the application. The HCI concept of human learning and understanding is also prevalent in the AIAL application through the gamification, reinforcement and other engagement techniques used. A few examples of these techniques are the trophies, timer and colours. These aspects are thought to contribute to the student enjoyability and increase focus on the worksheet questions given.

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