Artificial Intelligence Assisted Learning

[Progress Report]

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ABSTRACT

Education is currently facing various challenges. It is proving difficult for teachers to give each and every student the attention they need due to the number of students in classes with mixed abilities. Corrections are also time-consuming. On the other hand, students lack curiosity and interest when faced with outdated resources. In addition, students may find it difficult to cope with the workload, especially when they do not have assistance at home.

The Artificial Intelligence Assisted Learning (AIAL) browser-based application will generate personalized Mathematics classwork and homework for Year 4 primary school students (aged around 7 years). This app can be used on the students' tablets which the government has provided to students.

The AIAL system is preloaded with ready-made curricula but the teachers can also create their own exercise templates. When a teacher delivers a lesson, they simply instruct the system to give the class a worksheet on a particular topic. The system will then check the profile of every individual child and give them tailor made exercises which will be challenging and engaging for the student. Gamification elements will be implemented so that students complete more work whilst enjoying themselves. If the child has difficulties, the system will assist him with inbuilt explanations. At the end of the exercise, the system automatically corrects the worked exercises and provides immediate feedback which is expected to reduce the teacher' s workload of corrections. The AIAL system also provides analytics which will also predict students who will be facing difficulties in the following weeks.

The main expected outcome of this Final Year Project is to increase enjoyment of students learning mathematics which we hope will result in an overall improvement in results. By implementing intuitive and easy to learn controls for both teachers and students the app is expected to assist learning in classrooms.

Keywords

Artificial Intelligence Assisted Learning (AIAL) , application (app)

1. INTRODUCTION

Teachers are currently facing difficulties to give personalised attention to students due to the large number of students in classes with mixed abilities. Furthermore, students often feel overwhelmed by the quantity and difficulty of the work assigned. High achievers will often find the work assigned repetitive and boring while low achievers will struggle.

The Artificial Intelligence Assisted Learning (AIAL) application will provide a novel way of giving classwork and homework to students. It is aimed to help Year 4 students and assist their teachers in primary schools. This application will generate homework and classwork depending on each student's ability. This application can be generalised to work for any school subject. In this Final Year Project the AIAL application has been specifically designed for Mathematics as it is a core subject in all schools. In this way, the application could lead to beneficial outcomes in student's learning since the work assigned to the students will be directly targeted to their level therefore the students will find the work given to them both stimulating and challenging.

This application will also correct the given work and provide immediate feedback to the student on their performance in the worksheet. Additionally, the AIAL application will provide analytical feedback to the teacher regarding each student's progress so the teacher will then be able to focus on specific areas of difficulty. This application could also be particularly beneficial to low achievers and students with learning difficulties and could help close the gap in the primary school classrooms. The application will be used on the tablets which the government has provided to students. Year 4 male and female students aged around 7 years in various schools in Malta will participate in this study.

This project highlights an important aspect of the educational system. Classwork and homework is given to hundreds of students on a daily basis. The amount of time spent on the assigned work varies depending on the students' abilities. Thus, rather than giving repetitive exercises, this application will provide individual worksheets with tailor-made exercises. Therefore, the overall quality of education will be improved.

2. AIMS AND OBJECTIVES

The aims of the final year project are:

- To develop a fun, gamelike application which will personalise the learning experience for each student
- To create an app which all teachers can use regardless of their computer programming ability which reduces their workload and correction time
- To reduce student boredom in the classroom and repetitive homework exercises
- To reduce workload and correction time for teachers

The objectives of this project are:

- Easy to use drag and drop interface for both teachers and students
- The app will generate visually stimulating and fun to use
- The app will assign work directly targeted to the student's level

3. BACKGROUND RESEARCH AND LITERATURE REVIEW

3.1 Homework

Homework is defined as "the set of school tasks that are assigned by teachers for students to complete outside of school hours"[14]. Lee and Pruitt (1979) described three types of instructional homework purposes: practice (to practice the material that is covered in class), preparation (to prepare the next lesson) and extension (transferring prior learning to new situations)[30]. In a separate study about the different types of homework, it was concluded that as a result of extension homework, the primary students' mathematics achievement was positively impacted. On the contrary, practice and preparation homework did not positively affect the student's marks. Another result showed that the amount of homework completed did not directly affect the students' mathematical achievements[41]. Numerous studies have shown that the parents' level of education has a positive impact on students' academic performance.[20, 21, 24, 36, 40]. It has also been observed that adverse effects occur when parents engage in helping with homework in an intrusive way.

Prior academic achievement was also significantly associated with students' homework behaviors namely, the time students spend on homework and the amount of homework completed. Students who perform poorly tend to spend less time doing homework, manage their time less effectively and complete less homework. Moreover, students with lower achievements reported that their parents exhibited monitoring and controlling behaviors on their homework. Numerous studies confirm that, over time, parental involvement with students on homework is associated with higher student achievement[35].

One alternative to parental involvement is tutoring. A major shift in arithmetic problem-solving strategies from counting to fact retrieval was observed with tutoring. One study showed that after undergoing tutoring, students displayed notable improvements in the speed and accuracy of arithmetic problem solving and greater use of retrieval strategies (rather than counting methods). Moreover, no behavioral measures such as intelligence quotient, working memory or mathematical abilities predicted performance improvements that occurred after tutoring[46].

3.2 Continuous assessment

Continuous assessment refers to the use of one or several assessments during the course period, instead of a single final exam in the last weeks of the semester. Continuous assessment can be used to improve student learning in higher education settings [38] as well as to improve student engagement [26]. In both cases, continuous assessment can be used to provide feedback to students[15] and teachers [17]. It has two important cognitive benefits. The first benefit is the testing effect which states that repeated testing of information leads to better retention of this information[39]. The second benefit, the spacing effect, leads to longer retention than last minute cramming because studying occurs throughout the study period[29]. Other research regarding student ability and continuous assessment shows that higher achieving students benefit more from intermediate exams rather than from continuous assessments while lower achieving students perform better on each continuous assessment[16].

Continuous assessment can be used as a measure to improve student achievement and keep students motivated throughout the year. Furthermore, continuous testing is important as it will ultimately benefit students since a significant positive correlation between the continuous assessment grades and the final exam grades was noted. Moreover, a positive relationship between the continuous assessment grades and the percentage of students passing a given subject was also noted[23].

During continuous assessment and examinations, many students experience stress in the period before and during the actual tests. Research has identified stress as a major modulator of human learning and memory processes with critical implications for educational contexts. While stress around the time of learning is thought to enhance memory formation, thus leading to stronger memories, stress distinctly impairs memory retrieval and could lead to underachievement in exams. The study of Vogel and Schwabe (2016) showed the implications of stress effects on learning and memory processes for the classroom. It was concluded that moderate stress can enhance memory formation for emotional material and information that is related to the stressful context, whereas high stress levels may impair the encoding of stressor-unrelated material. Therefore, since emotional material is typically better remembered than neutral material, an emotional positive component may be added while students learn new information to enhance later memory. Another finding was was that giving students practice exams may familiarize the students with the exam situation and reduce stress levels [47].

3.3 Interactive Computer Based Learning Systems

According to Felder and Silverman (1988), individuals learn through three learning modalities: visual, verbal and kinaesthetic[19]. Technology-assisted learning tools provide new learning experiences that could help accommodate diverse learners with different learning styles. Ling, Harnish, Shehab (2014) presented active learners with the opportunity to follow along on their own app, while allowing reflective learners the chance to internalize these changing conditions as they happen[32]. The use of direct manipulation with hand and touch sense also allows for kinesthetic learning which could potentially increase student engagement. This aligns with other research that has shown that people are more motivated to learn when they are actively engaged in learning [18]. It was concluded that when learning through examples with the mobile app, students performed better on problems that required them to apply their knowledge [32]. AberÅąek and Kordigel AberÅąek (2012)'s main result showed that for good and effective e- learning tools

the philosophical and didactical part is equally or possibly more important than heuristics[3]. This tool implements learning strategies designed to involve the student in the learning process. A high level of interactivity with immediate feedback is also provided. Through these technologies and didactic techniques, the student is placed in an "active" role, as opposed to a "passive" environment of one-way teaching. The teacher can then act as a facilitator of the learning environment rather than being a one-way communicator. Adesina, Stone, Batmaz, Jones (2014) concluded that it is very important for Computer Aided Assessment (CAA) tools to focus on the steps and problem-solving processes that students use when solving mathematical word problems in order to provide more precise feedback[4]. Similar performance scores were obtained when the interactive tasks on the CAA environment were compared to paper and pencil tests. In addition, more insight into the student's problem solving process was provided by the CAA tool. Additional practical benefits of CAA include automatic scoring, rapid feedback and increased accessibility[13]. CAA can also perform Continuous Assessment and analyze the resulting scores. Continuous assessment ensures staged progression which indicates that the tasks the students are working on are challenging as they are slightly beyond their current level. The specific design features such as immediate feedback, continuous assessment and task repetition, found in the software, probably contributed to the observed learning gains. Thus children can control their own learning and this creates an individualized learning environment that is not typically found in classrooms [12, 42]. Learner control leads to better learning outcomes [34] and may create a sense of learning autonomy. Melnyk (2016) concluded that when creating Electronic Educational Game Resources (EEGR) in mathematics for primary school students, the integrity and systematization of learning material is an important criterion. The system should be designed in a way which is interesting and understandable to primary students and the assistance should be clear and precise. Visual aids and their conformity with the content of the EEGR is another significant quality requirement to increase students' interest and keep their attention. However, they should not cause any fatigue or negative emotions. In the design of EEGR, sounds should be soft and melodious while soft pastel colours should preferably be used. It is also important to provide the EEGR with a possibility to change the font size and style easily if required. All these factors aim to achieve a positive emotional environment. It is imperative that the teacher is able to monitor students' work in the network both individually and for the whole class by using an electronic device during the lesson. These techniques will help to increase the efficiency of education in primary school [33].

Intelligent tutoring systems are a type of computer system that aims to support and improve learning and teaching processes in certain domain knowledge, considering individuality of a student, as in a traditional one-to-one instructional process. This process, also known as human tutoring, has been confirmed to be successful and presents the most efficient learning and teaching process [10, 11]. Johnson, Phillips, Chase (2009) concluded that unlike many other computer-based education systems, artificially intelligent (AI) tutors respond dynamically to the individual learning needs of each student [27]. Thus an AI tutor does not employ pre-programmed instructions to anticipate particular student responses but it uses its own ability to try to understand the part of the problem the student is working on and constructs responses in real-time. In contrast to all other computer-based education systems, Koedinger and Aleven (2007) explain how "intelligent tutoring systems draw on artificial intelligence technology to provide interactive instruction that adapts to individual students' needs and, most typically, supports student practice in learning complex problem-solving and reasoning". When an AI tutor is designed, an appropriate balance between giving and withholding assistance needs to be established[28]. Withholding assistance thereby allowing students to solve a problem unassisted can at times be just as effective as giving assistance [25, 31, 44].

A model tracing algorithm enables an intelligent tutoring system to provide assistance. The system builds a model for solving each problem by using its production rules and then compares this model to the student's solution. This allows the tutor to provide confirmatory feedback, corrective feedback, or hints upon the student's request. Due to this feedback, support can be given according to the student 's needs, decreasing as competence improves. This pedagogical approach has been effective for human tutors [49] and is expected to be helpful for intelligent tutoring systems.This will work only if recognize when they need assistance [5]. Johnson, Phillips, Chase (2009) illustrated that both high and low achieving students improved as a result of using the tutor[27]. This indicates that the increase in performance can be attributed to the tutor. The research is consistent with prior results where an interactive computer based tutoring system has had a positive impact on students' learning [1, 48]. Students who use some kind of tutoring system for self-learning or evaluation also perform better in exams in comparison to students who use traditional study methods [2]. Outhwaite, Gulliford, Pitchford (2017) showed that large learning gains were sustained when students were re-assessed after five months suggesting that hand-held tablet technology with learner-centered software is effective in supporting early mathematical development [37]. These findings are consistent with other research demonstrating improved mathematical performance in young children following tablet technology-based educational interventions delivered at preschool [43] or at home [8]. Moreover, Fuchs and colleagues have also shown that the combination of computer-aided intervention and one-to-one tutoring can significantly enhance mathematical skills [7, 22]. Other findings suggest that the games were most effective in improving students' multiplicative abilities. The tool was more effective when the debriefing sessions occurred at school to show the students how to use the learning tool rather than when the students played the games at home without prior instructions [6].

Students' perception and feedback on Interactive Computer Based Learning Systems is very important. Biscomb, Devonport and Lane (2008) concluded that students did not perceive computer-aided assessment (CAA) negatively and staff clearly noted that this form of assessment had certain time saving benefits since it can provide lecturers with a solution to heavy marking workloads. An important finding was the fact that the lecturers acknowledged that the use of CAA was an up-front investment of time at the start of the module that leads to long-term savings. The time needed to write the bank of questions was then recuperated at a later

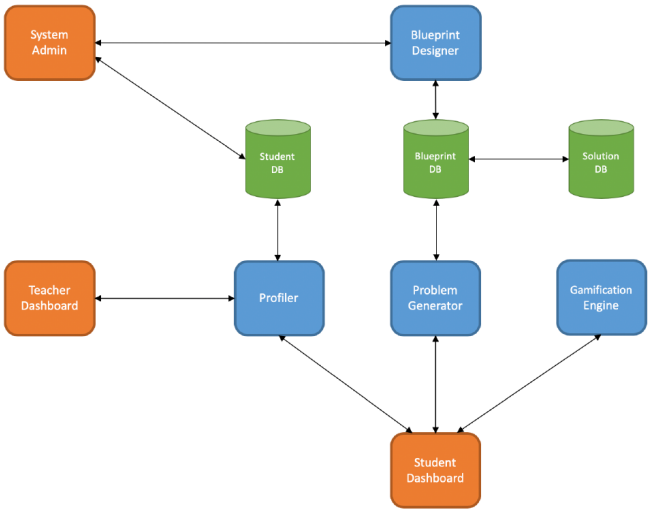

Figure 1. Basic AIAL system

stage as the marking process was not so time-demanding. In addition, the benefits of CAA for reflective practice were also highlighted as the technology allowed for an analysis of student progression and achievements in relation to each individual question set. A disadvantage was that it is hard to test deeper forms of learning through a CAA [9]. In another study a qualitative analysis of questionnaires' results revealed that most students were pleased while working with the evaluated system and that they were open-minded to embrace this kind of learning and teaching support [45].

4. PROPOSED SOLUTION

4.1 Overview of Artificial Intelligence Assisted Learning system

Figure 1 shows the basic structure of the Artificial Intelligence Assisted Learning (AIAL) system. The orange components show the different users of the system, the green components are the 3 databases which store data while the blue components are other important parts of the AIAL system.

The system administrator is the person responsible for setting up the system. This person populates the Student Database (DB) and makes use of the Blueprint Designer in order to design the class of questions or question templates which will be given to the students, together with the possible solutions. These question classes and solutions are stored in the Blueprint DB and Solution DB respectively. The teacher's dashboard is the interface seen by the teacher. Through this dashboard, the teacher can either schedule work for the students or check the various analytical reports. The student's dashboard is the main interface between the student and the system. Each student will download the work assigned to them via the profiler. The dashboard will invoke the AI in the Problem Generator which will then generate the actual problems together with their solutions. It will also invoke the Gamification Engine in order to gamify the learning experience.

The AIAL system will be mainly programmed using HTML and JavaScript as it will be a bro wser-based application. Other languages will also be used to store/retrieve the information to/from the databases.

The overall system can be broken down into 4 main sections:

1. Blueprint designer with Blueprint DB and Solution DB
2. Teacher Dashboard and Profiler
3. Student Dashboard with Problem Generator and Gamification Engine
4. Artificial Intelligence Component in Background

4.2 Blueprint designer

One of the essential parts of the AIAL system, mainly used by teachers, is the Blueprint Designer. The Blueprint Designer is used to design the type of questions that will be given to the students together with the possible solutions to these questions. The Blueprint Designer has a drag and drop interface for the teachers to use. The Blockly JavaScript library will be used so the interface will closely resemble that of a visual programming language. Consequently it will be easy to use with a low learning curve and does not require the teacher to have any prior knowledge in programming. The teachers select and drag these terms in order to form a question class/template. These templates are then stored in the Blueprint Database while the respective solutions to the questions will be stored in the Solution Database. The AIAL system will be preloaded with ready-made curricula based upon what is required by national governments. The teachers can then use the Blueprint Designer to add their own material to the system. The Blueprint Designer therefore aims to be a very useful tool for teachers as it will allow them to easily amend the questions given to students, namely if additional exercises need to be added throughout the scholastic year or when the syllabus is modified.

4.3 Teacher Dashboard

The Teacher Dashboard is the interface which is accessed by the teacher whenever they wish to assign work to the students or check the analytics generated by the Artificial Intelligence Assisted Learning (AIAL) system. Similarly to the Blueprint Designer, when the teacher inputs a topic or question classes to the AIAL system, they will use a drag and drop block style, similar to a visual programming language. Each time the teacher wants to assign classwork or homework to the students, he/she will indicate to the AIAL system which topic they should create the work for and the system will then begin to create the personalized worksheet for classwork or homework. The teacher does not need to specify the actual problems but only the class of problems. The quantity of questions and difficulty level of the worksheet will both be based upon the student' s abilities stored in the Profiler. The teacher can also mark particular exercises which they would like to have in every student's worksheet in order to ensure that all students will be given that particular exercise.

Furthermore, the teacher has access to various analytical reports which outline the performance of the students in a class and can also drill down to the individual performance of each and every student. The Teacher Dashboard will also alert the teacher if a student is having problems with a particular topic in order to prompt the teacher's intervention if necessary.

4.4 Student Dashboard

The Student Dashboard is the user interface used by the students. The students will be able to view the worksheets assigned by the teacher and can also access their profile. The student will then work the exercise generated by the AIAL system. Rather than using a mouse and a keyboard when completing a worksheet, the student will interact directly with the tablet through tap and/or drag motions for the numbers, operators or words. If the student is faced with a problem, he/she can ask the system to provide him with an explanation. This can include a step by step guide or even a video lecture. The level of explanations can also be tuned to match the abilities of the student. After the AIAL system corrects the exercise, immediate feedback will be given to the student to show them which questions were incorrectly worked out. Additional feedback might include a new explanation in order to teach the student how to solve a particular task or even additional exercises to polish their skills. From the Dashboard the student can access this feedback on incorrect questions and their explanations at any time. The student can also opt to rework previous worksheets in order to strengthen their knowledge of a particular topic.

Gamification elements will also be implemented in order to motivate students to carry out more work whilst enjoying themselves. An example will be the trophies that can be seen in the student's profile. If the student performs well on a worksheet they will be given a trophy for that topic. Another trophy will be given to a student if he/she performs all the worksheets given to them in that week.

Another gamification element which will be included in the application is timed minigames. The teacher can indicate to the system whether the worksheet should be given in the form of a minigame or not. If this is the case, each question in the worksheet will be given a time limit and if the student fails to answer the question or answers it incorrectly they will lose a life. Once all the lives are lost, the 'game' is over and the worksheet is completed. A minimum time spent playing will also be set in order to ensure that the student has worked a few questions before losing the game.

4.5 Artificial Intelligence Component in Background

The main task of the Artificial Intelligence (AI) implemented in the AIAL system is to analyse each student's profile and then create tailor-made worksheets from the question classes given by the teacher. It is important that the worksheet created is neither too easy nor too difficult so that the student feels challenged but does not feel overwhelmed. For each question in the worksheet, the AI will randomly generate the numbers(inside the given range) and/or choose a word from a predefined list to form part of the question. The AI will also provide explanations which will be tuned to match the abilities of the student. These explanations are particularly important during homework worksheets when the student encounters difficulties and is unsure on how to work out the given question. When the student completes the worksheet, the AI will also automatically correct the worked exercises and will then give feedback to the student on their performance and also update the student's profile with the new result of the worksheet. It will also create analytics from the student's profiles on the student's performance per topic or worksheet which can be viewed by the teacher. Through the analytics module, the AIAL will also predict and flag students who will be facing issues in the following weeks so that the teacher can intervene and help them directly.

5. EVALUATION PLAN

5.1 Evaluation strategy

Four schools will participate in this study once ethical clearance is obtained. The four schools are San Gorg Preca College Valletta Primary, San Andrea School, St Francis Primary School Cospicua and St Michael School. The application for ethical clearance from the University Research Ethics Committee is currently awaiting approval.

The subjects will be randomly divided into 4 groups:

1. Students given classwork only on the app (Group 1)
2. Students given homework only on the app (Group 2)
3. Students given both classwork and homework on the app (Group 3)
4. Students who will not use the app (Group 4)

If possible each class will be assigned to a group.The study will be conducted over 3 consecutive lessons. At the start of the study an explanation will be given to both teachers and students how to use the app and what the students are required to do. Then a 10 minute paper and pencil test will be given to all 4 groups at the start of the lesson. The test will be mathematically based and will be designed at a later stage after the app has been developed. Various topics will be evaluated to balance the level of difficulty.

The teacher will input into the AIAL app the past average grade of the students in order for the system to have a starting point for the user profiles.

In the second lesson, Groups 1, 2 and 3 will work on the worksheets generated by the app as detailed above. The worksheets generated will be on the same topic as the paper and pencil test given in the previous lesson.

In the final lesson, another 10 minute paper and pencil test on the same mathematics topic will be given to all groups. This test will be given in the lesson after the students use the app in order to evaluate any improvements/differences between the various test subjects. The students will also be given a questionnaire with ratings from 1 to 5 on how much they enjoyed using the app. Moreover, if there is sufficient time, a focus group will be conducted with the teachers and students to gather their feedback on the application.

5.2 Overview of Testing and Evaluation Process

Figure 2 shows the testing and evaluation process.

5.3 Analysis of Results

The following results will be analysed in detail. The difference between the results of the 1st test and 2nd test will be calculated per student. The results of worksheets completed on the AIAL app will be compared to the results of paper and pencil tests to see whether there is any correlation between their performance in the worksheets and their test performance. The average homework time will be calculated while the least and most time taken to complete a worksheet will also be noted. The worksheet given by the AIAL app to the lowest performing student on the 1st test

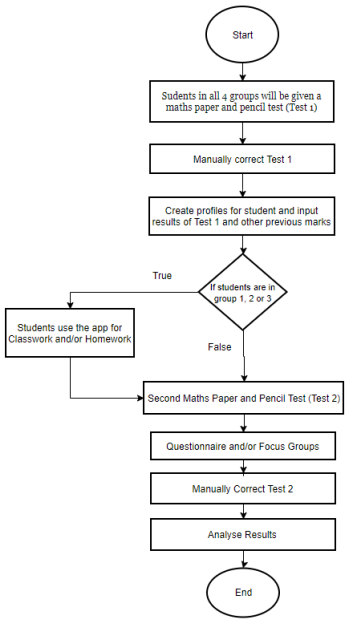

Figure 2. Overview of Testing and Evaluation process

will also be analysed in comparison to the worksheet given to the highest performing student on the 1st test. The overall feedback received from the questionnaire given to students to see whether they enjoyed using the AIAL application. Sample questions include: Did you enjoy using the app?, Is the app easy to use?, Did the app help you understand how to work out the questions? The results obtained from the focus group.

6. CONCLUSION

The main expected outcome of this Final Year Project is to increase enjoyment of students learning mathematics which we hope will result in an overall improvement in results. This improvement is expected to be noted in the maths results of the second test in the groups of Year 4 students who have used the AIAL app (Groups 1, 2 and 3) when compared to the control group (Group 4). Another expected outcome is a higher improvement in performance in the group which used the application for classwork and homework (Group 3) in comparison with the groups which used the app for classwork only (Group 1) or for homework only (Group 2). These outcomes are expected to be due to an increased enjoyment level of the students when completing the assigned work on the AIAL app.

This app aims to tailor-make worksheets according to students' abilities. Therefore it is expected that the students will react positively to this app, since unnecessary repetition is avoided, and students should find the work more stimulating. There is also the element of innovation in that students are using an app to do classwork and homework rather than paper and pencil, so this is expected to increase students' attention and decrease boredom. It is also expected that the in-built explanations will be extremely beneficial to students who may not have anyone to turn to when they encounter difficulties in their homework. Through the use of continuous assessment, the stress levels of the students are expected to decrease.

Teachers are also expected to view the app favourably as it does not require much training to familiarise themselves with the app regardless of their IT abilities. In the long run it is expected to reduce the workload of corrections. The AIAL system will also pinpoint struggling students so the teacher is able to give them more individualized attention and this is expected to be an important tool for the teachers.

One difficulty faced in this project was the limited responses received from the Head of Schools who were interested in their Year 4 students participating in this study. It was an additional challenge as we were unable to contact the Heads of Government schools prior to receiving approval from UREC. Another expected challenge is the time constraint for testing the application in schools and evaluation of the results.

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APPENDIX

A. APPENDIX A

The following documents are found in this Appendix:

- Information Letter to Heads of Schools
- Letters of Approval from Heads of Schools
  - San Andrea School
  - San Gorg Preca College Valletta Primary
  - St Francis Primary School Cospicua
  - St Michael School

ARTIFICIAL INTELLIGENCE ASSISTED LEARNING STUDY

Dear Head of School,

I am a 3rd year student at the University of Malta reading for a degree in Bachelor of Science in Information Technology (Honours) (Artificial Intelligence).

For my Final Year Project I am developing an Artificial Intelligence Assisted Learning application (AIAL app) under the supervision of Prof Alexiei Dingli. This app is aimed at Year 4 students who will be able to use it on their tablets. This app will generate homework and classwork, specifically Mathematics and English, depending on each student's ability. The app will be both stimulating and challenging and in this way the student will find classwork or homework assigned engaging, since it will be directly targeted to their level and will help them in particular topics. Moreover, it will provide feedback to the teacher who will then be able to focus on specific areas of difficulty.

The study will be carried out at school under the teachers' supervision. It is anticipated that the study will take one to two lessons to complete. I will explain how the app works to both teachers and students. The students will be randomly selected to either use the app at school only, for homework only or for both classwork and homework. A fourth group will not use the app but will only complete a paper and pencil test for comparison purposes.

The study is completely anonymous. Only the gender and ages of the participating students will be recorded. Students participating in this study may choose to opt out at any stage during the study.

I kindly ask you to sign the form below if you consent that the study can be conducted at the school.

Should you have any queries about this study, kindly contact me by email: lara.caruana-montaldo.16@um.edu.mt.

Prof Alexiei Dingli

Lara Caruana Montaldo

APPROVAL LETTER FROM HEAD OF PRIMARY SCHOOL

I give my consent to Lara Caruana Montaldo (ID 409798M) to carry out the AIAL study at

SAN ANDREA SCHOOL (Name of School)

STEFANIA BARTOLO

Name of Head of Primary School

Signature

31/10/2018

Date

San Andrea School
Parents' Foundation for Education
L-Imselliet, I/o Zebbiegh, Malta, MGR 2850
website. www.sanandrea.edu.mt
email. info@sanandrea.edu.mt
phone. +356 2143 8800

AD

APPROVAL LETTER FROM HEAD OF PRIMARY SCHOOL

I give my consent to Lara Caruana Montaldo (ID 409798M) to carry out the AIAL study at

SAN GORG PRECA COLLEGE VALLETTA PRIMARY (Name of School)

VICTORIA SPITERI		5/11/2018
Name of Head of Primary School	Signature	Date

San Ġorġ Preca College
Valletta Primary
Merchant's Street.
Valletta

APPROVAL LETTER FROM HEAD OF PRIMARY SCHOOL

I give my consent to Lara Caruana Montaldo (ID 409798M) to carry out the AIAL study at

ST. FRANCIS SCHOOL COSPICUA (Name of School)

SHIRLEY ANN GAUCI — Name of Head of Primary School

Signature

29/10/2018 — Date

ST. FRANCIS SCHOOL
15, Steeple Street
Cospicua BML 1572
Tel: 21828255 Fax: 21822955

AD

APPROVAL LETTER FROM HEAD OF PRIMARY SCHOOL

I give my consent to Lara Caruana Montaldo (ID 409798M) to carry out the AIAL study at

St. Michael School (Name of School)

Annemarie Carabot — Name of Head of Primary School

Signature

12/11/2018 — Date

St. Michael School
Alamein Road
Pembroke PBK1772
Tel: 21385027 - Fax: 21377008
infojunior@stmeduc.org

Rubber stamp of school

AD