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Research Paper

Iron Age in Augmented Reality

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Abstract: The declining number of average grade subjects in History in Sijil Pelajaran Malaysia (SPM) among Malaysian students is an increasing concern in Malaysia. The purpose of this study is to investigate the connection between the factors that cause the students to become uninterested to study History and how they affect the number of average grades. This study also aims to provide a solution to help students become more interested in learning History. Using a cross-sectional analysis, this study analyzed the factors that cause students to lack interest to study History from 2016 – 2019. The lack of the ability to imagine the situation of historical events was found to play the greatest role in causing students to be less interested in learning History. This study definitively answers the question regarding correlation between the cause of lack of students' interest in learning History and how it affects the number of average grade subjects.

Keywords: Augmented Reality, Educational Technology, History, RAD.

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1. Introduction

Roughly about 1,300 B.C to 900 B.C the discovery of ways to heat and forge iron kicked off the Iron Age. During this age, metal was considered as more precious than gold. Mass production of steel tools and weapons made the age further advances in architecture. In 'History' subject syllabus, this age is included in 'Prehistoric Period' chapter. However, learning history, specifically prehistoric can be quite intimidating because of the lack of the ability to visualize the facts [1]. As a result, students get bored and did not bother to remember the facts [2] [3].

In this new digital era, most of students use digital devices such as, smartphones, laptops, computers, tablets, and more to find resources, to read and to learn using e-books, digital online courses and mobile applications. With the help of technology such as Augmented Reality (AR), Virtual Reality (VR), students can learn more intuitively [4] [5] [6] [7] [8] [9] [10] [11] [12], eliminating the problem of being bored when learning history.

In Malaysia, the subject 'History' is still taught using the same old 'chalk and board' method which makes the subject is hard to grasp because it's dull and boring facts. The students find it hard to remember the places, dates and scenarios that took place in a particular historical event. In this case, prehistorical event requires the student to remember when the date that Iron Age happened, what are the characteristics of Iron Age, where the prehistorical sites that can be found nowadays are, and so much more facts that are hard to imagine or visualise without the help of the technologies.

This research aims to identify the key factors that influence the cause of poor interest of student in learning history and how the knowledge of these factors can contribute to help the history educators to improve the quality of their teaching with the help of technology.

2. Literature Review

2.1. Previous Research Related to the Iron Age in AR Application

Table 1 shows the previous research that related to the Iron Agen in AR Application.

Table 1. Previous Research Related to the Iron Agen in AR Application

Author	Title	Problem	Method
Ijaz et al [1]	Virtual worldsvs books and videos in history education	Traditional learning approaches often suffer from an inabilityto entertain the students and, consecutively, an inability to motivate them to learn. Reading textbooks, for example, sometimes failsto engage modernstudents and they often regard the traditional learning setup as boring and ineffective	Conducted a user study, in which learningin a virtual environment has been compared with learning from a text document or from an educational video.
Akçayır & Akçayır [2]	Advantages and challengesassociated with augmented reality for education: A systematic review of the literature	Usability issues and frequent technical problem in AR	The full range of SSCI journals was surveyed and atotal of 68 research articles were selected for analysis
Challenor & Ma [3]	A Review of Augmented Reality Applications for History Education and Heritage Visualisation	There has been remarkable little research into how Augmented Reality can be used to enhance its delivery orimpact	Multiple studies have been analysed
Nechypurenko et al [4]	Use of AugmentedReality in Chemistry Education	There are still no Ukrainian software products in thisfield	Analysis of the scientific researches results on theuse of the augmented reality in the chemistry education

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2.2. The Importance of Iron Age in AR application

Ijaz et al. [13] stated that Traditional learning approaches often suffer from an inability to entertain the students and, consecutively, an inability to motivate them to learn. Reading textbooks, for example, sometimes fails to engage modern students and they often regard the traditional learning setup as boring and ineffective. Jennifer & Ma [14] also stated in their work that there has been remarkable little research into how Augmented Reality can be used to enhance its delivery or impact. However, the conclusion of the study done by Ijaz et al. [13] shows that the study provides important evidence in favor of using virtual agents and interactive virtual worlds as a technological combination capable of improving students' motivation and academic performance. Thus, making the development of this application is a must.

2.3. Hardware and Software for Iron Age in AR application

The development of this application requires a multiple set of hardware like smartphone and laptop with minimum requirement of Snapdragon 660 or later generation and Intel Core i3 3rd Gen processing chipset or later generation respectively. For the software, minimum of 4.4.0 version of Android and Windows 7 operating system are required. To run the application, the devices must have minimum of 4.4.0 version of Android.

This application will be developed using C# programming language. In correlation of that, Unity will be used to setup the 3D world and environment. The creation of 3D models of the assets in the application would be done using Blender 3D. The Augmented Reality (AR) database and assets would be uploaded first to the Vuforia web-based application and then imported into Unity. The following software are used to develop the product:

1. Blender
   Blender is an open-source 3D graphics rendering application. 3D models in this product are developed using Blender application [8]. With this software, model creation, mesh rendering and model rendering becomes easier.
2. Vuforia
   As this product requires a visual target as a trigger to show the model, an image target what is referred as book is required for the product to be complete and whole [5]. Thus, Vuforia will act as a database for the image target.
3. Unity
   Unity act as an intermediary between 3D models, coding and connection to the image target's database [15]. Unity is the centre of the development and probably the most important software in developing this product.
4. Visual Studio Code
   Visual Studio Code (VSCode) is an Integrated Development Environment (IDE) that is used mainly to code the set of instructions such as playing a sound when the models appear on the image target [5]. In this product development, C# programming language was used to create the set of instructions and VSCode was used to write the code.
5. Canva
   Canva is an online visual graphic editor where most of the interface and icons are created using this powerful software [11].

3. Methodology

3.1. Rapid Application Development

In software engineering, there are numerous of methodology on building a software and they are called software development life cycle (SDLC) model. SDLC is the general overview of the software development while SDLC model is the methodology that are used to build the software or in this case to make the software up and running. In this research, the Rapid Application Development (RAD) methodology [16] will be used.

3.2. Research Framework

Research framework consist of four phases, are:

1. Requirement Planning
   In this phase, all of important information such as the theory and concept of Augmented Reality (AR), the content of chapter or topic in in this case, Iron Age is gathered and processed. In the

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previous chapter, the advantages of combining this technology in education was mentioned. Since the target user of this application is secondary school student, the information about learning theory, the current challenges that students are facing to learn history, the challenges to incorporate this technology into the education will be gathered. Similar existing products are also has been observed as a reference.

2. User Design
   This phase is the most time – consuming phase out of the model. Therefore, it is crucial for the developers to gather information quickly and finish previous phase as soon as possible. The activity in this phase includes finding and creating resources such as images and the details of the Iron Age.
3. Construction
   Construction phase requires the developer has to ensure the design phase has already been finalized and ready to proceed to reduce the risk of doing major changes later which will cost a lot of resources. A lot of coding will be done in this phase. System testing, integration and evaluation are also will be done in this phase.
4. Cutover
   Launching of the product will be done. Any changeover, user testing will be done in this phase. Debugging is done by the developers to ensure the security and making the application has a smooth user experience.

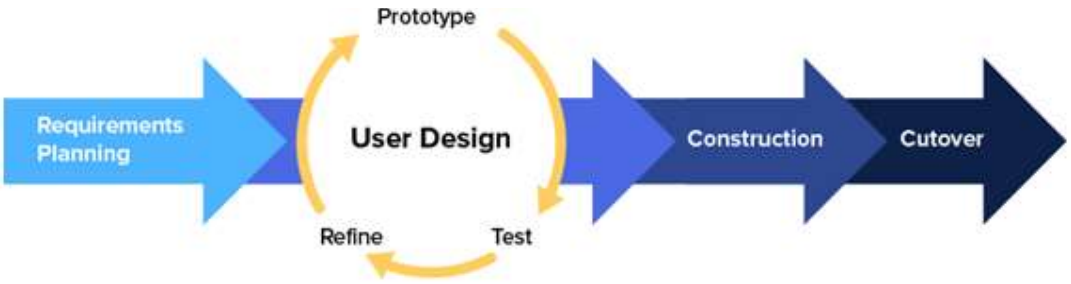

Figure 1. Rapid Application Development [16]

4. Finding and Discussion

4.1. AR Application

The application controls the device's camera, so that the according 3D images or models will be triggered when it pointed to the specific target image or the QR Code that available in every corner of the page. The animated 3D models have been applied and integrated with the AR markers of the target image by using Unity3D software. The 3D models would animate accordingly based on the target image. All the animations are controlled and altered by using the Mecanim Unity3D, which is the animator controller. Figure 2 shows the snapshots of the finished AR mobile application.

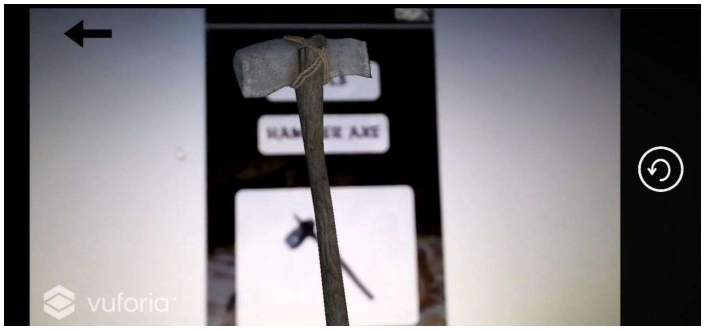

Figure 2. Iron Age Mobile Application

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Figure 3 shows the interface of Iron Age Mobile Application while Figure 4 shows the view of Iron Age Mobile Application.

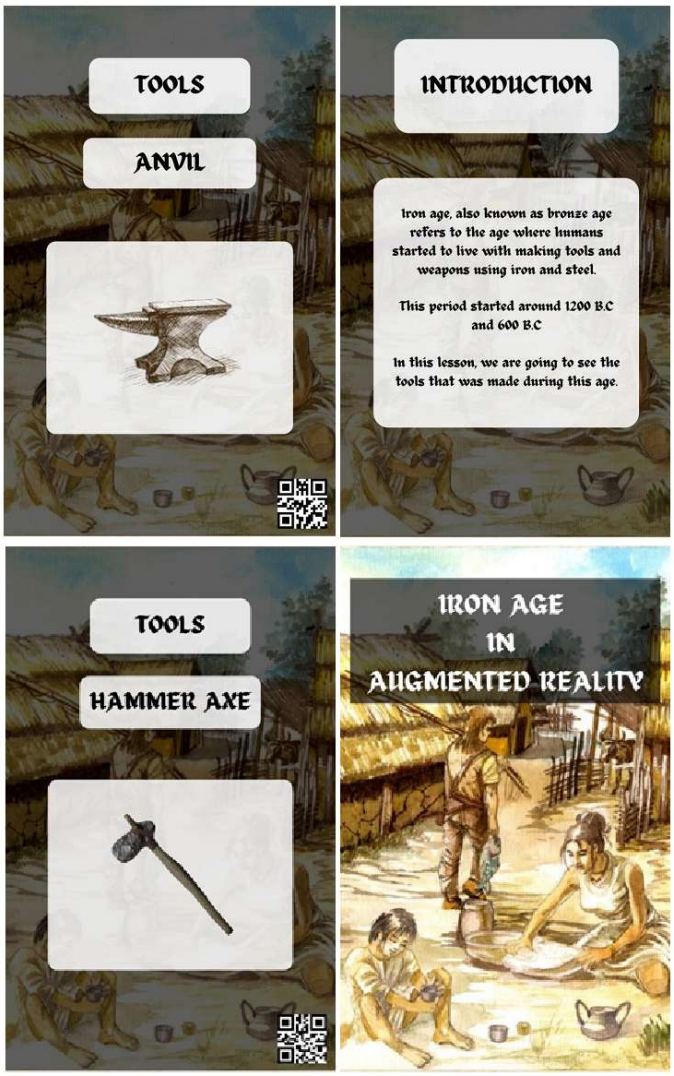

Figure 3. Interface of Iron Age Mobile Application

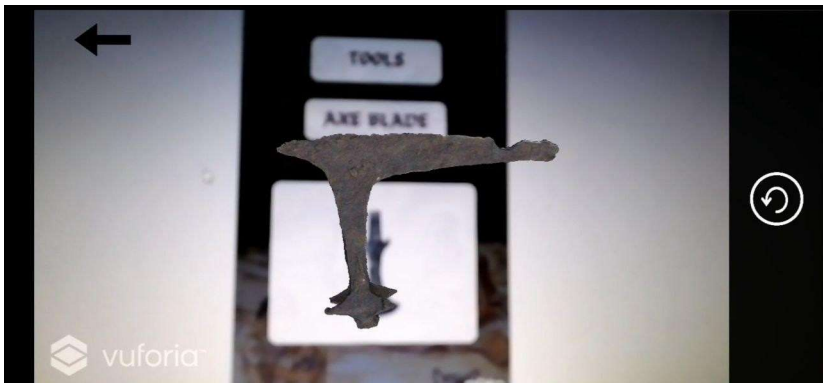

Figure 4. View of Iron Age Mobile Application

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4.2. User Feedback

The questionnaire was distributed online due to constraints of the Malaysian movement control order (MCO) phase. In general, the purpose of each of these criteria is to recognize the requirement and concerns of secondary student, as well as to gather input and opinions on this technology innovation. The outcome helps to promote the development of an application for further enhancement and alteration of the application.

The questionnaire survey was performed by a number of parents and teachers who had children who had taken the subject to school. In addition, the questionnaires contain four questions related to children's learning and also on the awareness of Augmented Reality that needs to be incorporated in education. The user acceptance survey asked the user four key questions. The survey included a variety of respondents, including parents and teachers. This questionnaire has been distributed to parents and teachers who have been equipped with Android Package (apk) applications for use. The graphs and pie charts below show the outline and explanation of the questions posed.

Based on the Figure 5, it can be concluded that most of the respondents are composed of both parents and teachers. This can be assumed that most of the respondents are teachers who already have children. The second highest list is teachers followed by parents.

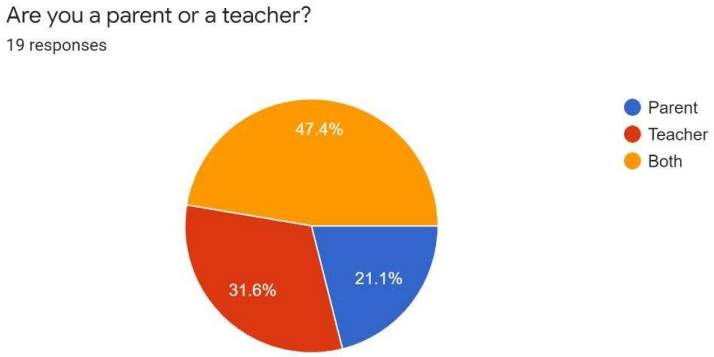

Figure 5. Questionnaire: Status Respondents

Based on the Figure 6, it can be seen that most of the respondents, they are not familiar with AR technology. It is assumed that this technology has not been expanded, especially in the field of education. These results indicate that there is still a lack of exposure to the public on the effectiveness of adapting AR in education. In the third question the respondent was asked to give an opinion on the important to apply augmented reality technology in education particularly in History subject. Most respondents give their impression that it is important to increase their understanding and interest in the subject of history.

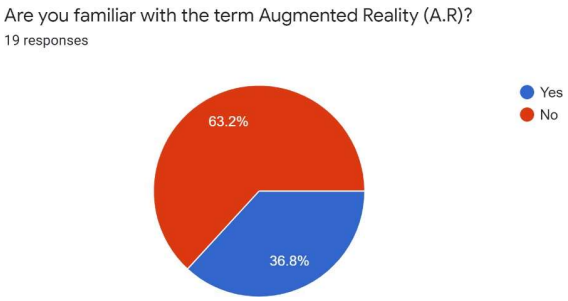

Figure 6. Questionnaire: Respondents Familiar with AR

Figure 7 shows a large percentage of respondents who agree to apply augmented reality technology in history education for students. It is seen to be able to help students to learn more about the history

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and technology itself. Followed by the answer 'maybe' assuming that is because they are still skeptical of the use of the technology or maybe because they prefer and are comfortable using traditional ways of learning that is through books and theory.

User test testing is split into two studies of user perception. Parents with children between the ages of 10 and 15 and teachers were involved, as well as observational research involving lower secondary school students. The outcome helps to sustain the application that has been built to further enhance and change the application. The outcome of the following question is as follows:

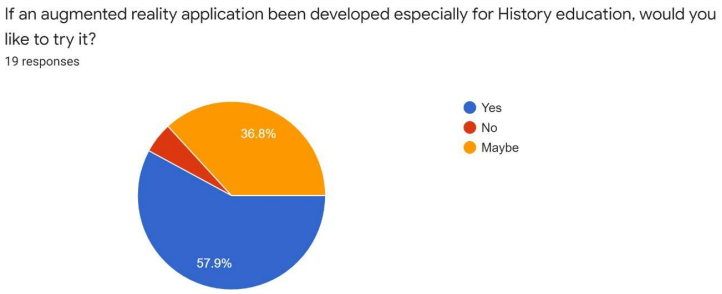

Figure 7. Questionnaire: User Perception-Q1

Figure 8 shows that the majority of respondents have seen the demonstration video provided to them so that they can more easily understand how to use and the effectiveness of this application. This also show the objective of the video has been fully implemented. The used of the video can help them in better understanding of the use of the application can fully evaluate the requirement gathered.

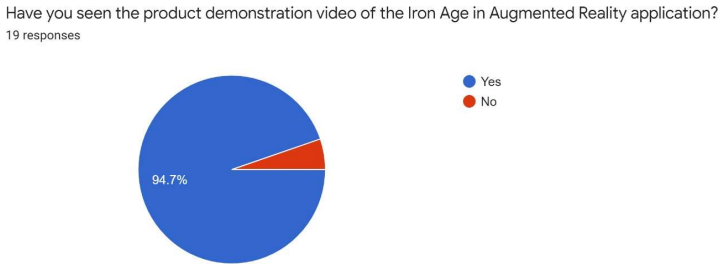

Figure 8. Questionnaire: User Perception-Q2

Based on the Figure 9, it can be concluded that the respondents agreed that the technology used in this application can be used in learning at school as well as outside the home. It can help students in learning something in a fun environment. Applying this technology in school learning can improve students' understanding because it can be shown in a more interesting way that is in 3D in the real world.

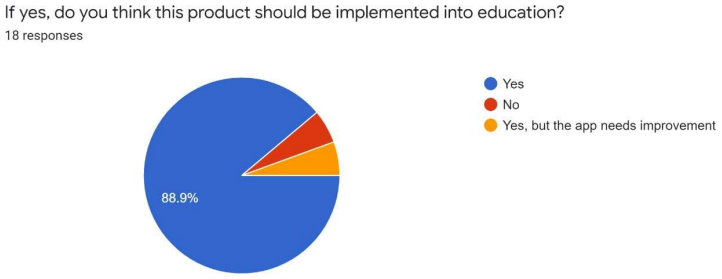

Figure 9. Questionnaire: User Perception-Q3

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Based on the Figure 10, it can be concluded that majority of respondents agreed that the application of AR in history education can help students identify a prehistoric artifact that is rarely found and difficult to show because it is in a designated place such as in a museum. Therefore, in this way it can help students recognize the artifact better because they can see the object in 3d in their device.

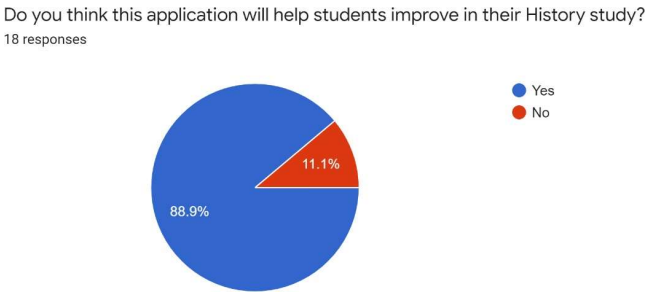

Figure 10. Questionnaire: User Perception-Q4

Question 4 is scaled from 1 to 5 at which are 1 is the least enjoy and 5 is for the enjoyable. The graph shows that majority of the respondents rated scale 4, which are likely enjoyable that they would use the product for educational purpose, and the remaining 3 rated in scale 3, which are slightly enjoyable means still prefer to use the current method to learn history. Overall, of the survey results, which based on these questions, asked shown positive feedback from the parents and teachers as all of the questions were rated at scale 4 and 5.

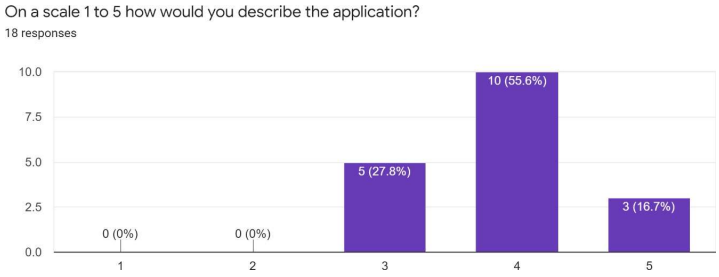

Figure 11. Questionnaire: Overall Survey Result

4.3. Discussion

Iron Age in Augmented Reality can increase understanding and enhance students' creativity in learning the subject of history by recognizing each artifact more carefully and clearly in 3d in the real world. Other than that, students can increase their interest in learning history which is generally boring because most history subjects are taught theoretically and formally in class. Most of the learning way to teach certain subject is just manually using book or theory lesson by teachers or their parents.

Therefore, the implementation of AR in mobile application would help the children on understanding and apply the learning about artifact in their life in fun and interactive way. By using the specific image target, they can know the artifact in 2D or otherwise they can just point the camera device to the images which is acts as the marker for better understanding more detail of the artifact in 3D. The AR mobile app has attractive and interesting interfaces and 3D animation character where the users can work simultaneously with physical storybook and mobile app.

Indeed, it will grab students or children's attention, creating more interesting and can stay focusing on their learning. To conclude, the research will possibly become the greatest improvement of existing learning guides for teachers and parents to teach their children computer science. The research can be strengthened and expanded in the future to make it user-friendly and will satisfy some other considerations.

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5. Conclusions

On the basis of the research and the findings carried out, the respondents preferred that AR should be introduced in children's learning in subjects such as recognizing prehistoric people, since it is more engaging and can interest children in their learning. In addition, if the characters' animations were longer and allowed a few more movements and positions, it would be even more interesting. Besides that, if it contained some interactive games and quizzes, it would be more engaging and intellectual for users. More advanced features may also be implemented in the AR mobile application for simple day-to-day human operation and additional subject such as mathematics and science. One of the best implementation decisions is that to expand the use of the AR smartphone app, it can be applied to the iOS system.

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