

Pop-Up Cards: An Android M-Learning Application with Augmented Reality for Preschoolers

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Abstract: The purpose of this research is to provide a mobile learning android application for preschoolers with the used of Augmented Reality to become more interesting and learn in a new exciting way. It is a tool for improving the learning process and also to expand their visual learning through 3D interactive objects using a handheld android smartphone device. The application has “Learn” and “Games” features which consist of different categories like alphabets, colors, shapes, animals, body parts, and planets. The application was created using Unity, Blender, and Maya for designing the game and 3D objects. The developers used C# Programming Language for the function of the app and Vuforia for the Augmented Reality. The researchers followed the Iterative Software Development Model as a guide in developing the application. The application was tested using Functional test, compatibility test and conformance test by preschoolers guided by parents and other researchers team. The developers got a percentage of 100 in compatibility testing, In Functional testing, the developers got a percentage of 94.43% and in conformance testing the developers got a percentage of 88.75%. The application was evaluated using Mobile Application Rating Scale (MARS) by IT Experts, Preschool guided by parents, Parents, and Android Users. The overall results have a mean of “3.68” and an average standard deviation of “0.52” that was interpreted as “Highly Acceptable”.

Keywords: Augmented Reality, Pre-schooler, Mobile Learning, Android, 3D, Interactive, Application.

I. INTRODUCTION

Nowadays, many technologies are used for teaching in schools. Earlier, children have learned through physical teaching by using pencils, paper, books, charts, and flashcards. With the advent of technology, people are allowed accessing information, getting educated, and entertained. It takes a lot of patience, perseverance, and effort to teach and get the attention of a pre-schooler. According to the interview by Kimberly Moore, Ph.D. to Dr. Bruce Perry, Ph.D., M.D, there are many positive qualities to modern technologies. The technologies that benefit young children the greatest are those that are interactive and allow the child to develop their curiosity, problem-solving and independent thinking skills. The use of technology work very well to help children even on the simplest level. When information is presented in a fun and engaging way, it is a lot easier to absorb the information [1].

Augmented Reality addresses the benefits of technologies that children need. It is a product of the evolving technology and has been a trend [2] and applied to education [3], [4]. According to Contero, Cascales, Lopez, Perona, and Laguna, the use of AR promotes active behavior in the student. Hence, students learn more when they are using AR and they achieve more learning goals. AR also promotes communication skills, promoting all kinds of interactions in the classroom between teacher and students, students and students, students and families, families and families and teachers and teachers [5].

Pop-up Cards is an M-learning Application with Augmented Reality for Pre-schoolers. It aims to help pre-schoolers to have a fun and exciting learning experience. Integrating technology on the daily classroom set-up may encourage students especially pre-schoolers to focus on their lessons such as alphabets, numbers, shapes, colors, animals, body parts and planets which this application have [6]. Pre-schoolers are kids ages 3 to 5 and their usual activity is all about playing and games, therefore the traditional teaching and learning set-up may not get their full attention and can be a burden to teachers or parents. Applying Augmented Reality as a learning tool can make pre-schoolers learn in a fun and engaging way of acquiring knowledge and understanding.

A. Objectives of the Study

In general, the study aims to develop an M-Learning Application with Augmented Reality for Pre-schoolers

Specifically, the project aims to:

1. Design an application with the following features:
 - a. Provide Pre-school lessons like Alphabets, Numbers, Colours, Shapes, Body parts, Animals, and Planets using Augmented Reality
 - b. Visualize 3D objects using Augmented Reality feature.
 - c. Gamified assessment for pre-schoolers
 - d. Adjust the application settings
2. Create a system using development tools such as Unity, Blender, Vuforia, and Maya as Front end and C# for the Back end.
3. Test and improve the application using Functionality, Compatibility and Conformance Testing.
4. Evaluate the system using Mobile Application Rating Scale (MARS).

B. Scope and Limitation

The M-learning application was developed using Unity, Vuforia, Maya Autodesk, and Adobe Photoshop CS6. The target users of the application are pre-schooler with ages 3 to 5 years old. The application provides preschools topics such as Alphabets, Colours, Shapes, Animals, Numbers, Body Parts, Planets. It also has a gamified assessment that covers the mentioned topics. The application makes learning more attractive as the preschool students visualized the 3D objects. The preschool students can interact with the 3D objects, by clicking the learning cards.

The android application only works on smartphones with a version Android 4.1 Jellybean up to 9.0 Pie. It will not run on any other mobile platform like iOS and Windows-based phones. Using the augmented reality feature the user must use the provided learning cards to see the 3D objects. The minimum specification of the Android camera should be a minimum of 8 megapixels that needs to be directly focused on the target (learning cards). The maximum distance of the android device to the learning cards is approximately 30cm away to best view the 3D objects.

The pre-schooler needs the supervision of parents/guardian in downloading and printing the provided learning cards and in using the augmented reality feature.

C. Significance of the Study

The Pop-Up Cards is an M-learning application with Augmented Reality for Pre-schoolers.

Teacher – The application can be used as a supplementary tool in teaching pre-schoolers.

Preschool Students – The application will make learning in an interesting and interactive way to pre-schoolers.

Parents – The application will help the parents to teach kids the basic topics in an engaging way.

Future Researchers – This application will open opportunities to other researchers to innovate the learning to pre-schoolers.

II. METHODOLOGY

A. Data and Process Model

The program flowchart that shows a design represents the sequence of operation of the project. This diagram only shows what the application does when executed.

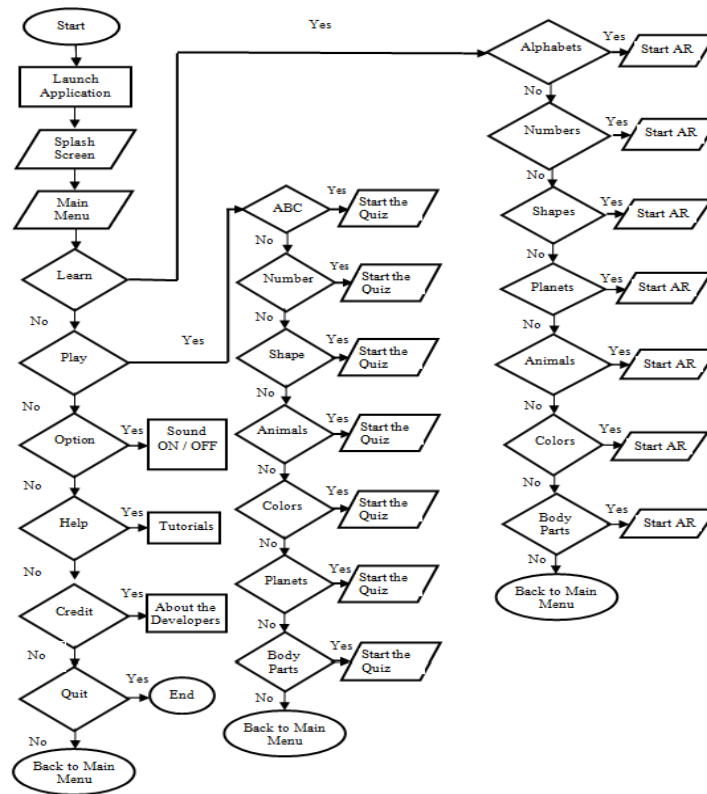


Fig. 1: Flowchart of Pop-Up Cards

Fig. 1 shows the flowchart design of the application “Pop-Up Cards”. Once the application is launch, it will show the splash screen and then the different option from the main menu. The user can choose from different option such as: Learn and Play. It contains fundamental topics of Pre-schools such as Alphabets, Numbers, Animal, Colours, Shapes, Planets and the basic Body Parts. The user can choose in any of the topics mentioned to view the 3D objects which correspond in the learning cards. In Play Mode, the user must answer the different questions from the different categories. The user can change the Settings of volume in Option. Another feature is the Help where the user can see the tutorial.

B. Development

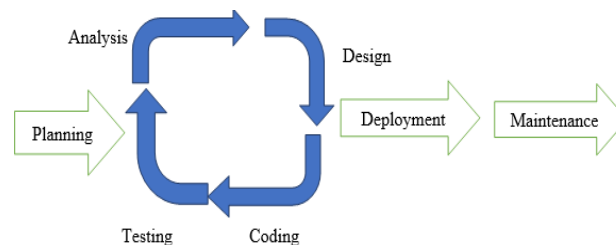


Fig. 2: Software Development Paradigm using Iterative Model

The researchers used the Iterative Software Development Model as shown in Fig. 2. An iterative development begins by planning and brainstorming all the needed data in developing the project. Next is the Analysis, where the researchers analyzed the must need in the development like the curriculum for pre-schoolers. Next, the Design phase is where the user interface design of the application is made. This is a crucial part since the design must a children-friendly. Then, the Coding phase is the very core of the application as this is where all of the functions of the application are developed. After

that is the Testing Phase where bugs and fixes are found to be able to know which actions should be done to make the application more efficient and functional. It is tested using Functional, Conformance and Compatibility Test. These four processes mentioned are then repeated until the application is good for deployment. The deployment phase is the part where the application will be uploaded in the Play Store and is good to use. The maintenance phase is part where the application will be updated to fix bugs that may be found in later years after its first deployment or uploading a better version of the application.

C. Test Plan

The mobile learning application used Compatibility Testing, Conformance Testing, and Functional Testing. Compatibility testing will have ensured that the game is compatible through various Android version and different screen sizes [7]. Conformance testing is based on the standards of the Android Core App Quality the visual design and user interaction, functionality, performance, and stability and adherence of the application through Google Play [8]. Functional Testing to test all functions of the application [9]. The test respondents are the pre-schoolers guided with parents, other capstone team and the developer's technical adviser. This assured that the functions of the developed application are well functioning. This also helped the developers on testing and maintaining the developed application and making sure that the application is working on an Android Operating system platform version 4.1 Jelly Bean to 9.0 Pie and compatible to specific screen sizes.

D. Evaluation Plan

The developers used different smartphones with different android versions during the evaluation period and used Mobile Application Rating Scale(MARS) Evaluation Instrument [10]. The learning cards were also provided during the evaluation. The evaluation respondents were participated by (10) IT Experts, (15) Pre-schoolers with guidance of parents, (10) Parents, (10) Android Users. The MARS criteria are Engagement, Functionality, Aesthetics, and Information

The gathered data were presented and calculated using statistical computations. The weighted mean [11] and the standard deviation [12] were computed.

The researchers used a Likert scale that is commonly involved in research that employs questionnaires. It used fixed choice response formats and are designed to measure attitudes or opinions.

Table I: Likert Scale

Likert Scale	
3.26 – 4.00	Highly Acceptable
2.51 – 3.25	Acceptable
1.76 – 2.50	Fairly Acceptable
1.00 – 1.75	Unacceptable

Table 3 shows the basis of scores during the survey. If the score is 3.51 up to 4.00 it is "Highly Acceptable" and if it is 2.51 up to 3.50 it is "Acceptable", and if the score is from 1.51 to 2.50 it is "Fairly Acceptable". The lowest score is 1.00 up to 1.50 equivalent to "Unacceptable".

III. RESULTS AND DISCUSSION

A. Design



Fig. 3: Main Menu of Pop-Up

The main menu of the application as shown in Fig. 3. It consists the Learn button, Games button to play games, Options button to on/off the music, Help button to show how to use the application, Credits button to show the information about the developers and the Exit button to close the application.



Fig. 4: Learn Category of Pop-Up

The learning category of Pop-Up Cards shown in Fig. 4. The user can choose topics about Alphabets, Numbers, Animals, Shapes, Colors, Planets and Body parts.



Fig. 5: Play Category of Pop-Up

The Play Category of Pop-Up Cards display in Fig. 5. The user can Play about Alphabets, Numbers, Animals, Shapes, Colors, Planets and Body parts.

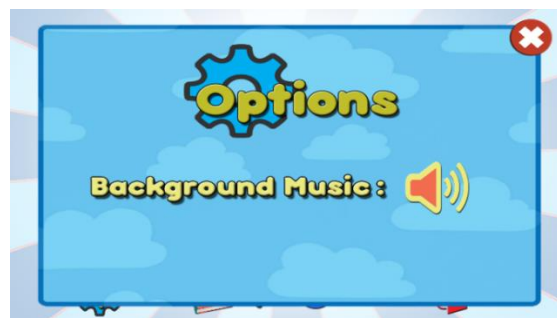


Fig. 6: Option Feature of Pop-Up

The Setting of Pop-Up Cards shown in Fig. 6. The user can turn on/off the background music and the button sounds.



Fig. 7: Help Feature of Pop-Up

The Tutorial of Pop-Up Cards shows in Figure 13. Tutorial will help the user on how to use the application.

B. Test Result

Table II: Summarized result of Compatibility, Conformance and Functional Testing Conducted on “Pop-Up Cards: An M-Learning Application with Augmented Reality for Pre-schoolers”

System Testing	Pass	Fail	Total number of test condition/ Test Criteria	Percentage
Compatibility Testing	14	0	14	100%
Conformance Testing	71	9	80	88.75%
Functional Testing	102	6	108	94.43%

In compatibility testing, the developers tested the application in different mobile devices with the different operating system. The developers got a 14 pass over 14 having a percentage of 100 in compatibility testing. The application runs smoothly in android with versions 4.1 Jelly bean up to 6.0 marshmallow and different screen sizes.

In conformance testing, the developers used the Android Core App Quality. The application conforms on most of the criteria of the conformance testing but the test criteria under Google play were all failed because, during the testing, the application is not uploaded on the Google Play. The developers got a 71 pass over 80 having a percentage of 88.75 in conformance testing. Google Play error was resolved by uploading the mobile application in the Google Play store

In Functional testing, the developers got a 102 pass over 108 with a percentage of 94.43. Functional testing conforms to its specifications including the menu functions, core application functions. Some bugs and errors seen in the application like the buttons are not functioning during the test and the body parts a choice doesn't fit correctly. The developers fixed the bugs and errors in the buttons of the application encountered during the test.

C. Evaluation Result

Table III: Overall Evaluation Results

Level of System Acceptability	Mean	Standard Deviation	Interpretation	Rank
Engagement	3.53	0.59	Highly Acceptable	2
Functionality	3.44	0.71	Highly Acceptable	4
Aesthetics	3.66	0.53	Highly Acceptable	1
Information	3.50	0.59	Acceptable	3
Average Mean & SD	3.68	0.52	Highly Acceptable	

The highest rank in the overall evaluation results is the “Aesthetics”. The majority of the respondents strongly agreed that the application has a good design

The second is the “Engagement”, The respondents strongly agreed that the application is fun and interesting to use.

The third is “Information”. The respondents strongly agreed that the content and visual explanation of concepts are appropriate and sufficient for the target user.

Lastly, the criteria of “Functionality” rank the least but still interpreted as “Highly Acceptable”. The respondents strongly agreed that the application conforms with the expected result.

IV. CONCLUSION

The developers successfully developed an M-Learning application with Augmented Reality for Pre-schoolers. The application is aligned from the DepEd Pre-School Curriculum that includes topics in Alphabets, Numbers, Colours, Shapes, Body Parts, Animals, and Planets that utilizes an Augmented Reality.

The application was designed and created using the development tools such Unity 3D as the game engine, Adobe Photoshop CS6, Blender, and Maya for designing the GUI, text, backgrounds, logos, and animation. Vuforia for Augmented Reality feature and C# for the programming language.

The project was tested and improved based on the functional, conformance and compatibility test did. The evaluation was conducted to achieve the system's acceptance to the user based on the Mobile Application Rating Scale (MARS). The overall result got a mean of "3.68" and an average standard deviation of "0.52" that was interpreted as "Highly Acceptable". This concluded that the m-learning application with Augmented Reality can be a tool in learning fundamental lessons in Pre-school. To enhance the application, the following are recommended future features: availability to another platform like iOS, improve 3D figures; and advanced topics in preparation for Grade 1.

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