

Implementation of Educational Play Game

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Abstract— In recent years, educational phone games have been ineffective as educational tools. This has been mainly due to players being aware that they are learning whilst playing these games. This leads to players being bored and not learning whilst playing the phone games. This research work tries to answer the academic question, which is “Can phone games teach basic educational principles to primary school children without them being aware that they are learning?” The research starts with discussing, if phone games are effective tools to teach students. The research work continues by inspecting on what role motivation plays when students play fun games. This led to consider whether different learner styles can affect students on how much they can learn from playing phone games. Using this information, research is conducted into a suitable design methodology on how to effectively implement educational content into phone games. The given research showed that students tend to prefer learning by using phone games.

A phone game was created using the research conducted on the design methodology for implementing educational principles into phone games. To develop the phone game, background research had to be conducted on modern phone games teaching, educational principles, appropriate tools for coding phone games and suitable testing methods. The testing was done on parents using a quiz and a questionnaire. The results of the test were used to answer the academic question, which showed that phone games can be used to teach basic educational principles to primary school children without them being aware that they are learning. This research concludes with what has been achieved and a critical evaluation of the methods and tools used during the research.

Keywords: phone, games, primary school, children, teach students.

I. INTRODUCTION

Phone games’ is a term that is widely used to describe many different activities on the phone. Games can be categorized into broad groups and these teachers led categorizations are comprehensible to parents. Primary teachers perceive that many educational titles contain a game element, and this perception is shared by children using such applications. The games included in this evaluation were all outside this traditional classroom software group. Games provide a forum in which learning arises as a result of tasks stimulated by the content of the games, knowledge is developed through the content of the game, and Skills are developed as a result of playing the game. It seems that the final obstacle to games use in schools is a mismatch between games content and curriculum content, and the lack of

opportunity to gain recognition for skill development. This problem is present in primary schools, but significantly more acute in secondary. Many of the skills valuable for successful game play, and recognized by both teachers and parents, are only implicitly valued within a school context. Teachers and parents both valued the conversation, discussion, and varied thinking skills demanded by some of the games employed. However, these alone could not justify the use of the games within a crowded school curriculum. Teachers have highlighted and indicated elements of game structure and form which would enable some of the games to be incorporated into the school context.

II. LITERATURE REVIEW

a. What are we looking for?

There is a widely held view that games software is capable of developing a degree of user engagement which could be usefully harnessed in an educational context. This research work was seeking to:

- Explore the notion of the computer game.
- Understand the complexity of the genres.

Identify what, if anything particular types of game might contribute to the development of learning related skills or the knowledge of content. Consider the match and mismatch between these skills and content and those recognized as valuable within traditional educational settings. The aim of this research work provides the answer the academic question, which was: Can phone games teach basic educational principles to primary school children without them being aware that they are learning? To answer the academic question, a phone game was created with its main criteria being that it was educational so that users would learn whilst playing.

This report presents the phone game development cycle from the requirements specification stage to the implementation stage. The phone game was designed to answer the academic question. Whilst creating the phone game, the following criteria were considered and answered:

- Selecting appropriate software to develop the phone game.
- Choosing suitable educational principles to be implemented in the phone game.
- Ensuring the phone game was suitable for primary school children.

In addition to answering the academic question, this research work also intended for achieving four aims. They were:

- To evaluate the use of phone games as educational tools.
- Investigate educational phone games.
- Evaluate the phone game development process.

- Develop knowledge in a scripting language. These aims were then broken down into several objectives which were:
 - ✓ Complete a literature survey and literature review on how phone games are being used as educational tools.
 - ✓ Identify and evaluate game design of existing educational phone games.
 - ✓ Develop a suitable game.
 - ✓ Evaluate the effectiveness of the phone game using appropriate tests.
 - ✓ Identify phone game development approaches suitable for modeling educational games.
 - ✓ To learn and develop skills in a scripting language dependent on the tools used to develop the phone game.
 - ✓ Complete final report.

III. METHODOLOGY

Every player has a different learning style, whether they are a child or an adult. There is no research indicating that there is one learning style suited for all children in a certain age group. This indicates that for an effective educational fun game, it should have aspects of all different learning styles. To ensure this a learning model should be used. Walter Leite et al. suggest using the Neil Fleming's VARK model as it is the most popular and most commonly used model. The VARK model covers three distinct learning styles, which are visual, aural and kinesthetic.

Visual learners are individuals who learn by seeing images. An effective educational fun game for visual learners would use images, and not be just text based. Aural learners are individuals who enjoy learning with sound. An effective educational fun game for aural learners would use sound to indicate clues. This will ensure that individuals with these learning styles will enjoy the phone game. Kinesthetic learners are individuals who learn by doing. An effective educational fun game for kinesthetic learners would be interactive to ensure that individuals can learn from playing the game. Nalin Sharda claims that learning outcomes depend upon the match between learning styles and those offered by the system. This means that if the learning styles offered by an educational fun game are similar to its players, they will learn more compared to an educational fun game that does not offer the player's learning style. However, research conducted by Harold Pashler et al. contradicts the views of Nalin Sharda and indicates that users will not learn best when they are taught in their preferred learning style. Research conducted by Peter Fenrich (no date) expands upon both Nalin Sharda and Harold Pashler views where it states that

“A match between learning style and instructional design can result in increased achievement as well as better attitudes. However, when a learner's preferred learning style does not match the instructional design, effective learning can still occur.”

This indicates that even if educational phone games do not cover all distinct learning styles equally, it will not mean that players of that learning style will learn less. To ensure that

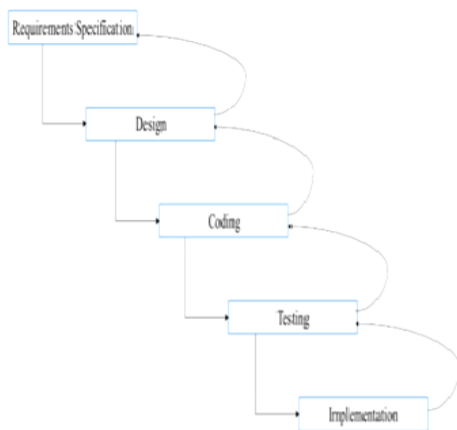
every learning style is motivated to keep playing, Peter Fenrich (no date) suggests providing varied activities so that each learner is likely to have a preferred activity for a reasonable amount of time. This signifies that challenges in an educational fun game should have an equal amount of visual, aural and kinesthetic activities so that all distinct learning styles will be motivated to keep playing. Educational phone games are systems that use digital technology to create games for enhancing learning outcomes and have been recognized as pedagogical tools which are engaging and effective. This indicates that educational phone games are a viable method to teach students about educational principles. Mark Griffiths expands upon Nalin Sharda's views by revealing that for several decades, phone games have been used as educational tools as students. This was because students prefer this type of approach to teaching. This signifies that students prefer this method of teaching instead of the older method. According to Mark Prensky, the reason that students prefer this method over the older method is because: “Educators teach in an outdated language (that of the pre-digital age) and are now struggling to teach students that speak an entirely new language (which is post digital-age). This is because today's students have grown up around technology, which has resulted in them to find the current method and pace of teaching too slow.”

This signifies that the current education system is not designed to teach today's students. This leads to students being de-motivated and bored while at school, which means they will not be learning. Katie McClarty et al. declares that by continuing to provide this type of education as the world continues to evolve will not serve the students well. This is because students are not learning because they are not motivated to do so. This will lead to them not achieving necessary skills for the future.

IV. DESIGN AND IMPLEMENTATION

a. Development Cycle

The development cycle that was chosen for the artefact development was a Winston Royce's waterfall model. The waterfall model is where the development is broken down into different stages. Once a stage is completed, the user goes on to the next stage. The waterfall model allows going back to a previous stage, which is known as splashing back. This model was found the most suitable for the artefact development as uncertainty and complexity were both low for the user interface design and user requirements. This was because the requirements of the artefacts were clearly understood at the beginning of the development stage. There was a high risk for the artefact in terms of schedule, but the waterfall model is a structured approach that allowed for easy time management. An alternative development cycle that was considered for the artefact was rapid prototyping, also known as an evolutionary prototyping model. Rapid prototyping is an unstructured approach in which the core artefact is produced. It is then built upon that every time during the development cycle. Rapid prototyping was found



not suitable as there was limited time for development. Rapid prototyping requires time, so that a prototype can be shown to a client and then continue building upon with any changes recommended by the client. Rapid prototyping is most suitable when there are uncertainties in the user requirements. The requirements for the artefacts were clear at the beginning of the development, hence the rapid prototyping development cycle was found not suitable. The waterfall model which will be used in the development of the artefacts can be seen. Rapid prototyping was found not suitable as there was limited time for development.

Rapid prototyping requires time, so that a prototype can be shown to a client and then continue building upon with any changes recommended by the client. Rapid prototyping is most suitable when there are uncertainties in the user requirements. The requirements for the artefacts were clear at the beginning of the development, hence the rapid prototyping development cycle was found not suitable. The waterfall model which will be used in the development of the artefacts can be seen.

There are five different stages of the waterfall model which all serve a different purpose towards the development of the artefact. The stages where requirements specification, design, coding, testing and implementation.

b. Requirements Specification

The requirements specification stage was where the artefacts requirements were stated and what it's intended to achieve. The first requirement of the artefact was to answer the academic question, which was to see if phone games can be used to teach basic educational principles to primary school children without them being aware that they are learning. To use the artefact effectively to answer the academic question, it was going to be designed as a phone game. Gary Geisler et al. stated that phone games are sophisticated applications, which are graphic-intensive and contain immersive experiences. This meant that the phone game that was going to be created had to contain graphics and create immersive experiences for its primary user. To ensure that the artefact was a fun game it is designed first. This included background research on previous and current

educational phone games. As the phone game had to teach basic educational principles to primary school children, research was also undertaken on what primary school children are learning during the ages of 7 – 11. This was also a part of the design section. Another requirement for the phone game was to aid in achieving the aim of developing knowledge in a scripting language. The aim is linked to the objective of developing skills in a scripting language dependent on the tools used. A scripting language is a high level programming language used to create programs or scripts. Some examples of scripting language are C++, Java, Python and Ruby. To achieve this requirement, the phone game creation tool had to involve a scripting language. Background research was conducted into the tools used to develop phone games. This would ensure that the tool included an opportunity in developing skills in a scripting language. This research was done in the justification of tools. The phone game also had the requirement of achieving the objective of creating a suitable phone game. This meant that the phone game's content had to teach its primary user, which were primary school children. This requirement was linked very much to the first requirement, which was to answer the academic question. This was due to both requirements needing a suitable phone game which had educational principles built in. For the phone game to teach effectively, it had learning outcomes. The learning outcomes were stated in the design section.

c. Design

The design stage was where the phone game was designed to meet the requirements set out in the requirements specification stage. The design was used to code and develop 11 the phone game. The first phase of the design stage was to conduct background research. The background research consisted of evaluating modern phone games that taught educational principles. This gave a greater understanding on how educational principles are implemented into phone games. The background research can be seen in section A list of criteria was derived after conducting the background research. The list contained five elements of what made modern educational phone games effective. The five elements in the list were:

- Educational phone games should be short so that users could pick up and play them when they wish to.
- Educational phone games should include a variable feedback system that reacts to user inputs.
- Educational phone games should have one main goal which the user intends to achieve.
- Educational phone games should have additional optional quests or challenges which users should complete by using the educational content they learned from playing the phone game.
- Educational phone games should have an open world so that users do not feel restricted on what they could do.

This list was taken into consideration when the phone game was designed. This was to aid in creating an effective educational fun game. By completing the background research led to achieving the aim of investigating educational

phone games. This aim was important to the research work as it gave knowledge of what made an effective educational fun game

d. Coding

Following the design stage was the coding stage, which was where the phone game was coded and developed. The first phase of the coding was to find suitable software to develop the phone game. To find the most suitable software, research was conducted on several different games developing software. The software had to meet certain requirements in order for it to aid in the development of the phone game and achieve the aims and objectives of the research work. After the research, Unity3d was found the most suitable software as it was well-matched to the initial game design of the phone game. Unity3d also aided in achieving an aim, which was to develop knowledge in a scripting language. It did this as it included C# which was a scripting language that was used to code the phone game structure. The next phase was to code the phone game. The coding was done primarily through a GUI (Graphical User Interface). To implement the mathematical educational principles in the phone game, Unity3d was used as these functions did not exist in the software. An example of the Unity3d coding can be seen later. During the coding, the phone game was tested several times to ensure that it was working how it was intended. After coding was completed for the phone game, more testing was occurring.

e. Justification Of Tools

There were numerous software found that could have been used to code the phone game. To find the most suitable software for the phone game, the most common game developing software was researched and evaluated.

f. Game Maker

The first software researched was Game Maker. Game Maker is used generally to create 2D games which could be exported to multiple platforms. Game Maker could have been beneficial with the coding of the phone game as it had a simple drag-and-drop interface which allowed for fast prototyping. Complex functions had to be coded using GML (Game Maker Language). This was the scripting language of Game Maker, which was based on the C programming language. This meant Game Maker would have been suitable to achieve the aim of developing knowledge in a scripting language. A limitation of Game Maker was that it did not support the initial phone game design. This was due to the software being targeted for 2D games, which the initial design of the phone game was not.

Overall, Game Maker would have been the most appropriate software for the coding if the development cycle was going to be rapid prototyping. This was because it had a relatively simple user interface which allowed for quick prototyping. However, the development cycle for the phone game was a waterfall model so there was no need for rapid prototyping.

g. Unity

The next software that was researched was Unity, which is a development suite used to make 2D and 3D games. A benefit of Unity was that it would aid in achieving the aim of developing knowledge in a scripting language. This was because Unity used C# and Javascript.

Unity also contained every tool needed to create phone games of any type and genre. This included characters and locations. Unity also matched the initial phone game designs. This meant Unity was suitable to code the phone game. Unity 3D clearly comes out on top because of the number of assets in its store. It has everything, from animation and GUI generators to extensions for AI control and ORK Framework for creating RPGs. Hence, with a better asset store, you can build awesome games with unity 3d. The more platform access you have, the more you increase your customer base. Let's see, which engines offer you what. IOS, Android, Windows Phone 8, Tizen, Android TV and Samsung SMART TV, as well as Xbox One & 360, Windows PC, Mac OS X, Linux, Web Player, WebGL, VR (including Hololens), SteamOS, PS4, Playstation Vita, and Wii U. These are all platforms that unity supports.

h. Unreal Development Kit

The last software researched for coding the phone game was the Unreal Development Kit, which is a development suite used to make 2D and 3D games. Unreal had similar features as Unity. A benefit of using the Unreal Development Kit would be that it included all the tools needed to develop the phone game. This includes tools to create characters, locations and user interfaces. Unreal also used the C++ programming language to code, phone games, which would have aided in achieving aims and objectives. A limitation of the Unreal Development Kit was that it was designed for professionals. Because there was no prior knowledge of Unreal, this would have led to extended 18 development time for the phone game. Another limitation of Unreal was because of the vast amount of tools, it was designed to be used by teams. This meant that Unreal was unsuitable to code the phone game as it was going to be coded and developed by only one person.

i. Testing

After the coding was the testing stage. This was where the phone game was tested. The testing ensured that the phone game worked as intended and aided in answering the academic question. There were three different tests done on the phone game. They were system testing, usability testing and beta testing. All the tests, methods and results are recorded in the following three sections.

1. System Test

The first test was a system test. The system test was an alpha test which was done following the phone game development. This test checked whether all the functions of the phone game worked as intended. This was done by trying every possible scenario during installation and playing. This

test was important to the research work as it ensured that there were no bugs or errors in the phone game.

The method of testing was done by creating a table with a list of all possible scenarios that can happen at any stage in the phone game. Every scenario was then broken down with all possible inputs that could occur. Expected results were recorded first on what should happen for all the possible inputs. The test was then conducted and the results were recorded in an actual test result section. If the actual test results did not match the expected results, it meant there was an error in the phone game. This was recorded and the error would be fixed. After fixing the error, that element of the phone game was tested again. After every possible scenario was tested and all test results passed, the test was finished.

Most of the results in the system test were accurate as they worked as intended. There were two errors found. The first error found was a small bug which did not allow the user to click on certain signs during the phone game. This had to be fixed as the signs were meant to help players know where to go next. The second error found in the phone game was that it did not accept correct answers during the mathematical aspect of the phone game. This was important to correct as this aspect was vital for players, as they could not continue playing the phone game unless they inputted the correct answer.

2. Usability Test

The second test was a usability test. This was an alpha which was conducted after the system test. This test evaluated the HCI (Human-Computer Interaction) of the phone game. This would identify which aspects of the phone game work well and which could be improved. This test was important to the research work as it stated how effective the phone game was and where it lacked.

3. Beta Test

The last test was a beta test. This test consisted of two parts. The first part of the test was a short quiz, which users took before and after playing the phone game. The quiz showed whether users had learned any educational principles or not. The second part of the test was a questionnaire, which the user took over playing the phone game. The 20 questionnaire showed how users felt about the phone game after playing. Both these tests were important to the research work as the results aided in answering the academic question. Both parts of the beta test were done on parents of students. The test was not done on the phone game's primary users, which were primary school children, due to time constraints and health and safety risks.

V. IMPLEMENTATION

The last stage of the development cycle is the implementation stage. At this stage the phone game was implemented so that it can be played by users. The first phase of implementation was to create an epic file. The apk file would be used to start the phone game. The file was placed in a zip folder and in Dropbox to share with others. The next

phase of the implementation was to create a user manual. The user manual will benefit the users as it included an overview, phone requirements and how to install and start the phone game. The game will be uploaded to the App store so that players can easily install them directly from stores. The store will include a description and screenshot of the phone game. This technique is to ensure that the game was interesting for primary school children. The icons used in the phone game also followed the initial designs. This ensured the implementation was of a professional quality.

VI. DATA ANALYSIS

The first aspect of whether phone games could teach players any educational principles. To answer this aspect, the phone game created and the quiz results of the beta test were used. The questions used in the quiz were about the Count and Pop, which was used as the educational content in the phone game. The results showed that players achieved a higher score in the quiz after playing the phone game. This indicated that players learnt about history, specifically the Count and Pop. Players had also learnt about geography and mathematics even though there were no questions based on them in the quiz. This was proven as players could not complete the phone game without encountering and completing challenges about geography and mathematics. As all players had completed the phone game meant they had learnt all about math's and count.

VII. RESULT AND DISCUSSION

If players are motivated to keep playing a phone game, they will not feel like they are learning. This indicated that the phone game was motivating the players. This meant that the phone game was providing intrinsic motivation, which it was aiming to do. This was because intrinsic motivation comes from the individual and not from any apparent awards. This meant that the phone game was providing the right kind of motivation for players to continue playing because if it provided extrinsic motivation, players would not be motivated to continue playing.

The reason of the phone game is motivational for players were because it was enjoyable. This was because the educational content and the game's narrative complemented each other. As the phone game was based on educational content, which was the Count and pop, this was easily implemented. The goal of the phone game was to win the battle. As this was the only viable by the player completing challenges that had educational content, players were motivated to learn. In the end, by using the phone game created for the artifact, the beta test results and the research conducted in the literature review, it can be stated that phone games can teach basic educational principles to primary school children without them being aware that they are learning.

VIII. CONCLUSION

This research aim is to answer the academic question. The academic question was: Can phone games teach basic

educational principles to primary school children without them being aware that they are learning? Using the phone game created and the results from the tests, it can be stated that phone games can teach basic educational principles to primary school children without them being aware that they are learning. The phone game had four main learning outcomes. They were to teach players three main educational principles from different subject areas, which were:

- a. English Alphabets
- b. Number Counting
- c. Urdu Alphabets
- d. .Poems

By players completing the phone game, it can be stated that they learned about alphabets and mathematics. If they did not, they would have not been able to complete the phone game. The research work also had four aims, all of them which were achieved. The aims of the research work are important as they identified what the research work was trying to achieve. They aim is:

1. To evaluate the use of phone games as educational tools.
2. Investigate educational phone games.
3. Evaluate the phone game development process.
4. Develop knowledge in a scripting language.

The first aim of the research work is to achieve by conducting a literature review on how phone games were being used as educational tools. The findings showed that phone games could be used as educational tools. However, further research showed that on how effective they were determined on how well the educational content are implemented. Achieving this aim was important to the research work as it gave the basis of the research work.

The second aim is to investigate educational phone games. This involved getting existing phone games and evaluating them on how effectively they teach players. The games chosen were not all designed to be educational, but because of their educational impact on players they were chosen to be evaluated. This aim was important to the research work as it led to giving an understanding on how phone games can be effective at teaching educational principles.

The third aim is to evaluate the phone game development process. This was achieved during the literature review and the design stage of the research work. During the literature review, 26 researches were completed on a suitable methodology for designing and implementing educational phone games. This research was then used to design the phone game. The design showed how the phone game came from initial idea to the finished phone game. This aim was achieved when the methodology was evaluated in the critical evaluation section. This aim was important to the research work as it benefited in the development of the artefact. The last aim of this research work was to develop knowledge in a scripting language. This was achieved by developing knowledge in Unity3d and C#. Learning a scripting language was important as it aided in personal development. It also

benefited in the creation of the phone game by allowing customizing certain features.

IX. EXECUTIVE SUMMARY

The summary of the research is broken down into several objectives. The objectives were important part of the research work as they identified specific, measurable achievements that build towards achieving the aims of the research work. The objectives were:

1. Complete a literature survey and literature review on how phone games are being used as educational tools.
2. Identify and evaluate game design of existing educational phone games.
3. Develop a suitable phone game.
4. Evaluate the effectiveness of the phone game using appropriate tests.
5. Identify phone game development approaches suitable for modeling educational phone games.
6. To learn and develop skills in a scripting language dependent on the tools used to develop the phone game.
7. Complete final report. All the objectives were achieved. The first objective was achieved as it was to complete the literature survey and literature review.

The literature survey was completed during the research work proposal and it gave a basis of the research. The research was then expanded upon in the literature review. This was important for the research work as it provided with information about educational phone games. The second objective was to evaluate educational phone games, which was related to the second aim of the research work. The objective was achieved at the same time as completing the aim, which was during the background research on the research work.

The third objective is to develop a suitable phone game. This is important to the research work as it was going to be used to answer the academic question. The fourth objective is to evaluate the phone game using appropriate tests. This was important to the research work as the results of the tests were used to answer the academic question. 27 Choosing and justifying the use of a development cycle for the artefacts led to achieving the fifth objective. This was linked to the third aim of the research work. The development cycle was chosen after using the research from the literature review. Using this, it led to building a suitable phone game. The sixth objective was linked to the last aim of the research work, which was to learn and develop skills in a scripting language. This was important as it aided in personal development.

The last objective was to complete the research work. This was an important milestone in the research work. By completing all the aims and objectives of the research work, it can be started the phone game met all the requirements which were specified during the requirements specification stage. They were:

Answer the academic question.

8. Develop knowledge in a scripting language.
9. Develop a suitable phone game

The requirements are all linked to some of the aims and objectives of the research work. This meant that completing the aims and objectives led to achieving the phone game's requirements.

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