

Investigating the Use of 3D Mobile Games for Teaching Ethics & Basics to Children

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ABSTRACT

DIY (Do It Yourself) approaches have led the way for learning things in a new and smart way. One way to learn things practically is to play computer or smartphone games. Gaming for learning has several uses, you master your skills in a fun way. Since the children most of the time these days are busy with playing games on smartphones, therefore, in this research we focus on how to use the modern 3D mobile games for teaching ethics and Islamic values. We have built two mobile apps for this purpose, Akhlaqee-1 and Akhlaqee-2, using the Unity 3D gaming engine. Akhlaqee-1 has been built with virtual reality applications i.e. Oculus Touch where the player can wear the Oculus headset and using an oculus rift can play the game. The other application Akhlaqee-2 has been built to be a heavy graphics-based computer virtual reality game. Additionally, the students used an olfactory display and a new mechanism for walking in virtual reality environments to increase the realism of the virtual environment. This research compares the effectiveness of both games from the development and user perspective. Experts' evaluation (user experience) reveals that 73% of users like to play Akhlaqee-1, while 58% of them preferred the Akhlaqee-2 to be suitable for teaching and its cost-effectiveness. In addition, Akhlaqee-1 was concluded by 82% of the users to be more expensive with the inclusion of VR features such as Oculus VR Headset and Oculus rift.

Keywords: V Games Development, Prototyping, Unity 3D, Learning games, 3D games

Author's Contribution

^{1,2,3}Manuscript writing, Data analysis, interpretation, Conception, synthesis, planning of research, Interpretation and discussion, Data Collection

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INTRODUCTION

Engaging students is an essential part of learning. Researchers [1] have emphasized the necessity of the learning process to be more fun and not boring. From learning mathematics [2] by games to learning matter and heat subjects [3] to the development of serious games for

children [4], the emphasis of learning is always been on children to learn through gamification [5]. learning Islamic values to Muslim scientists is also a quest and zeal to engage the new generation in the learning process of the basics of Islam, research such as et al [6] emphasizes

developing digital games with Islamic values. Different scholars' view is also to be considered while developing Islamic games to keep the traditional norms and respect intact. Aziz et al [7] talk about the views from different Muslim scholars and about the benefits of digital games for learning the basics of Islam. Mobile applications have put the world into a new race, now to learn anything and to do anything from ordering, purchasing, tracking, driving to everything is through smartphone applications. Many surveys have been conducted in this regard, one popular survey about the Islamic applications was conducted by Machfud et al [8] in which the different education and research was a focus.

Many Muslim countries have a rich learning culture of Islamic teachings at a very young age. Families send their children to religious schools (Madrassas). With more than 35,000 madrassas operating in Pakistan, where more than 3.5 million children are enrolled to get religious education [9]. In the tribal culture in special the "Pathan / pukhtoon" tribal culture in the early 1980s and before that, most of the families after the "Maghrib prayers" in summer, used to ask the young ones to recite verses of Quran, Duas / prayers and other small "Ahadith" as described by Jamal [10] that they adhere to their culture strictly. While in the winter season, families will gather around the fireplace, and the elder will start telling prophets stories from Quran and other Islamic books such as "Qisas ul Anbiyaa"[11], "Fazail-e-Amaal" [12]. This way the children will be rich with all the religious information since childhood. With time, these things disappeared, now the culture has completely changed with time, kids no more do the same practice and are most of the time busy playing with mobile phones. While minimizing the generation gap of learning good manners and basics of Islamic teachings, we thought of using the tools and devices which the kids like and thus will try to achieve the goal of teaching them the basics of Islam with good morals through games.

Many educational games researchers have been conducted recently. We are living in an era where technology possessed most of our attention, therefore most of the parents are busy with what we call smartphones, as a result, they don't pay much attention to the environment that surrounds their children where they lack most of the Islamic duties and manners. It is thus

better to have games that show these duties and behaviors in an animated, fun and attractive imitations that make the child wants to keep improving and learning. Research on special needs students (those with disabilities) is also one of the hot areas of research as Durkin et al [13] and Al-wabil et al [14] highlight in their study. Special needs students, those with blindness also are an emphasis on recent research work such as Milne et al [15]. multiplayer educational games are also an area where gamers and educators are exploring such as Garzotto et al [16].

This research includes in detail, the development of 3D Game applications using Unity 3D. The first application is a virtual reality application that uses Oculus VR, an Olfactory display and a VR movement sensor. The second application is a mobile phone application. Both are discussed and compared in this paper. Section II discusses the related work, section III puts forward the proposed Akhlaqee-1 and Akhlaqee-2 applications for learning, section IV discusses implementation and testing results, and finally, section V concludes the research.

RELATED WORK

This section has two parts, in the first part, we will discuss the effectivity of gaming engines for developing educational games. Section B will address some games/applications that exist for learning and educational purposes, and in the end we will compare some popular learning games.

A. Game Engines as a Facilitator for Developing Educational Games

More than 63 3D Gaming engines exists as of today [17]. The most popular among all of them are Unity 3D and Unreal. While their competitor is Wave, Urho3D, Panda3D, Godot, Cryengine, Xenko, Esenthel, etc. Unity 3D assets store provides a huge number of assets (free and paid) for the developers to build quality games. With Unity 2D games, 3D games, virtual reality applications, and augmented reality video games and other simulations can be built. There are currently more than 750,000 registered developers of Unity 3D. It is supported by many platforms such as Windows, Linux, Mac, IOS, etc. [18]

B. Learning/Educational Games

This section highlights some of the learning and education-based games.

Researchers in [19], developed a sophisticated learning tool for high school and undergraduate computing students is the soloLearn application, it is a cross-platform application i.e. supported windows, android, and IOS platforms through which Java, Python, C#, PHP, JavaScript, and around 12 languages can easily be learned through this application in a fun way. The application supports issuing certificates as well at the successful completion of the game.

Rumble blocks [20], is a game that is developed using the Unity 3D engine for teaching science concepts and some engineering concepts of tower stability, to young children aged between four to seven. The game was developed with the help of expert's knowledge (researchers and early childhood teachers). Development in unity gives the flexibility of being a standalone gaming application to cross-platform running on IOS and android operating systems.

Another game is the "Fort Ross Virtual Warehouse Project" (FRVWP) [21]. It is an initiative aimed to create an educational game for students, schools and visitors about Fort Ross. Playing this single-player game, students have the chance to encounter instructive substance and "pretend" in a condition that is immersive and exceptionally intelligent

Immersive learning using computer animation and simulation to deliver flying lessons in NASA is well known. This paper aims to use this technology with tablet PC to develop a game that can help to teach the student handwriting [1]. The goal of this project was to develop a game that helps the students to learn how to write using the D'Nealian Handwriting System? While playing, the student is taught to write new letters by writing them. Thus the students gain access to new features, with an intelligent tutoring system which provides feedback by communicating them what they did right or wrong and how to correct the mistakes [22]

In recent years, the internet, smartphones "games" became part of our lives. Accessing the internet through a portable device plays a critical part in making children addicted to it. This attraction to games can be utilized by developing game-based learning applications. Google PlayN technology can be used to develop such a game. PlayN is an open-source cross-platform abstraction layer that uses google web toolkit compiler to take one code

written in java and compile it to run on different platforms without the need to learn each one of those platforms [23].

Researchers in [24] describe a study of developing a video game aiming to teach the alphabet sign language through gestures, a leap motion controller is used to detect the fingers and hand with high accuracy and resolution. This topic is important in the interaction and sociability of deaf people. The Leap Motion Controller is used to allow the user to interact with the machine. It has 2 monochromatic Cameras and 3 LED's to observe about a 1-meter radius. It has a high resolution because the observation volume is reduced.

Researchers in [25] propose a serious game for clinical training. Their work describes a supporting environment for medicine students, this game is available in various computing devices to resemble a real clinic case to evaluate students' knowledge. The diagnostics are simulated using a 3D environment. The reason behind developing such a game is research in Brazil that showed increasing medical errors since 2011, as a result, the government produced a test for all the students to see how much knowledge the student has acquired during the course. The test showed 46% of the students have been disapproved of large mistakes in public health. This work aims to present a tool for the student to simulate real patients, the system has a software agent that simulates health problem and ask for diagnosis the system build in 3D with the ability to use VR system technology. [25]

Work in [26] proposes an android based e-learning solution for early childhood. Pre-school age is an important age for a child to gain knowledge, and the parents are facing a challenge to address the learning needs of their children. They can't devote time and not able to keep up with the flow in the technology changes. The need for user-friendly and efficient learning assistance has gotten more essential. This research studies the route to self-train of today's preschoolers. "Kids Training e-Learning System" (KTeLS) is a self-learning encouragement tool for kids. It is built on a strong notional basis and allows kids to grow cognitive and psychomotor skills such as drawing, writing, recognition of numbers, basic shapes and colors and logical thinking. It integrates a special algorithm to spot and direct the child to write a letter in the correct direction without direction

from parents. It comes with a kid-friendly environment. The tool was designed as an Android application for tablets and was verified by a focus group. The backgrounds, sounds and colors are specially designed to keep the interest of kids. [26]

A highly sophisticated system that includes an intelligent virtual avatar is proposed in [27]. The system includes a virtual avatar with an inbuilt chatbot that will deliver the class in a virtual reality environment instead of the actual teacher. The agent is improving itself from its interaction with the students and it was able to answer more and more questions after each class. However, each lecture has to be specially prepared for this environment.

Researchers in [28],[29] and [30] studies the impact of games in terms of morality and they all concluded that video games have a great impact on gamers and that it is possible to teach morality from video games. However, they did not cover religious practices that this research is focused on.

C. Learning/Educational Games

This section highlights some of the learning and education-based games.

Table 1. Comparison of Different Educational / Learning Games				
Game	Domain	User/age group	Players	Development language /Engine
SOLOLEARN	Programming Languages	High school and graduates	Single-player	Not Known
RUMBLEBLOCKS	Teaching science concepts	Kids (4-7 years)	Single-player	Unity 3D engine
INTELLIGENT TUTORING SYSTEM	Learn Kids to write D'Nealian Handwriting	Kids (5-8 years)	Single-player	C#
THE FORT ROSS VIRTUAL WAREHOUSE:	Virtual Tourism	Students, schools, and visitors	Single-player	Unity 3D
KIDS TRAINING E-LEARNING SYSTEM	Teaching drawing, writing, and shapes, etc.	(3-5 years) early childhood education students	Single-player	Android studio
Interactive VR Classroom simulator	The intelligent virtual avatar that can deliver the lecture and answer questions. It becomes better on answering questions after each class.	University students	Multi-player	Unity3D

As can be seen in Table 1. Most of the games are single-player games, while unity 3D is used for most of these learning games, the emphasis yet on kids most of the time when it comes to educational games. One out of five games from the above table can be seen i.e. SoloLearn which is for young people and not kids. Game development for education can be just a single product development (containing a set of features) or development of a product line (with a different set of features for every game). Fazal et al [31] give an in-depth overview of the model and meta-model used in software product line engineering. Such an approach was employed in this research.

CASE STUDY 1: AKHLAQEE-1 PROJECT

The electronic age has the young generation caught by it, as they have become a huge consumer of electronic devices and applications. Social networks have made people unsocial. More importantly kids not learning the Islamic duties and behaviors, and how to implement it. Unity3D is used to develop this game, and it is released on android smart-phones and tablets, so the kid can play it on his/her smart-phone or tablet. The application can also be played wearing Oculus Rift and Virtual Reality (VR) headset. Every stage can play using VR. Additionally, the application supported olfactory display [31] by releasing scents when the player was approaching certain objects such as apples. A smartphone with an application for moving in virtual environments [32] was used for translating movement. This app helps the kids know the Islamic manners and duties by showing him/ her how to do it in a fun and kid-friendly way. The goal of this application is to help the kids to have fun and be entertained while they learn, also the parents can see their kid's scores and keep track of what the kid has learned. For the moment we only provide five stages, but we plan on adding more along the way so that the kids have more reasons to come back to the game and learn new things. Finally, of course, we know we cannot replace the parent's duty to teach their kids, but we want to aid them while doing it and give them something that entertains their kids.

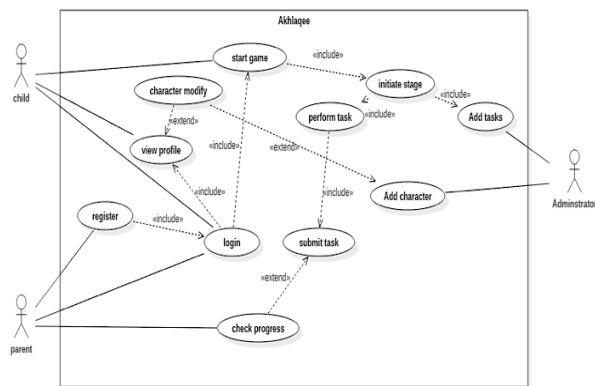


Figure 1: Use Case diagram of Akhlaqee-1

Figure 1. The use case shows how the child interacts with the game and what the functions are for the parents and the child.

The diagram is explained through Table 2 below:

Table 1. Use-Case Description		
Use-Case / Function	Actor	Description
Register	Parent	Create an account for the parent
Login	Parent	To access the game
	Child	
View profile	Child	To check the profile of the user
Character modify	Child	The child can change the character in the game
Start game	Child	Enter the game
Initiate stage	Child	Start doing tasks
Perform task	Child	The child does the task in real-life
Submit task	Child	Confirm that he/she did the task
Check progress	Parent	The parent sees the progress of his/her child
Add task	Admin	Add more tasks to the game
Add character	Admin	Add more characters to let the child choose

The application Akhlaqee-1 has the following stages:

- **STAGE 1:** Cleaning Environment
- **STAGE 2:** Organizing Picture For “Wodoo”
- **STAGE 3:** Organizing Picture For Salah
- **STAGE 4:** Select People Better Than Others

The main screen of the application looks like the one displayed in the following figures along with the characters.

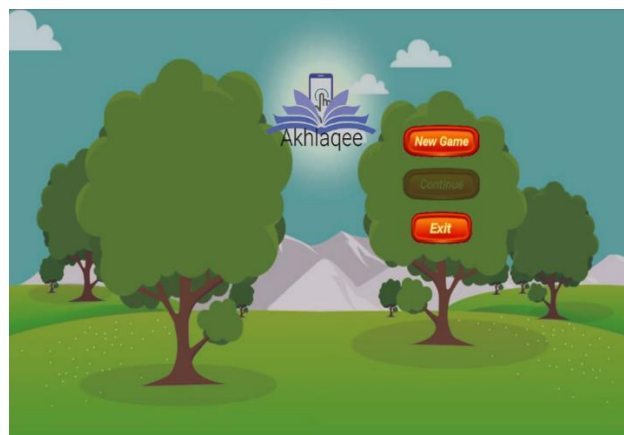


Figure 2. Login Screen

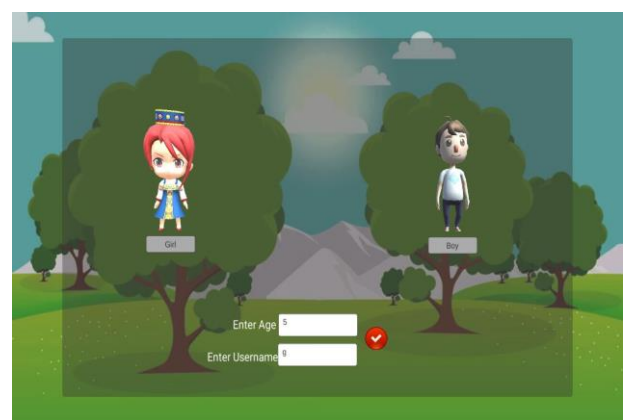


Figure 3. Choosing the Character Screen

Figure 2 and figure 3 shows the main interface of starting the game and choosing the appropriate character and other input required by the system such as Age and username. Below we will explain the different stages of the game:

Stage 1: Learning Prayer steps/arranging the Slots to hold the images in figure 4. Each slot acts as a parent for one image and whenever the player releases an image over it the image gets centered in the slot.



Figure 4. Interface Salah / Prayers steps -Akhlaqee-1

This stage task includes the steps of salah/prayers. The GUI is presented in figure 5.

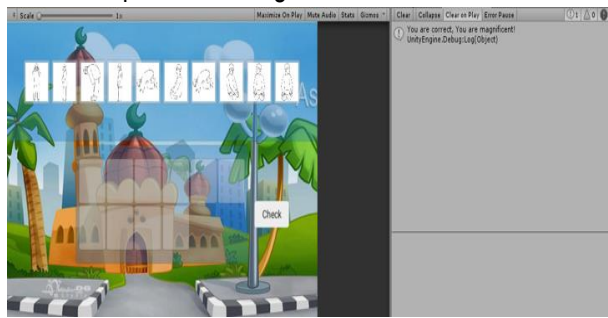


Figure 5. Check Button of Salah Steps- Akhlaqee-1

Stage 2: Learning Wudu steps (see figure 6) arranging the Slots to hold the images: This shows a hint of what is the correct order for ablution, press the “close” button to dismiss the hint. The hint button will give you hints of learning the steps.

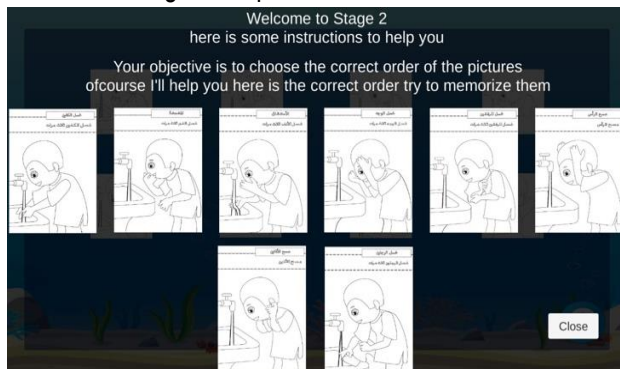


Figure 6. Second Stage help in learning how to do Wudu

Again, if you want to replay the stage press the #1 button, if you want to the levels screen press the #2 button, and to go to the next level press the #3 button, and it will be the same for each stage.

Stage 3: Learning Good manners / arranging your room in this stage (see figure 7) a child learns that “cleanliness is half of the faith” a hadith which is played at the start of this stage. In this stage the child learns cleaning his room by putting things in the right place where it belongs. This stage is the best when played in a virtual reality environment with an oculus rift and Oculus VR headset.



Figure 7. The third stage helps in learning how to clean the room

Stage 4: Learning Good manners / Respecting everyone and ahadith in this stage a child learns a hadith which says about all human beings are equal and there is no difference between an Arab and Non-Arab as narrated from the prophet Muhammad (PBUH) in the last sermon at Hajj. in this stage a child is asked to choose the picture the one he thinks is superior to others. As can be seen in figure 8.



Figure 8. The fourth stage helps in learning on equality of humans

CASE STUDY 1: AKHLAQEE-1 PROJECT

Akhlaqee-2 is an advanced sequel of the original game Akhlaqee-1, which is a fun way for instructing the youngsters with the Islamic conduct and obligations using Unity3D. It is a phase-based. So, there is a probability of including more stages at whatever point is required. Akhlaqee-2 is an application that helps the parents to train their children on the common Islamic duties and teach them good behaviors such as how to behave and perform the prayers, ablution, fasting, etc. The purpose of this game is to show these duties and behaviors in an animated, fun, and attractive imitations that make the child wants to keep improving and learning. It will enable

the children to have a fabulous time and be engaged while they learn, additionally, the guardians can see their child's scores and monitor what the child has realized. For the occasion, we just offer four phases however we intend to include more end route with the goal that the children have more motivations to return to the diversion and learn new things. It is a known fact that we can't supplant the parent's obligation to instruct their children however we need to help them while doing it and give them something that engages their children.

Akhlaqee-2 had implemented additional stages:

Stage 5: General manners

Self-Respect

- Don't Lie - (With the help of Quranic verses / Hadith)
- Don't Do Haram - (With the help of Quranic verses / Hadith)
- Don't Break Promise - (With the help of Quranic verses / Hadith)

Respect Others

- Parents - (With the help of Quranic verses / Hadith)
- Brother & Sister - (With the help of Quranic verses / Hadith)
- Neighbors - (With the help of Quranic verses / Hadith)
- Other People - (With the help of Quranic verses / Hadith)

Stage 6: Dua' :

- Home Entering/Leaving
- Mosque Entering/Leaving
- Bathrooms Enter/Leaving
- Car And Travelling Dua'
- BedTimes
- Waking Up

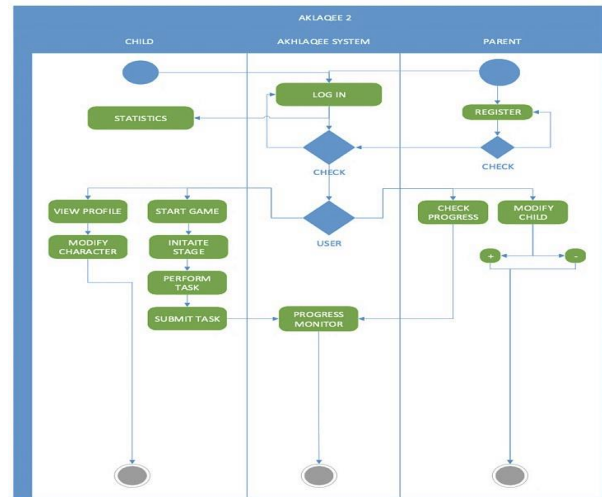


Figure 9. Activity diagram of Akhlaqee-2

As can be seen in Figure 9, the movement outlines the stream of the activities, on how they start and the dynamic conduct of the framework. Parents will begin the record and add the youngster to the amusement then he can check the advancement of the child. The Child will begin playing the diversion and goes through stages and can change the characters.

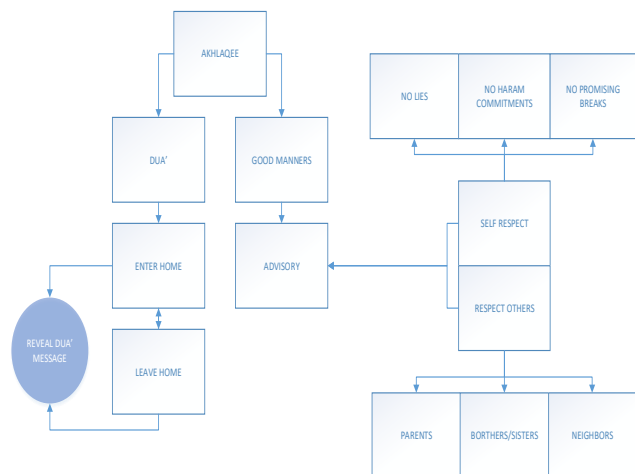


Figure 10. The block diagram of Akhlaqee-2

As can be seen in Figure 10, the block diagram lies upon the new project achievement, users gain access to a specific feature and defy the functionality of this grace. For instance, the Good Manner and Advisory feature extend into two figures "SELF RESPECT" and "RESPECT OTHERS" and upon every feature includes another feature "NO LIES", "NO HARAM COMMITMENTS", "NO PROMISING BREAKS"... etc.

Game Exploration: as we can see there are many places to explore and navigate: In Figure 11, we can see

the level design, the catchy graphics, HUD, as well as the Radar Navigator Map

HUD include:

- Collectible Information
- Collectible Star, thus every 5 info adds 1 star
- Collectible Quizzes
- Collectible Cups (Trophies) and can be gained via 5 stars
- Collectable Trashes (Cleaning), if all is trashes collected then it gives one cup
- Time to play
- Radar Map
- Time Played (Above Radar Map)
- Scores (as each element has its own valued score)



Figure 11. The level designs

As for this option “paused” as shown in figure 12, freezes the game but not entirely and can be resumed once the players click on the Resume button. Pause Menu also contains features like preview the HUD information, OPTIONS functionality, Return to MAIN MENU button if the player decided to quit or change advanced settings.

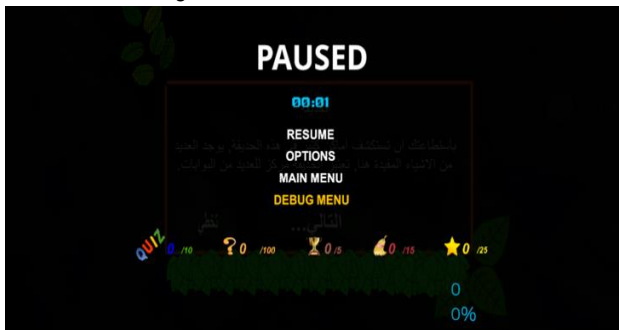


Figure 1. Pausing the interface of Akhlaqee-2

The audio functionality is a tough decision to make, choosing the best audio for different options and levels.as shown in Figure 13, each level has audio, a character when reaching a particular board like the one shown in

figure audio will be played that will either read the script written or play Adhaan (Muslim call to prayers).

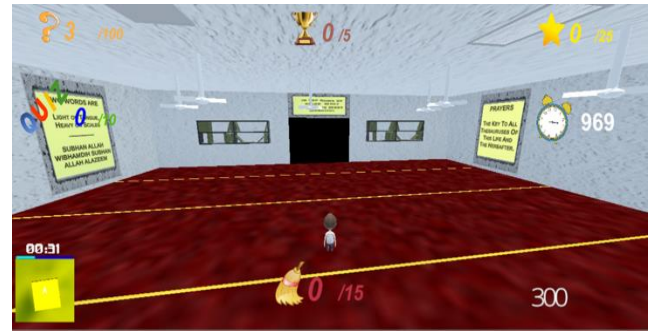


Figure 2. Boards and Prayer room / mosque- Akhlaqee-2

The Player can interact with many obstacles, for example the TV has to items to collect “Quiz token” and “Information token” the quiz token pops up a window to solve a question as can be seen in Figure 14.



Figure 14. Quiz token and Information token

DISCUSSION

A. Data about the student groups and their Supervision.

Both Akhlaqee-1 and 2 were developed as part of a mandatory graduation /senior project at the Department of Information Technology, faculty of computing and information technology. Both groups of students were Unity 3D gaming engine users and developers with sound programming skills taking their senior project under the same supervisor Dr.Fazal Qudus Khan. Akhlaqee-1 was developed by student Mr.Abdurrahman Ali Alsalahi and Ayman Sami Hussain in Fall 2016, while Akhlaqee-2 was developed by Abdulaziz Mjawer and Nashmi Alotaibi.in Fall 2018.

B. B. Difference between Akhlaqee-1 and Akhlaqee-2

The difference between the two projects Akhlaqee-1

and 2 can be summed up in table 3,

Table 3. Difference between the two Akhlaqee Projects								
Project	No. of stages	Players	3D or 2D	VR Support	Game Duration	Level Selection	Developers	Evaluated for comparison by
Akhlaqee-1	4	Single	3D	Yes	Short (4-15 minutes /stage)	One after another- one level must be completed to proceed to the next level	2(students) +1 (supervisor)	11 Faculty members
Akhlaqee-2	4+2	Single	3D	Not tried	Long (25-25 minutes per stage)	Random level selection except for the first four.	2(students) +1 (supervisor)	11 Faculty members

As can be seen in table 3. Both games are single-player mode and were developed by a group of two students and under the supervision of the same supervisor. Game duration for akhlaqee-1 due to its short stages is less compared to akhlaqee-2. Both games were developed using Unity 3D. Akhlaqee one was tested with Oculus VR headset, olfactory display and mobile for simulating movements.

C. Comparing the two projects (Akhlaqee-1 and 2) with the state of the art learning games:

Akhlaqee projects were developed keeping in mind the state-of-the-art systems for education and learning purposes as can be seen in Table 1. If we compare both of these projects with Table 1, it is also levels/stages based, single-player, built-in 3D for more entertainment and for learning in a fun way.

D. User Experience and Evaluation of the two Projects:

FabLab of the faculty of computing and information technology was selected as a venue to test and compare both the projects for usability. Eleven faculty members were invited to see the evaluate the two projects. These faculty members belong to the department of IS (3), IT (6) and CS (2). The student's set up the projects and demonstrated the working of each stage in a 15 minutes presentation. There was a question and answer session for 5 minutes at the end of each presentation. At the end of the demo from the students, some faculty members were interested especially in Akhlaqee-1 project to play the game using VR headset and Gloves (oculus rift). At the end of the session the supervisor asked for voting from the faculty members by gathering them in the lounge and will say to raise their hand for the different criteria mentioned in the table below. The voting results are documented in the table. 4.

Table 4. Vote Recording vs Criteria of Evaluation of both Projects							
User Experience / Vote Recording							
Project Title	Student IDs	More enjoyable	More affordable	More consistent	More Graphics and Colors	Good Audio	Total votes
Akhlaqee-1	1207273	8	2	7	5	1	23
	1317592						
	1409241						
Akhlaqee-2	1410286	3	9	4	6	10	32

Table 5. %age of Vote Recording vs Criteria of Evaluation of both Projects							
Project	More enjoyable (%age)	More affordable (%age)	More consistent stages (%age)	Graphics and Colors (%age)	Good Audio (%age)	Total votes (%age)	
Akhlaqee-1	72.72727273	18.18181818	63.63636364	45.45454545	9.090909091	41.81818182	
Akhlaqee-2	27.27272727	81.81818182	36.36363636	54.54545455	90.90909091	58.18181818	

As can be seen in Table 4 and from the observation, the faculty members like playing Akhlaqee-1 due to the availability of VR mode but it was termed expensive. Overall Akhlaqee-2 due to more stages and learning materials got more votes. Table 5. represents the data in table 4 in terms of %ages.

This research compares the effectiveness of both games from the development and user perspective. Experts evaluation (user experience) reveals that about 73% of users like to play Akhlaqee-1, while 58% of them like the Akhlaqee-2 to be suitable for teaching and its cost-effectiveness. Akhlaqee-1 was concluded by 82% of the users to be more expensive with the inclusion of VR features such as Oculus VR Headset and Oculus rift and the rest of the setup.

DISCUSSION

From the analysis, it can be concluded that it is better to develop more and more educational and learning stuff for children using games. It is better that instead of children wasting time playing useless games, they learn something as well, improving and enhancing their intellectual and moral capabilities. Both of the projects developed were just a case of an initial attempt to educate the kids on learning the basics of Islam, Duas, good morals. There is still a lot of things to be done. More stages need to be added. Directions from the Islamic scholars needed to be taken, to avoid any sensitivities. Multiplayer games need to be made. Since VR games are more of an interest to the children, affordability is an issue. But since due to age restriction of the use of VR headset and rift, measures and precautions need to be taken. Concussion and headache are reported as normal problems while using these devices and proper care has to be taken while using such devices.

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