

# An Interactive VR Game Development for Improving the Learnability of the Teenage Groups

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## Abstract

Existing usability challenges for Virtual Reality (VR) applications minimizes the learning capabilities for users. There are different applications of VR that helps in education includes: In Mind VR 2, Titans of Space, Discovery VR, anatomy, Ninja, VR Lessons by Thing Link, King Tut VR, VR Roller Coaster and Tilt Brush. Different issues in these applications are: usability difficulties, learner differences, learning and teaching issues etc. The combination of Virtual Reality along with the education can remove the usability difficulties in teenage learning groups. The present research undertakes a survey to find out the response of different students about the game "PUBG" and the proposed prototype. In future, this technique can be used to find out different issues in VR learning and this prototype can be helpful as well.

## Key words:

*Virtual Reality, Usability challenges in VR learning, Importance of Virtual Reality.*

## 1. Introduction

By making the headsets or software to complete the demands of education, virtual reality (VR) is becoming approachable. It can be said about the virtual reality that it can be something to be used by millions of people. The technology that attracts the user with the virtual world is known as virtual reality.

Virtual environment (VE) designs are presented in the form of VR applications [1]. An author, Michael R. has recognized the idea of VR include immersion, simulation, interaction, telepresence and network communication [2] [5-6]. To get the information from senses and interrupt from the brain, such process is called as perception [2]. While developing the virtual world, the purpose is to use the perceptual system of human with believing that they are part of the virtual world [2]. Basically, while creating the virtual world the main objective is to gain the sense of being present into the virtual environment (VE) [2] [7].

### a. Immersion

When a person reads a book then it creates attention of the user and makes an image in the mind of the person.

There are three types of systems in Virtual Reality [9] [10].

1. Fully immersive systems give the experience of the reality through the full or large presence of the

user, with high-quality graphics and performance.

2. Semi immersive systems are among the above two. There is a good example of flying simulators.
3. Non-immersive such as Desktops, which are not too good or refined form for VR, as they are cheap and don't require great performance.

### b. Perception

The idea is through the physical emotion of the environment. Therefore, to give the concept of something, serious encouragement should be used. Two approaches are available [9] [11].

- The data-oriented approach aims to expand quality of data; means that more data looks like a reality, its experience is more dangerous.
- The constructivist approach uses human capacity to build a reality, is thus unable to expose anyone with such high-quality techniques.

### c. Telepresence

VR also uses the concept of Telepresence, which is capable of feeling different from your real location, different remote presence.

## 2. Types of Virtual Reality

There are three types of Virtual Reality. They are as following:

### 2.1 VR Based Learning

VR technology only makes for e-learning deficiencies [8]. There are three methodologies to education includes: full-time, part time and distance education.

Full-time education normally used in classrooms on daily basis [8]. This technique is not immersive but interactive as well [8].

Part-time education is the education which is the combination of classroom and the distance based modern technology [8].

Distance education is such kind of learning where teacher and student can interact through communication technology, but it's like they both are completely separated in different space or time [8] [12].

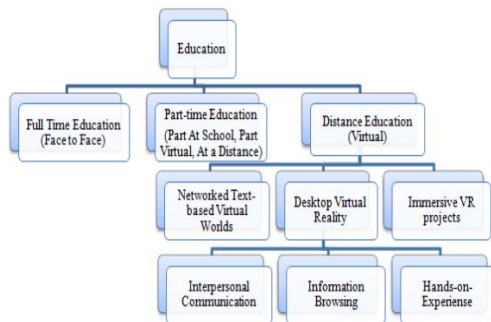


Fig. 1 Approaches of Education [8]

## 2.2 Networked Text Based Learning

This text-based virtual environment (VE) was designed primarily for entertainment or fun. One of the earliest export networks is a networked virtual world, where the kids use the fully computer controlled environment.

## 2.3 Desktop Based VR

The use of virtual reality in the classrooms is limited because of its cost. VR applications on personal computers allow users to run through simulated environment created by the available software, such as via virus walk-through [8].

## 2.4 Immersive VR Environment

This immersive system is seen through HMD (Head Mounted Display). This system uses the images generated through computer that interact with the orientation and position of the head [13]. The user feels him the complete part of the environment [13].

## 3. Fields of Virtual Reality

There are different fields of virtual reality, which are as follows:

- a) Education
- b) Military
- c) Medical training and mental health
- d) Sports
- e) Business
- f) Media
- g) Engineering and design

## 4. Need of Virtual Reality

Virtual reality is now a day's consider most immerging and efficient technologies which has not only overcomes limitations of augmented reality but also made the human life simpler and easier [13]. Some of the growing needs of virtual reality are as follows:

- Simulate the real world dynamically by use of computer software, hardware and virtual world integration technologies [13].

## 5. Age Group

There are different age groups, which are as follows:

- Children (0-12)
- Teenage (13-19)
- Adult (20-60)
- Aged (61+)

Teens are the different from adults and children because of their needs and talking styles. Teens develop their self from which they learn [3]. This age group includes the child from 13 to 19.

## 6. Existing Applications of VR

In education, there are different virtual reality applications for teens which are as follows:

- In Mind VR 2
- Titans of Space
- Discovery VR
- Anatomyou
- Psychonauts In the Rhombus of
- Ruin –PlayStation VR

## 7. Existing Problems in VR Applications

These problems are as follows:

### 1. Less sophisticated research strategies:

If teens have no search strategies, then they cannot search out any knowledge on the internet.

### 2. Lower level of patience:

Teens have a low level of patience. If they don't like the game, then they will skip the game and try to do something new. If the game is not according to teens then this is impossible that they will learn a single word from the game. In this age group, we know that if a negative concept of the subject enters into the mind, then this cannot be removed from the mind of the person.

### 3. Less sufficient reading skills:

If students are not aware with knowledge, then, they cannot get the point.

#### 4. Understandability difficulties:

Users rate that the virtual or augmented reality based systems are more difficult to use than the ordinary system [4].

#### 5. Learner differences:

This differentiation is occurring between the high level and low level student. When the lower level student will learn through the source of media, then he will get more information than others.

#### 6. Attention tunneling:

According to some of the surveys, students share their experienced high attention demand virtual/ augmented reality systems [4].

### 8. Research Questions

#### RQ1 How to overcome the usability challenges for the understandability differences?

There are different issues for usability challenges for teenage learning groups like:

- Attention tunnelling [4]

In many of the surveyed papers, students experience high attention demand from VR or AR system [4]. That's why the students used to play games and don't pay attention to team work [4]. This results that they have no experience of team work or any practical work.

To resolve this problem, there should be the practical or team work that is to be concerned with the VR system. There should be any game or setup that teaches the teen to perform the team work along with the system. Such algorithm can be made on the basis of Nielsen's 10 heuristics.

##### 1. Usability difficulties [4]

In some of the studies, users rate that AR/VR applications are more difficult than the desktop based or physical alternatives [4]. To resolve this problem, there should be the user manual or nay other guide to help out the participants.

##### 2. Learner differences [4]

There are different types of students like low, average or high achieving students. This is difficult for the low or average students to pick all the points from the VR or AR systems. Higher achieving students gain more knowledge in the small time than others.

This problem can be resolved when this is the use of VR system along with the lecture or detailed discussion about the topic.

##### 3. Learning and teaching issues [4]

There are different levels of teachers and students. If the teachers have no knowledge about the VR system, then they cannot teach the students. But, if the students have no knowledge about the VR system, then, this is difficult for them to use this system for learning purposes.

This problem can be resolved by providing the manual for both (students and teachers)

#### RQ2 How to design the improved VR applications for teens?

Every product in the market can never be 100% accurate or updated according to the increasing demands. This is not about teens or about another age group. This is about all age groups. Everyone has different demand. All their demands depend on the interaction between the user and the game.

If the game is according to the teen and also updated on time, then this is preferred by the teens. Otherwise, this causes an interaction problem. There are different usability issues in the games that are to be improved in the future.

### 9. Research Methodology

Teens (18-19 age group) are the participants in this research. This research work deals with 36 participants from which are from 18 to 19 in age. There are 3 games and the proposed prototype, which are to be played the participant.

**Step 1:** Start the game.

**Step 2:** Set the score zero.

**Step 3:** Allow the teen to play the game.

**Step 4:** Check out that level solved? If yes, then move to step 5, otherwise play again.

**Step 5:** Note down that how much scores does he have?

**Step 6:** Perform a cognitive walk-through and get the questionnaire to be filled.

**Step 7:** Compare all the features of the game with the Nielsen's Heuristics.

**Step 8:** After evaluating, conclude the result

**Step 9:** Provide the prototype and the new game for the teens.

**Step 10:** Evaluate this game by repeating all the steps and conduct the result.

#### Data Collection:

Data for the experiment was gathered via questionnaires

#### Participants:

There are 36 participants taken from Superior University, Lahore. They are from different departments, BS Computer Science, BS Architecture and BS Interior Designing. The selected participants are between 18 and 19 in age. These participants are selected on the basis of the tool. Those who were having windows 10 with Memory: 8 GB of RAM or more, Graphic card: R7 Readon, CPU: Intel Core i5/i7 processor was selected. Windows VR is provided. All the participants are then allowed to play two games (PUBG (Player Unknown's Battlegrounds) and C puzzles) for 15-20 minutes until they lose as shown in figure 2. Both are played on different platform. PUBG was played on windows VR whereas the C program was played on mobile phone.

#### Questionnaire:

The questionnaire is the combination of Nielsen, usability heuristic evaluation questionnaire [16] and the questionnaire used for the evaluation of indoor and outdoor games [15].

#### Measurement of Result:

All the questions are evaluated on the basis of likert scale.



Fig. 2 Participants during survey.

## 10. Result

Table 1: Mean and standard deviation for the usability challenges in games

Usability Heuristics	PC		Mobile Phone	
	PUBG		C Puzzles	
	M	SD	M	SD
Icon of the game makes sense	5	0	4.69	0.62
Simple and natural Interface of the game	3.58	1.07	4.41	0.93
Can you read the text?	3.67	1.24	4.5	0.81
Minimizes the memory load	3.5	1.13	4.11	0.78
Consistency of the game (order of the game)	3.33	0.98	4.16	1.02
Feedback	3.05	1.43	4.36	0.76
Exits	3.27	1.16	3.97	1.27
Shortcuts	3.38	1.35	4.19	0.92
Error messages	2.83	1.10	3.86	1.22
Easy to use	3.19	1.30	3.77	1.12
Help and documentation	3	1.43	3.80	1.34
The pace of the game is appropriate	3.22	1.07	4.11	1
The controls for the game confused me	3.22	1.26	3.58	1.33
If I were interrupted while playing the game, I would have been annoyed	3.67	1.14	3.58	1.38
I enjoyed playing the game	3.52	1.31	4.25	0.87
I found the instructions helpful	3.56	1.27	4.11	0.97
This game is not for me	3.63	1.41	3.72	1.30
I enjoyed the sound effects	3.39	1.27	4.27	1.03

Participants	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %	NA %
Question 1	100%	0%	0%	0%	0%	0%
Question 2	17%	47%	19%	11%	6%	0%
Question 3	31%	28%	28%	8%	3%	3%
Question 4	17%	42%	19%	17%	0%	3%

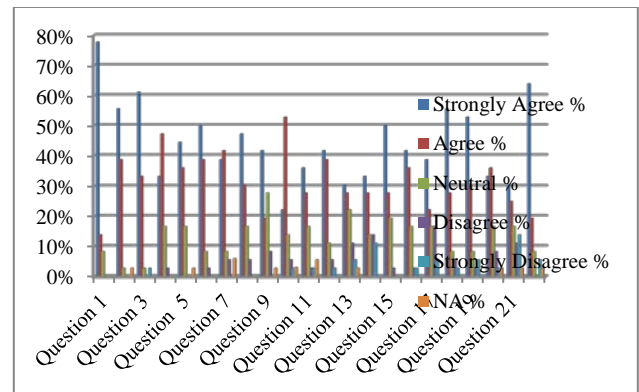
Do you find the game useful for your coursework?	1.89	1.30	4.22	1.09
Graphics of the game	2.89	1.40	3.80	1.23
I did not know when the game ended	3.02	1.64	3.38	1.51
I found to play the game again and again	2.83	1.34	4.2	1.27

Table 2: Result for C puzzles

Participant s	Strongl y Agree %	Agree %	Neutra l %	Disag ree %	Stron gly Disag ree %	N A %
Question 1	78%	14%	8%	0%	0%	0%
Question 2	56%	39%	3%	0%	0%	3%
Question 3	61%	33%	3%	0%	3%	0%
Question 4	33%	47%	17%	3%	0%	0%
Question 5	44%	36%	17%	0%	0%	3%
Question 6	50%	39%	8%	3%	0%	0%
Question 7	39%	42%	8%	6%	0%	6%
Question 8	47%	31%	17%	6%	0%	0%
Question 9	42%	19%	28%	8%	0%	3%
Question 10	22%	53%	14%	6%	3%	3%
Question 11	36%	28%	17%	3%	3%	6%
Question 12	42%	39%	11%	6%	3%	0%
Question 13	31%	28%	22%	11%	6%	3%
Question 14	33%	28%	14%	14%	11%	0%
Question 15	50%	28%	19%	3%	0%	0%
Question 16	42%	36%	17%	3%	3%	0%
Question 17	39%	22%	17%	17%	6%	0%
Question 18	56%	28%	8%	6%	3%	0%
Question 19	53%	31%	8%	3%	6%	0%
Question 20	33%	36%	17%	8%	3%	3%
Question 21	31%	25%	17%	11%	14%	3%
Question 22	64%	19%	8%	0%	6%	3%

The table shown above has created the mean and standard deviation of the result deducted from the survey. There were twenty two questions asked by the participants of superior college. The results deducted from linkert scale.

The resultant chart for the proposed game named as C puzzles is given below.



The above chart shows the bars according to the percentage of the strongly agree, agree, neutral, disagree and strongly disagree respectively.

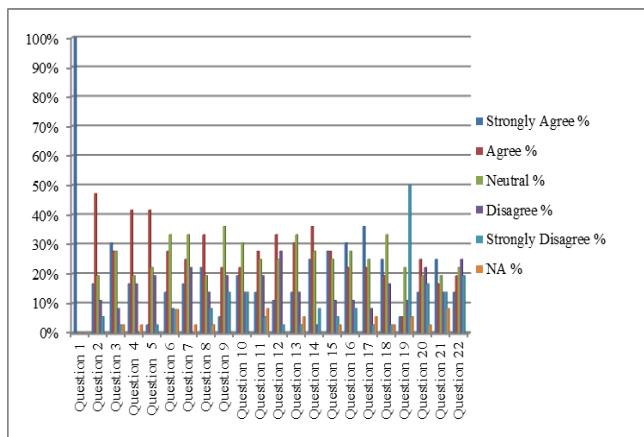
Question 5	3%	42%	22%	19%	3%	0%
Question 6	14%	28%	33%	8%	8%	8%
Question 7	17%	25%	33%	22%	0%	3%
Question 8	22%	33%	19%	14%	8%	3%
Question 9	6%	22%	36%	19%	14%	0%
Question 10	19%	22%	31%	14%	14%	0%
Question 11	14%	28%	25%	19%	6%	8%
Question 12	11%	33%	25%	28%	3%	0%
Question 13	14%	31%	33%	14%	3%	6%
Question 14	25%	36%	28%	3%	8%	0%
Question 15	28%	28%	25%	11%	6%	3%
Question 16	31%	22%	28%	11%	8%	0%
Question 17	36%	22%	25%	8%	3%	6%
Question 18	25%	19%	33%	17%	3%	3%
Question 19	6%	6%	22%	11%	50%	6%
Question 20	14%	25%	19%	22%	17%	3%
Question 21	25%	17%	19%	14%	14%	8%
Question 22	14%	19%	22%	25%	19%	0%

The table shown above has created the mean and standard deviation of the result deducted from the survey. There were twenty two questions asked by the participants of superior college. The results deducted from the linkert scale.

The resultant chart for the proposed game named as C puzzles is given below.

## 11. Result for PUBG

The resultant chart for PUBG is given below



The above chart shows the bars according to the percentage of the strongly agree, agree, neutral, disagree and strongly disagree respectively.

## 12. Design of the Prototype

The design of the prototype is different from existing games. The other games include the puzzles which are to be solved. The puzzles are about pictures, but they are not like other game. The main theme of the game is to learn and understand the coding in C. The front screen includes the play button and setting option along with the icon named as C puzzles.

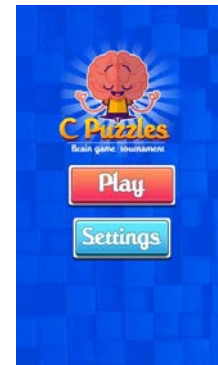


Fig. 3.1 Front screen of the prototype

The play button helps to move to the stage selection as shown in the figure 3.1. The setting button helps the user to turn on and off the sound and music of the game.

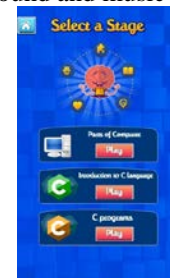


Fig. 3.2 Stage selection in the prototype

In the designed system, the stage selection screen shows three options respectively, which are shown in figure 3.2. These options include:

- Parts of Computer
- Introduction to C Language
- C programs

### Parts of Computer:



This part includes the pictures of the parts of the computer. The parts of a computer include the monitor, CPU, keyboard, speakers, etc. All pictures are available in figure 3.3 When the user clicks the picture, then it opens the puzzle of that picture. There are parts of pictures which are available in the footer of the system. There is the drag and drop system in the prototype to solve all the puzzles. The user can drag all the parts one by one. The user can move the parts in the respective section of the picture. If this is difficult for the user to solve the puzzle, then there is an option for the user to click on the question mark icon. This allows the user to see the complete picture of the puzzle. In the figure 3.3 the first pic shows the parts of the computer and the second one shows the puzzle for such part. It shows that how the drag and drop part is done in puzzle solving. In the third one, it shows that the complete picture of such puzzle.

This part of the prototype is just for the learning purpose. If the person is playing game then it helps the user to learn the picture of name of such part of the computer.



Fig. 3.3 Puzzle for parts of the computer

### Introduction to C Language

This part includes the theoretical introduction of the C language. This includes the following points:

- Intro to C
- Why we use this language?
- Uses of C language
- C compiler
- Different parts of compiler
- Interpreter

This part is also shown in figure 3.4. This is the extra theoretical part of the prototype. This helps the user to learn the C language from basics. This is just the introduction to C for the users. If the user want to read then this is optional otherwise the game can also be played except this part.

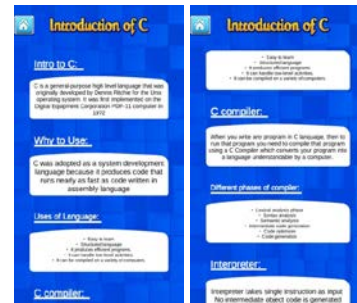


Fig. 3.4 Introduction of C

### C programs:

C programs include the pictures of different natural scenes. There is a code written on the picture. This is basically done for learning purpose of the teenagers. If the user is playing the game then this is help the user to remind the code of different topics. This code covers the specific topics for the student of computer science like to print hello world, print an integer, add numbers, multiply numbers, check the leap year etc.

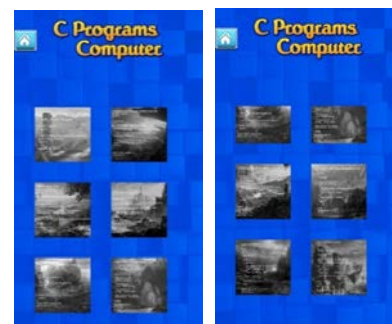


Fig. 3.5 C Programs

The complete screen of the puzzle solving of the c puzzle is shown below in figure 3.7.



Fig. 3.6 puzzle solving of C programs

If we are turning on the sound and music then shows the blue sign. If we are turning off the sound and music then it

shows the red sign. The on and off state of the system is shown in figure 3.8



Fig. 3.7 Sound and music setting in the prototype (Both are turned on and off)

### 13. Conclusion

Education matters a lot. This research work performed the survey to check that the PUBG game is beneficial for the education or not. Now-a-days most of the students are playing this game. But this is just for fun. This research work has introduced a prototype for the game C programs. This is basically designed for teenagers to learn code for different topics. This prototype covers the code for programming fundamentals. In future this work can be done to find out the issues faced by teenagers in education. These issues can be resolved through different techniques.

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