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Virtual Reality Acceptance in Classrooms: A Case Study in Teaching Science

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ABSTRACT

Virtual reality can be defined as "near reality" where virtual is near and reality is experience by humans. The aim of this research is to explore the benefits of VR technology in education that can engage the learning process using Virtual Reality (VR) in the classroom. Thus, the research objectives are to seek for student design and development of application, convenient, facileness and gratification of VR application in learning process. Using quantitative method, data from questionnaires and evaluations of existing Virtual Reality applications were analyzed in descriptive way to assess the viability of mobile Virtual Reality as a medium for improving learning. The developing process of an VR mobile based application is defined explicitly, and the final graphical student interface of the application is demonstrated to show overall look of the final product that is developed for this project. This includes three types of testing in this project which are performance testing, user acceptance testing and usability testing. Based on the 40 respondents results, it can be concluded that virtual reality application is a good application that can enhance and also engage students learning process in science subject as the mean value for perceived of convenient items was 3.67, followed by 3.66 for perceived of facileness items and finally mean value for perceived of gratification items was 3.61. To conclude, virtual reality application is an effective application for students' science learning process in school especially in the 21st century teaching and learning.

Key words: Augmented Reality (AR), teaching and learning strategies, classroom improvement, Technology Acceptance Model (TAM).

1. INTRODUCTION

In this modern era, technology engaged in every part of our lives and the existence of technology can be seen everywhere. Research indicated that there is continual evolution in the technologies that develop improvements to learning; however, the process of redesigning the technology content can help to improve a course's results [1],[2]. This great existence of technology plays an important role in education for students learning especially in 21st century learning as it is being emphasized in Malaysia education system. Educators in Malaysia currently took this opportunity to teach students using variety of technologies in the classroom. The implementation of technologies in teaching and learning helps students understanding and development. Most common technologies being used in teaching by Malaysia teachers are such as projector, smart board, tablet and educational based application downloaded from play store. All these technologies bringing learning process to whole new level. One of the less and mapped technology in education now is virtual reality (VR). Virtual reality can be determined as "near reality" where virtual is near and reality is experience by humans. In a simple definition, virtual reality means experiencing something that doesn't exist. According to [3], the virtual reality revelation enhances students into the understanding of real-world process. Many of us have seen the usage of virtual reality (VR) in various source of applications such as YouTube, smartphones and computers. Without we realize, our daily activities take place using online tools in a virtual based environment. Other than the most impactful of VR in the form of entertainment, other uses of VR into arts, military, educational industrial section and education [4].

Most educators have not yet explored and understood much that VR could be emphasized and used in teaching and learning to enhance students learning by implementing in the learning process [5]. A research conducted based on physical classroom through 3D immersive virtual environment proved that the learners feel more confident, creative, open participatory and understanding because they are interested in learning [4]. The purpose of this research is to establish the role of VR in teaching science for primary five students. Hence, Google Expedition application exploited in teaching and learning science. The benefits of learning and teaching processes also have been identified and summarized through a model. As a next step, the possibilities for merge VR learning objects in learning environment are examined.

2. FRAMEORK OF THE STUDY

The conceptual framework in figure 1 shows the development of Virtual Reality (VR) as an application in learning process through constructivist learning. The aim of the study is to engage the learning process using Virtual Reality (VR) application for standard 6 students in Science subject by constructivist learning that is that the virtual reality to be one of technologies capable of promoting constructive learning. Virtual reality offers a controlled environment in which learners can access and modify the virtual objects embedded within it, and more significantly, the results of such communication can be experienced in real time.

Two concepts of Rogers are ' Design Diffusion Model [6] and Technology Acceptance Model (TAM) [7]. These two have been established as the conceptual framework of the research study as shown in Figure 1. Rogers's theory stated as the learning process are innovated through using VR technology. The process begin with the "knowledge" of the VR that reflects the characteristics of the student's unit for decision making to integrate the technology into its learning process and ends with the student's " confirmation " to accept and integrate the technology according to it. The TAM theory consists of different parts that illustrate the learning process of science subject using the VR application for students including the perceived convenient and perceived facileness. The perceived convenient refers specifically to the extent to which the student believes the advantages of using the Virtual Reality (VR) application by enhancing their confidence, being motivated, memory to learnt concept, communicate to the content easily, focus to the subject content, engage to the subject content, master the science concept independently, understanding Science subject and also accomplish subject task/experiment more quickly and easier.

Perceived facileness refers to the importance of VR technology for the student to be user-friendly. For example, it easy to apply VR application in learning science subject to explore the information that the student need, no difficulty to explore the VR system, easy to understand the content delivers, be flexible to interact with VR application, easy for student to become skillful, engage my learning process and also very useful in learning Science subject. User gratification refer to satisfaction of student by using the VR technology. For example, student feel more confident excited in accomplish the task quickly, to learn science subject and improve the performance of the learning process by using VR application. Other than that, the theory of TAM was developed to calculate efficacy or performance of VR technology in supporting to grasp the science subject's idea and content.

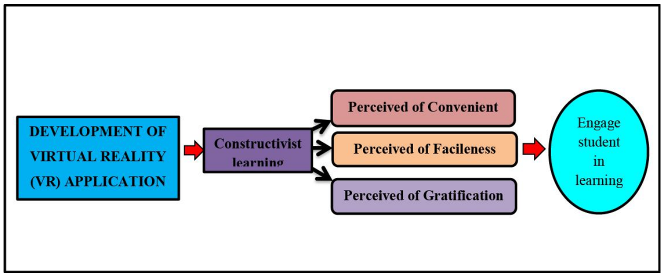

Figure 1: Conceptual Framework shows the process of learning with acceptance of using Virtual Reality (VR) application

3. BACKGROUND OF THE STUDY

According to [8]. [9], VR is a simulation produced by a computer that will replace or stimulates the real world with different media. Unlike traditional HCI (Human-Computer Interaction), such as GUI (Graphical User Interface), VR systems aim to give users a sense of ' presence ' that can be defined in two ways: a sense of ' presence ' [10], [11], [12] and a perception of ' non-mediation ' [13], [14].

"Non-mediation" defines an optimal intuitive condition communication, implying life-like control without the operating system knowledge. Unfortunately, with artificial input devices such as keyboard and mouse, the traditional computer model cannot be accomplished. Tracking software [14]. [15] is the secret to integrating natural communication in the sense of VR. Participant activity information can be categorized and converted to instructions from motion tracking systems such as sensor gloves [16], handheld tracking stations [17] and full-body motion tracking systems with or without markers [18] based on data obtained. Today, in the VR field, all kinds of technologies are rapidly developing. CVR (Collaborative Virtual Reality) supports multi-participant interaction, and remote CVR based on telepresence may be implemented. The real world is superimposed by AR (Augmented Reality), computer-generated images and MR (Mixed Reality) blends both VR and AR. While VR's history approximately half of a century old, its strengths applied to several areas of application for an example like aircraft cockpit and vehicle simulators [19], sports and recovery motion analysis [20], archaeological site and museum scene depiction [21], [22], surgical skills training.

In the area of sport practice, realistic sport simulations aim to maintain the naturalness of the real world to deliver participants with a life-like experience that includes distinct benefits when the actual training environment is unsafe or requires a specific sporting environment. By using VR technology, all parameters of the environment are strictly controlled, which is not possible in the real world for learning. It is then possible to transfer the skills acquired by players from virtual experience to the real world [23]. Since athletes ' coherent body movements can be monitored and portrayed using VR motion detection and visualization technologies, VR is very useful in biomechanical, physiological and behavioral neuroscience research [24]. For example, it is possible to simulate a competitive environment where the competitor competes with an avatar of her / his real opponent. The athlete's sport quality and physiological and psychological input can be registered and analyzed during this virtual competition.

Here on the other hand, sports focused on motion is more fun than regular workouts, thus involving people mostly in physical activities [25]. Exergame (also known as the exertion game) is a combination of video game and physical exercise practices in the interactive game filed [26], [27], [28] and usually uses tracking technology to obtain participants ' body movement data, which can be called a tiny-scale VR. The great success of the commotional exergame that has been introduced over the past few years, games released for Nintendo WiiTM, Microsoft KinectTM for XboxTM 360, and PlayStation have shown tremendous interest in people's innovative communication technologies. The latest exergame generation uses stereoscopic screen and more reliable tracking technologies such as Astro jumper [29], and Swordplay [30] to provide more immersive experience.

4. PROBLEM OF THE STUDY

A widespread educational issue is that traditional strategies of teaching lead to students being disengaged [31]. This deficiency of dedication is seen as a significant reason for numerous adverse behaviors, including deceit, negative experiences and school dropout [31]. Accelerating student engagement with educational activities also increases student's personal development and also learning [31], [32]. Recognized two learning opportunities that can complement traditional teaching methods provided by VR in this study.

Several VR applications provide a chance to improve student participation. As a hands-on, immersive experience, engaging, it provides a new way of learning for the students, providing powerful new experiences they may not have encountered before this [33], [34], [35], [36], [37], [38]. For example, Google Expeditions encourages teachers to take students on digital field trips to Mars, the bottom of the ocean, and many other settings that may inspire new interest in the subject, offer shared experience for a better conversation in the classroom, and increase overall engagement [39]. Thoughts and feelings like these offer special and new moments of learning for students. Such increased engagement can provide an opportunity to fix issues that are typically boring or low appeal. For example, [40] found that VR shows increased interest in archaeology, especially where there was low interest in the past. The novelty and entertainment value of VR can be used effectively to capture the attention of students who are lost and completely uninterested, even in subjects that some students usually find boring or insignificant. From there, VR-specific pedagogy will maximize these experiences ' learning capacity that will be explained later.

In addition to conventional learning environments, VR also improves interaction by giving students a clear sense of presence and immersion [41], [42]. Various types of classroom interactions are present at different levels: reading literature in the classroom; watching videos passively; attending theatre performances; and the most engaging actors and objects in VR [43]. VR brings a subject area to life by enveloping a student in an authentic, multi-sensory experience. For example, in The Body VR (The Body VR, n.d.), students have the capability to travel within the bloodstream of the body of man as a red blood cell. One of VR's Many relevant ways to make learning activities more engaging is the capacity to modulate the environment and increase the student's sense of presence.

5. LITRATURE REVIEW

In the teaching-learning process, the technological revolution has allowed the use of new approaches. One of the conductive technologies to build innovative educational tools is the Virtual Reality, which provides advanced forms of interaction with three-dimensional computer environments that can provide more motivation for the learning process. We might find a very short time ago that the great potential of using VR was in small groups located in large urban centers and in institutions of teaching and research. Nevertheless, the VR-VRML integration democratized its entry, the its capacity and allowing use of fields [44]. For example, using tools from some modelling and animation systems such as the Blender 3D, the use of VR can help students understand and assimilate concepts, emerging as a valid alternative to achieving good results. Certain benefits are found with the use of Virtual Reality in education.

According to [45] the Virtual Reality can be used to make learning more interesting and fun with the aim of improving motivation and attention, reducing costs when using the objective and the real environment, regardless of how expensive the simulation is. It also makes it possible for situations that could not be explored in the real world to be done, for example: exploring a planet like Mars, traveling inside the human body, exploring submarines or indoor caves, visiting very small places to be seen (molecules) or very expensive or very far away, or because this place is in the past (historical places).

5.1 Educational VR Applications

One of the challenges in educational software development is to ensure that apps are easy to use while improving education at the same time. A well-documented concept of instructional design of educational software is the theory of immersive learning [46]. [47], [48], which notes that learning takes place best when descriptions are provided using a combination of words and pictures rather than just words or pictures. Words can be spoken (for example, narration) or printed (for example, text). Multimedia learning theory was built based on the Cognitive Theory of Multimedia Learning (CTML) [47], which explains how learners learn from the information presented in both words and images. Three assumptions are based on this theory: Dual-channel assumption: Learners use two separate channels to process the representation of audio and visual data. Limited capacity assumption: Only minimal information can be processed simultaneously in one stream. Active learning: Learning takes place when the learner becomes interested in immersive learning cognitive processes which pick, organize and incorporate words and images. The cognitive system as a whole is not linear, and learners can switch in any way from one process to another. The theory suggests that the capacity of learners to access channels of both words and images is limited. It implies, therefore, that simply adding words and pictures to a multimedia program does not improve training. It is important to view the combination of words and pictures in a way that improves learning without causing cognitive overload. A series of multimedia learning concepts were developed based on the results of different multimedia learning experiments as a framework for the presentation. A common feature of most of the VR applications reviewed is the use of multiple pages to display linked information, regardless of whether they are used as a learning resource or as a VFT. While these implementations also follow the multimedia principle (learners learn better by presenting information in words and pictures rather than in words alone), the use of different locations (not in the same display) to link related information results in a lack of integration of linked data.

The Process Flow Diagram (PFD) is significant in engineering, for example, because it describes a theoretical chemical process [49]. According to Maynard [50], it has also been found that the relation between panoramas and diagrams is useful. If the PFD is not made available and integrated with other information, it may be difficult for users to connect the ideas in order to understand the information. For example, two panels are used by the BP VR application to view the map and panoramas. Users are led to a new page without showing the panoramas or the map while viewing the PFD or other data connected to some equipment in a panorama. When linking related information to the physical environment, this can cause users difficulties. When the information is presented sequentially (in this case at a different location), the cognitive load of the user will likely increase as the user will have to keep the information presented on the previous page until they reach the next related page [51]. While other applications such as the Tempe Butte VR application [52] the Grampians National Park application [53] and the ViRILE application [54] use two-panel displays, one displaying the panoramic and the other providing the panoramic background, there are no specific links between the information presented in the submission. On the other side, the digital forest [55] has a format of four boards. Such tables, however, are primarily used to share information among application users rather than to incorporate related information. The lack of data integration is therefore a key issue for the applications being reviewed. The large number of different forms of information (e.g. charts, text, photographs, videos, etc.) and the associations between related information lead to the desire to create and evaluate an application that integrates information so that it can be used easily while offering a functional learning tool for learners. Linking the data helps students to better understand the individual elements of the studied materials [56]

5.2 Previous VR Applications in Educational Settings

In medical settings, simulations have played a significant role in educating medical professionals, and sensibly so – it's generally not a good idea to put someone's health in the hands of a novice. While historically most of these simulations have been physical models of actual body parts that may or may not have computer representations, more recently virtual simulations are being used more frequently [57]. These range in levels of immersion from videogame like virtual worlds to surgical simulations encompassing the most dominant human senses of visuals, sound, and touch. This has allowed the medial field to educate new practitioners without the need for live patients, bypassing cost, availability, and ethical restrictions. It has also given the profession novel and more effective ways at assessing medical knowledge and competency. These technologies have been used in outreach initiatives for recruiting interested secondary school students into the medical profession [58]. These students that participate in these programs report high levels of engagement, enjoyment, and assuredness regarding their desire to pursue a medical career. Other high-risk work environments such as airlines, militaries, and nuclear power plants have similarly benefited from virtual simulations.

In the classroom, the two-dimensional physics simulation program "Interactive Physics" utilized for K-12 teacher professional development was shown to increase not only the teacher's content knowledge but their ability to integrate this technology into actual lesson plans [59]. Another computer simulation program "Real Time Relativity" has been shown to have a positive effect on student performance on exam questions, increase student confidence of their understanding of the concepts, and enhance their enjoyment of the subject [60]. The teaching of modern physics may benefit greatly from virtual reality since understanding many of the concepts requires a reconceptualization of common-sense notions of reality. In the subject of mathematics, Hwang and Hu [61] studied how an Interactive Future Mathematics Classroom (IFMC) VR program can be used to promote fifth grade students understanding of geometry, proficiency with geometric problem solving, and familiarity with multiple representations of geometrical concepts. This system employed interactive geometrical manipulatives within a virtual environment that included a table where shapes could be added, stacked, removed, and moved around, "whiteboards" where students could write equations and notes, and a peer-chatting tool to communicate with other students. The chat tool allowed students to share alternative viewpoints and cooperate to solve problems. Two classes were used in the research, one as a control group and one using the IFMC program. They administered pre- and post-tests to evaluate prior knowledge of geometrical concepts and learning that was gained through the program. They found that students that were administered the interventions learned more about geometrical concepts and scored higher in problem-solving than the control group.

Also designed for mathematics education is the virtual environment CyberMath, which was developed specifically to investigate several key issues in virtual reality-based education [62]. One is the effectiveness of free-choice learning that is normally found in VR educational programs (similar to what occurs in museums) as opposed to formal, directed instruction. Secondly the differing levels of immersion offer distinct advantages and disadvantages that have not been explored – high levels of engagement for full immersion environments vs. low cost and high availability of low immersion desktop environments. How high levels of visual realism can either detract from or enhance learning, along with how to most effectively handle large amounts of users in collaboration can also be explored with the program. Unfortunately, the designers of this program have not reported any outcomes of their studies at this time. Chemistry is also a subject that requires geometrical visualization skills with the arrangements of atoms to form molecules. [63] used the online virtual environment Second Life in order to explore its potential for enhancing spatial skills in the context of chemistry concepts. Their study did not find that the program enhanced the spatial ability and chemistry achievement of their subjects - undergraduate college students in an introductory chemistry course. However, they did show that students who had trouble manipulating two-dimensional objects performed much better in the three-dimensional environment. The study also showed no significant difference between male and female spatial abilities, challenging common-held views that males are superior in this area.

6. RESEARCH METHODOLOGY

The researchers applied quantitative research design for this research. Analysis of descriptive from a survey instrument used. Purpose of this design was to display and classify convenient, facileness and gratification of virtual reality (VR) application for students in one of the primary Malay school in Iskandar Puteri district. A total of 10 samples from a small population selected. The researcher used a set of questionnaires which consist of 2 segments which is part A demographic details and part B is acceptance of virtual reality (VR) as an instrument to collect data. The rising need for a representative statistical sample in academic research has generated the need for an appropriate sample size determination process. To fix the current void, a table for easy reference was created by Krejcie & Morgan [64] to assess sample size for a given population. According to the table, Population 40 is equal to 36 sample size. This research showing that as the population 40 equal to sample size 40 at a diminishing rate.

7. RESULTS AND DATA ANALYSIS

7.1 Demographic analysis

The demographic analysis in Part A is about the gender, ethnics group, owned a mobile, purpose on using the mobile and duration of using mobile a day. First, the demographics of respondents will be discussed as follow:

Table 1: Gender

Gender	Frequency	Percent
Male	25	62.5
Female	15	37.5
Total	40	100.0

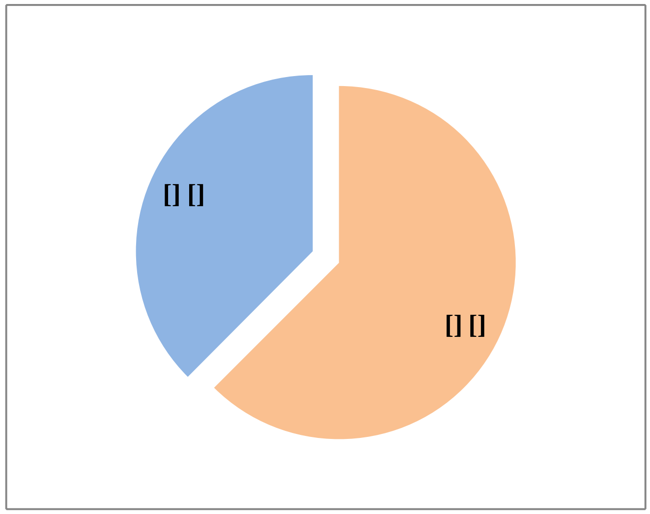

Figure 2: Pie Chart of Gender

Both table and figure 1 indicates the graph that shows the overall samples are 40 samples of respondents include the both gender male and female. Based on the gender, there are 25 male and 15 females with a percentage of 62.5% male as compared to 37.5% female respondent.

Table 2: Ethnic Group

Ethnic	Frequency	Percent
Malay	34	85.0
India	4	10.0
Others	2	5.0
Total	40	100.0

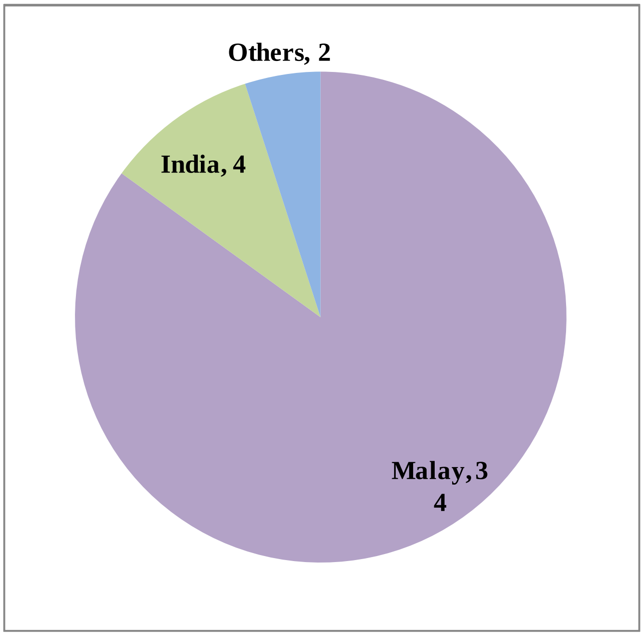

Figure 3: Pie Chart of Ethnic Group

Based on table 2 and figure 3 which indicates the graph that shows the overall 40 respondents samples based on the race, the highest frequency of respondent are Malay with a total of 34 (85%) followed by Indian with 4 (10%), then Others with 2 (5%).

Table 3: Owned a mobile

Owned mobile	Frequency	Percent
Yes	20	50.0
No	20	50.0
Total	40	100.0

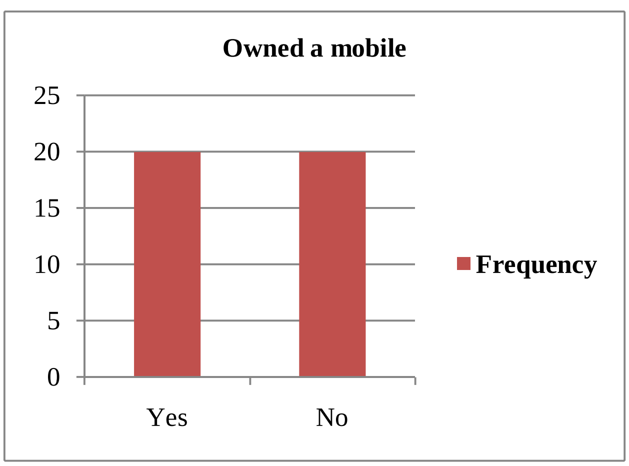

Figure 4: Bar Chart of Owned a Mobile

Both table 3 and figure 4 indicates the graph above shows the overall samples based on the respondents own a mobile, frequency of 'Yes' are 20 (50%) respondents and frequency 'No' are 20 (50%) respondents from total of 40 (100%) respondents samples. That shows the equableness of students that do own or did not own a mobile.

Table 4: Purposes on Using Mobile

Purpose using mobile	Frequency	Percent
Education	15	37.5
Social media	12	30.0
Games	3	7.5
Calls	10	25.0
Total	40	100.0

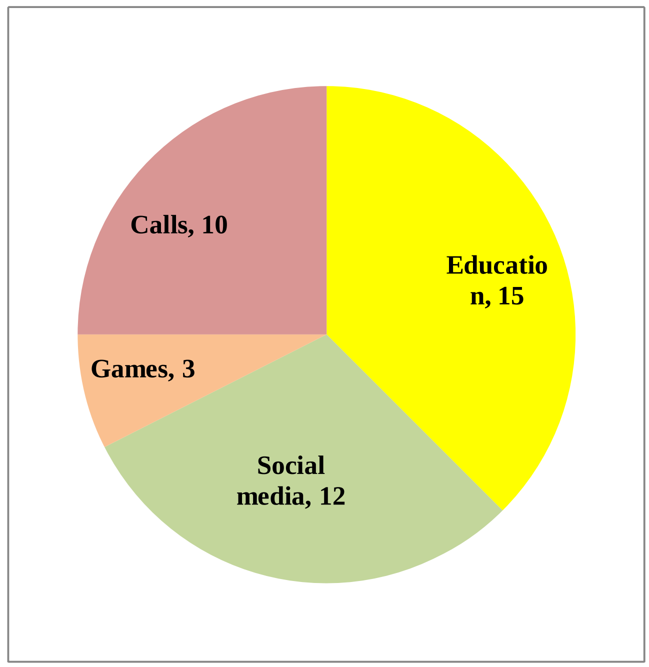

Figure 5: Pie Chart of Purposes on Using Mobile

From the overall samples based on the respondents purposes on using mobile are shown in the above Table 4 and Figure 5, frequency of education are 15 (37.5%) respondents, social media are 12 (30.0%) respondents, games 3 (7.5%) respondents and calls are 10 (25%) from total of 40 (100%) respondents samples. That shows the students purposes on using the mobile are more frequency in education than social media, games and calls.

Table 5: Using Mobile in A Day

Using mobile in a day	Frequency	Percent
0-2Hours	29	72.5
3-4Hours	6	15.0
More than 5 Hours	5	12.5
Total	40	100.0

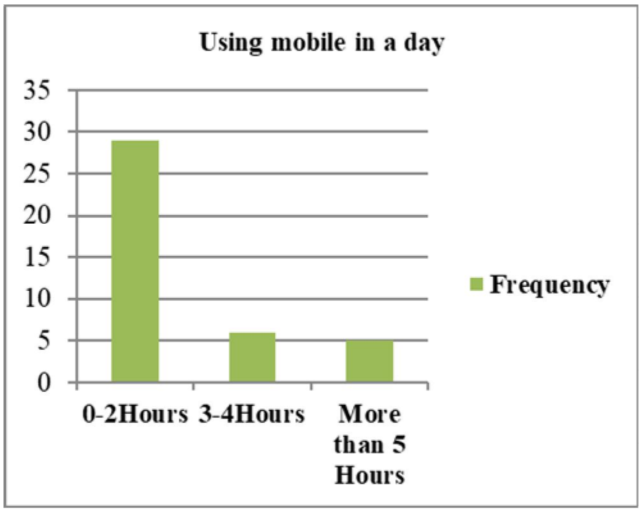

Figure 6: Bar Chart of Using Mobile in A Day

From the overall samples based on the respondents using mobile in a day(school days) are shown in the above Table 5 and Figure 6, frequency of using mobile in a day within 0-2hours are 29(72.5%) respondents, 3-4hours are 6 (15.0%) respondents and more than (> 5 hours) are 5(12.5%) respondents from total of 40 (100%) respondents samples . That shows the students frequency of using mobile in a day are less than 3 hours.

Table 6: Owned Virtual Reality Box

Owned VR box	Frequency	Percent
Yes	4	10.0
No	36	90.0
Total	40	100.0

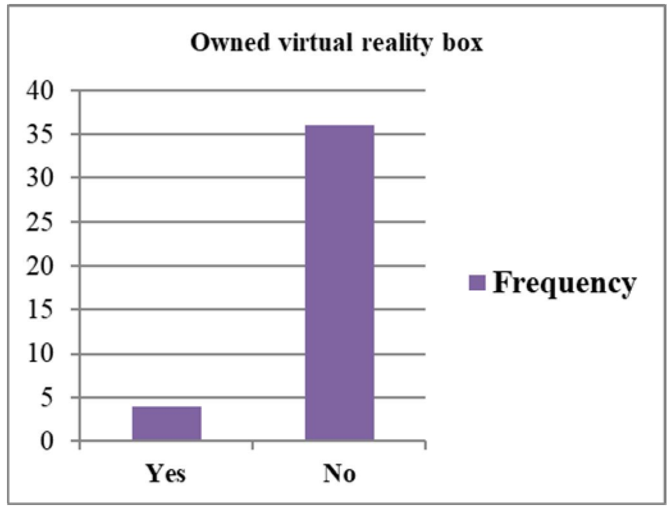

Figure 7: Bar Chart of Owned Virtual Reality Box

Both table 6 and figure 7 indicates the graph above shows the overall samples based on the respondents who owned Virtual Reality (VR) box, frequency of 'Yes' are 4 (10.0%) respondents and frequency 'No' are 36 (90.0%) respondents from total of 40 (100%) samples of respondents. That shows the frequency of 'No' respondents are more than 'Yes' respondents. So, from this, we can know that most of students do not owned Virtual Reality (VR) box.

Table 7: Used Virtual Reality Box

Used VR box before	Frequency	Percent
Yes	4	10.0
No	36	90.0
Total	40	100.0

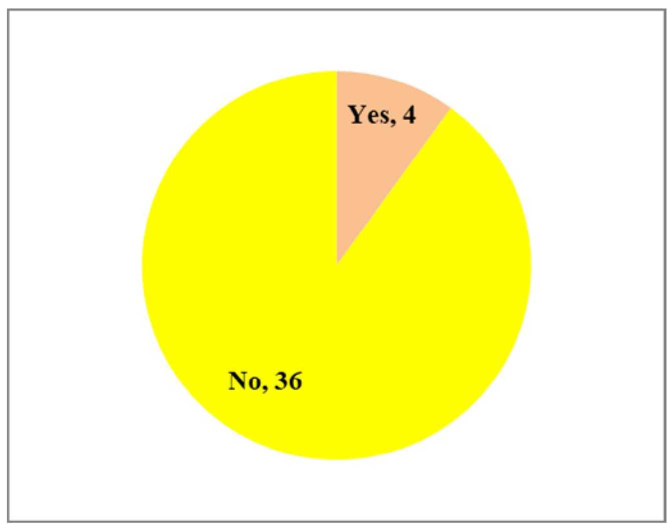

Figure 8: Pie Chart of Used Virtual Reality Box

Both table 7 and figure 8 indicates the graph above shows the overall samples based on the respondents who use Virtual Reality (VR) before, frequency of 'Yes' are 4 (10.0%) respondents and frequency 'No' are 36 (90.0%) respondents from total of 40 (100%) samples of respondents. That shows the frequency of 'No' respondents are more than 'Yes' respondents. So, from this, we can know that many students do not use Virtual Reality (VR) application before.

Table 8: Used Google Expedition Application Before

Used Google Expedition application	Frequency	Percent
Yes	1	2.5
No	39	97.5
Total	40	100.0

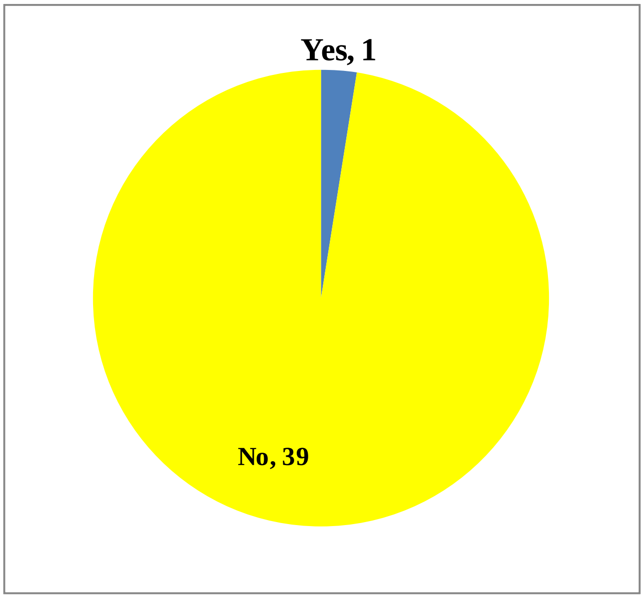

Figure 9: Pie chart of used Google Expedition Application before

Both table 8 and figure 9 indicates the graph above shows the overall samples based on the respondents who used Google Expedition application, frequency of 'Yes' are 1 (2.5%) respondents and frequency 'No' are 39 (97.5%) respondents from total of 40 (100%) samples of respondents. That shows the frequency of 'No' respondents are more than 'Yes' respondents. So, from this, we can know that majority students have not been used Google Expedition application. In Part B, data were analyzed to identify the frequency of three section; perceived of convenient items, perceived of facileness items and perceived of gratification items. Respondents response using the rating scale from 1 to 4; 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree. Quantitative analysis of the convenient of VR application in student learning was conducted on feedback respondents from section B of the questionnaire containing questions 27 which comprises the 11 main components of a convenient of VR application. Components including confidence to complete science experiment, motivated to learn science subject, increase the memory, communicate the content easily, focus to the subject content, me to engage the subject content, me to master the science concept independently, enhance my understandings for science subject, is easier to study the science subject and convenient in learning science subject All components of an item are 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree. Table 9 shows the analysis of the convenient of VR application in student learning. Based on the following table, the virtual reality enables me to communicate the content easily are the main factor that convenient of VR application is the mean of 3.88 and followed by the virtual reality enables me to increase the memory to the learnt science concept is 3.78. Finally, the component with the lowest mean is virtual reality enables me to focus to the subject content and I am being motivated to learn science subject with mean values of 3.28 and 3.52 respectively. Overall, the mean value for perceived of convenient items was 3.67 that is in the simplest of circumstances.

Table 9: Perceived of Convenient Items

	Strongly Disagree		Disagree		Agree		Strongly Agree		
	Count	Row Valid N %	Count	Row Valid N %	Count	Row Valid N %	Count	Row Valid N %	Mean
I feel more confidence to complete science experiment after exploring virtual reality.	0	0.0%	2	5.0%	6	15.0%	32	80.0%	3.75
I am being motivated to learn science subject after experiencing virtual reality task.	0	0.0%	2	5.0%	15	37.5%	23	57.5%	3.52

I realized that using virtual reality enables me to increase the memory to the learnt science concept.	0	0.0%	2	5.0%	5	12.5%	33	82.5%	3.78
I feel using the virtual reality enables me to communicate the content easily.	0	0.0%	1	2.5%	3	7.5%	36	90.0%	3.88
I realized that the virtual reality enables me to focus to the subject content.	0	0.0%	9	22.5%	11	27.5%	20	50.0%	3.28
I found that the virtual reality enables me to engage the subject content.	0	0.0%	1	2.5%	9	22.5%	30	75.0%	3.72
I feel using the virtual reality enables me to master the science concept independently.	0	0.0%	3	7.5%	9	22.5%	28	70.0%	3.62
I found using the virtual reality enables me to enhance my understandings for science subject.	0	0.0%	1	2.5%	7	17.5%	32	80.0%	3.77
I believe the virtual reality is easier to study the science subject.	0	0.0%	2	5.0%	6	15.0%	32	80.0%	3.75
I realized using the virtual reality is easier to understand the science content.	0	0.0%	0	0.0%	10	25.0%	30	75.0%	3.75
I find using virtual reality convenient in learning science subject.	0	0.0%	0	0.0%	16	40.0%	24	60.0%	3.6
								Average	3.674545

Quantitative analysis of the facileness of VR application in student learning was conducted on feedback respondents from section B of the questionnaire containing questions 27 which comprises the 11 main components of a facileness of VR application. Components including would be easy for me, learning science subject to explore the information I needed learning science subject is user friendly, I have no difficulty to explore the virtual reality system, focus to the subject content, learning science subject would be flexible to interact with, I found that it would be easy for me to become skillful, I able to enhance my learning process in science subject through virtual reality, I found the various functions in this applications were well integrated, I think that I would like to use this virtual reality application always and I find the virtual reality to be very easy in learning science subject. . All components of an item are 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree. Table 10 shows the analysis of the facileness of VR application in student learning. Based on the following table I able to enhance my learning process in science subject through virtual reality are the main factor that facileness of VR application is the mean of 3.8 and followed by I think that I would like to use this virtual reality application always is 3.78. Finally, the component with the lowest mean is I find the virtual reality to be very easy in learning science subject is 3.45 and I have no difficulty to explore the virtual reality system is 3.52 respectively. Overall, the mean value for perceived of facileness items was 3.66 that is in the simplest of circumstance.

Table 10: Perceived of Facileness Items

	Strongly Disagree		**Disagree**		**Agree**		**Strongly Agree**		
	Count	**Row Valid N %**	**Count**	**Row Valid N %**	**Count**	**Row Valid N %**	**Count**	**Row Valid N %**	**Mean**
I found learning to use virtual reality application that would be easy for me.	0	0.0%	1	2.5%	8	20.0%	31	77.5%	3.75
I would find it easy apply virtual reality application in learning science subject to explore the information's I needed	0	0.0%	1	2.5%	15	37.5%	24	60.0%	3.58
I could feel my interaction with virtual reality application in learning science subject is user friendly.	0	0.0%	1	2.5%	14	35.0%	25	62.5%	3.6
I have no difficulty to explore the virtual reality system.	0	0.0%	1	2.5%	16	40.0%	23	57.5%	3.55
I find it is easy to understand the content delivers in the virtual reality application.	0	0.0%	0	0.0%	15	37.5%	25	62.5%	3.62
I would find virtual reality application in learning science subject would be flexible to interact with.	0	0.0%	3	7.5%	9	22.5%	28	70.0%	3.63
I found that it would be easy for me to become skillful at using virtual reality application.	0	0.0%	0	0.0%	12	30.0%	28	70.0%	3.7
I able to enhance my learning process in science subject through virtual reality.	0	0.0%	2	5.0%	4	10.0%	34	85.0%	3.8
I found the various functions in this application were well integrated.	0	0.0%	3	7.5%	4	10.0%	33	82.5%	3.75
I think that i would like to use this virtual reality application always.	0	0.0%	0	0.0%	9	22.5%	31	77.5%	3.78
I find the virtual reality to be very easy in learning science subject.	0	0.0%	6	15.0%	10	25.0%	24	60.0%	3.45
								Average	3.655455

Quantitative analysis of the gratification of VR application in student learning was conducted on feedback respondents from section B of the questionnaire containing questions 27 which comprises the 5 main components of a gratification of VR application. Components including I believe that using virtual reality application in science subject will improve the efficiency of the learning process, I am completely gratified using the virtual reality application on learning science subject, I feel very confident using virtual reality application on learning science subject, I can accomplish the task given quickly using virtual reality application and I am excited to learn science subject every day.0 All components of an item are 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree. Table 11 shows the analysis of the gratification of VR application in student learning. Based on the following table I believe that using virtual reality application in science subject will improve the efficiency of the learning process are the main factor that facileness of VR application is the mean of 3.77 and followed by I feel very confident using virtual reality application on learning science subject.is 3.7. Finally, the component with the lowest mean is I can accomplish the task given quickly using virtual reality application is 3.48 and I am excited to learn science subject every day is 3.55 respectively. Overall, the mean value for perceived of gratification items was 3.61 that is in the simplest of circumstances.

Table 11: Perceived of Gratification Items

	Strongly Disagree		**Disagree**		**Agree**		**Strongly Agree**		
	Count	**Row Valid N %**	**Count**	**Row Valid N %**	**Count**	**Row Valid N %**	**Count**	**Row Valid N %**	**Mean**
I am completely gratified using the virtual reality application on learning science subject.	0	0.0%	2	5.0%	14	35.0%	24	60.0%	3.55
I feel very confident using virtual reality application on learning science subject.	0	0.0%	2	5.0%	8	20.0%	30	75.0%	3.7
I can accomplish the task given quickly using virtual reality application.	0	0.0%	2	5.0%	17	42.5%	21	52.5%	3.48
I am excited to learn science subject every day.	0	0.0%	2	5.0%	14	35.0%	24	60.0%	3.55
I believe that using virtual reality application in science subject will improve the efficiency of the learning process.	0	0.0%	0	0.0%	9	22.5%	31	77.5%	3.77
								Average	3.61

Table 12: Analysis of acceptance constructs

Acceptance constructs	Mean
Convenient	3.68
Facileness	3.65
Gratification	3.61
Average	3.65

From the table 12 above, perceived of convenient has highest construct which is 3.68, perceived of facileness has medium construct which is 3.65 and perceived of gratification has lowest construct which is 3.61. Overall average mean showing 3.65. Therefore, student feel convenient to use Virtual Reality (VR) mobile based Google Expedition application to engage in learning process.

8. DISCUSSION

According to [6], the perceived convenient refers specifically to the extent to which the student believes the advantages of using the Virtual Reality (VR) application by enhancing their confidence, being motivated, memory to learnt concept, communicate to the content easily, focus to the subject content, engage to the subject content, master the science concept independently, understanding Science subject and also accomplish subject task or experiment more quickly and easier. The findings show that the factors the convenient of VR application in student learning. Based on the tables, the virtual reality enables me to communicate the content easily are the main factor that convenient of VR application is the mean of 3.88 and followed by the virtual reality enables me to increase the memory to the learnt science concept is 3.78. Finally, the component with the lowest mean is virtual reality enables me to focus to the subject content and I am being motivated to learn science subject with mean values of 3.28 and 3.52 respectively. Overall, the mean value for perceived of convenient items was 3.67 that is in the simplest of circumstances.

In conclusion, the findings of the study indicate the main contributing factors that is convenient of VR application in student learning enhancing their confidence, being motivated, memory to learnt concept, communicate to the content easily, According to [7], [14], [15], [16], facileness and gratification were both perceived as predicting the use of the VR application, defined as the students ' desirability to use the VR application. He assumes that a student who has perceived of gratification in the VR application can help improve their performance. He also assumes that the quality of the learning process will be effective with perceived of facileness because the application should help the student perform better. The facileness of VR application in student learning. Based on the tables above, I able to enhance my learning process in science subject through virtual reality are the main factor that facileness of VR application is the mean of 3.8 and followed by I think that I would like to use this virtual reality application always is 3.78. Finally, the component with the lowest mean is I find the virtual reality to be very easy in learning science subject is 3.45 and I have no difficulty to explore the virtual reality system is 3.52 respectively. Overall, the mean value for perceived of facileness items was 3.66 that is in the simplest of circumstances. In conclusion, the findings of the study indicate the main contributing factors that is facileness of use of VR application in students learning, learning science subject to explore the information I needed learning science subject is user friendly, I have no difficulty to explore the virtual reality system and focus to the subject content.

According to [7], [8], [9], [10], Virtual Reality application offer the emotional gratification and excitement in learning Science subject. The gratification of VR application in student learning. Based on the following tables, I believe that using virtual reality application in science subject will improve the efficiency of the learning process are the main factor that facileness of VR application is the mean of 3.77 and followed by I feel very confident using virtual reality application on learning science subject.is 3.7. Finally, the component with the lowest mean is I can accomplish the task given quickly using virtual reality application is 3.48 and I am excited to learn science subject every day is 3.55 respectively. Overall, the mean value for perceived of gratification items was 3.61 that is in the simplest of circumstances. In conclusion, the findings of the study indicate the main contributing factors that is I believe that using virtual reality application in science subject will improve the efficiency of the learning process, I am completely gratified using the virtual reality application on learning science subject and also I feel very confident using virtual reality application on learning science subject.

9. LIMITATIONS AND FUTURE WORK

Future works for this current application is used to justify new and improved features that would give more usability to end user and benefits the marketing potential of this current application in terms of research area or non-research area. There are several ways to improve the current application program. The first is to improve the current 3D model. It is problem that sometimes 3D object cannot display texture since the current application created does only static model of Science syllabus. If provided enough time to do further development of the project, Integration with other technology like Leap Motion and voice recognition in the game would be a great idea to let the players has more immersive experience in the VR environment. There will be many kinds of interaction thus will make the game more interesting to play with. As to the limitation of the motion sickness earlier, some studies need to be done to find the best algorithm to decrease this effect. Besides speed and stability, the use of lighting, color and contrast in the game might as well affect the motion sickness. Instead of using Google Cardboard, the project could use other devices or invent new similar device that is more comfortable to wear but affordable in the same time. Since the project objective is developing web based virtual reality project does not focus as game functionalities. Other functions can be added to make Virtual Reality game more interactive. The Virtual Reality pages displayed as a sequence. That’s why user may know the order of correct answers. The project can be developed by generating pages randomly. Other possibility is generating the random answers for user. It will avoid user to guess answers. The program can also be improved by having admin side. For example, admin can add more 3D object or may want to update or delete the current 3D objects.

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