

# Utilization of Virtual Reality Content in Grade 6 Social Studies Using Affordable Virtual Reality Technology

Asia Pacific Journal of  
Multidisciplinary Research  
Vol. 5 No.2, 1-10  
May 2017 Part II  
P-ISSN 2350-7756  
E-ISSN 2350-8442  
www.apjmr.com

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*Date Received: March 28, 2017; Date Revised: May 10, 2017*

**Abstract** – *Virtual Reality is fast becoming a breakthrough in education technology and is headed towards a path where learning has become immersive. Virtual reality (VR) offers both learners and educators a great opportunity to bridge gaps in the pedagogical sense. With the emergence of the Google Cardboard (GCB) platform, a low-cost, virtual reality gadget comes a wide range of opportunities for educators and institutions to bring about an immersive type of learning environment for the 21st-century learner. Using Grade 6 Middle school students, this research explores the learning outcomes and student reactions using the GCB and Google Expeditions application. The study showed no significant difference in pre-test scores of the control and experimental group. There is however, a significant difference in the scores of the experimental group compared to the control group after post-test. Utilizing t-test in comparing the two groups, it was found that the mean of the post-test scores for Group A (experimental) was significantly higher than Group B(control). The result of the independent samples t-test was significant,  $t(18) = 2.33, p = .032$ , suggesting that the mean of posttest score was significantly different between Groups A and B. This difference in score performance gives light to how VR can be used as a tool that enhances the learning experience. By using VR technology that is low cost and effective, more institutions will be able to help students learn better.*

**Keywords** – *Android, Education Technology, Google Cardboard, Google Expedition, Interactive, Virtual Reality,*

## INTRODUCTION

Twenty-first-century learning and modern education can be revolutionized by using virtual reality (VR) and making the learner fully immersed and engaged in the concepts or subjects being taught. The Google Cardboard (GCB) is one such project that has recently captured everyone's attention on the use of Virtual Reality for Education. Google made its design and components available for everyone to use or copy, which makes it one of the most affordable virtual reality gadgets in the market today.

Recent studies show how VR technology has evolved from being unaffordable for educational institutions to being accessible. Companies were already developing VR head mounted displays (HMDs) but were concerned how the public will react or accept buying a new hardware [1]. Due to this challenge, Google was the first to use existing smartphones paired with the Google Cardboard HMD [1]. Up until the creation of the Google Cardboard

(GCB), VR was largely inaccessible even if the technology was already available.

Youngblut's [2] survey about the use and effectiveness of virtual reality in the K to 12 education found that most teachers would only opt to use this technology when the following criteria is met: affordability, ease of use, and availability for both educators and students. A study that was done around 19 years ago seemed to still validate this concern of educators and institutions up until Google introduced the Google Cardboard in 2014, which was just around three years ago. The author wanted to highlight using the Google Cardboard and Expedition for its affordability. Affordability does depend on the financial capacity of who is paying for a particular item. For this study, the author used the term "affordable" in reference to the Google Cardboard HMD (average price \$5-\$15) vs. mobile HMDs like Samsung Gear VR (average price \$80-\$100). With the GCB platform and how Google has invested

millions of dollars in making VR accessible to anyone, learning can now be as immersive as educators and learners want it to be. The fact that one would only need a cardboard means anybody can do it. In the Philippines, the lack of technology and resources for a more interactive type of learning set up is one of the primary reasons of the author in exploring the use of the Google Cardboard (GCB) platform and its VR capabilities is a great tool for education where students from all walks of life can enjoy fun-filled and totally immersive learning environment.

VR technology such as the GCB can be used for social studies where learners can actually experience history coming to life and they can participate in it. Perhaps La Valle [3] said it best when he mentioned that a great opportunity in VR education now lies in the areas of humanities and social sciences where it is now possible to visit ancient cities or 19<sup>th</sup> century Victorian era or even actual museums. Integrating VR into Social studies is something that's already being done in many schools. In fact, VR teacher training is already ubiquitous in the US, UK, Europe and other countries. An example of one training happened to be attended by 24 social science teachers from Allegheny County where they were able to test VR tools and even experience travelling the world [4]. These types of training allows for social science educators to learn how to use VR in their classes and use it to teach their students not just historical landmarks but much more important social contexts such as openness and acceptance of one's culture, religion, and way of living.

The constructivist theory really fits well in a virtual environment due to its ability to provide students with an immersive synthetic environment where they become learners who can construct knowledge through the learning-by-doing process[5]. Constructivism is based on the assumption that people are able to form their own understanding of concepts of the world around them through experience and reflection. Generally speaking, it is allowing learners to use activities like experiments or real world problem solving in order to gain more knowledge, to reflect on this notion, and to use these to open the lines of communication on how their understanding is changing [6]. For constructivists, motivation is a key component in learning. It is essential for learning to take place. The connection between constructivism and educational technology

through a thorough review of research trends have led to the conclusion that constructivism was the theoretical basis for the creation of IT based environments such as e-learning and other learner centered environments [7].

This opportunity to construct knowledge within a synthetic, virtual environment makes learning successful due to the fact that learners are able to interact and observe what happens to this environment when they perform certain actions with it [8]. Virtual worlds are environments that allow for the construction of a deep understanding on concepts as one where students are able to base their knowledge through knowing by doing, which, ultimately gives them the ability to drive their own learning process [9].

The study on Virtual Reality Learning Environments (VRLEs) supports the notion that constructivist learning is indeed the driving force behind the creation of VRLEs and presented case studies to validate VRLEs for learning [10]. Such learning environments that are based on technology offer many avenues for students to learn that can't otherwise be done in a traditional classroom type setting [11]. This setting in which the curriculum is student or learner centered shies away from the idea of the learner as a person to be changed [9].

With virtual reality in education, we look to Edgar Dale's theory on the cone of experience, which he formulated in the 1960s and theorizes that a learner has the ability to commit to memory about 90% by doing a task compared to just hearing, seeing, or writing. Many of today's tools for technology education including VR is about learning by doing. The revelation that 90% of learners retain lessons through simulation and by doing means that educators need to pay attention to the medium of instruction or approach that they will use in class.

#### **OBJECTIVES OF THE STUDY**

Using technology in the classroom is easier said than done especially in public schools where teachers do not have ready access to different types of technologies. The aim of this paper is to show an economical way to integrate technology into the classroom through an affordable platform such as the Google Cardboard. Specifically, it aims to determine the level of performance in the pre-test, post-test of the control and experimental group; compare the difference in test score performances between a group taught through the traditional method (control group)

and another group using virtual reality (experimental group) and assess the experience of the students in using an affordable virtual reality technology.

## **METHODS**

### **Design**

This study used a quasi-experimental research design with a control group and an experimental group to assess the efficacy of using virtual reality as a valid educational intervention that can be used to help students learn subjects better. The researcher selected the two groups in which a pretest and posttest were administered. The researcher wanted to be able to gather data that can compare two group behaviors and measure any changes from a particular activity.

### **Procedure**

Group A is the experimental group that will use Virtual Reality in the lesson plan while Group B is designated as the control group that doesn't use VR. Herein, the chosen respondents were all from Grade 6 classes having an equal number of 10 students each per class. The researcher engaged students in an actual class using VR technology and another class without using VR. Both classes conducted used the same lesson plan and were administered the same set of pre-test and posttest questionnaire. In order to eliminate the possibility of the results being influenced by the Hawthorne Effect- a process wherein test subjects modify their behavior due to the awareness that they are being studied; participants were deliberately uninformed about their participation in this research.

### **Participants**

The study participants are from the International School of Kazan (ISK), the first International school in the city of Kazan, Republic of Tatarstan, Russia where the researcher works as a Middle School Design and Technology teacher. The school has a relatively small student population as it only opened a few years ago. It is currently offering an International K-9 curriculum and is set to open Grades 10 to 12 beginning school year 2017-2018. The middle school of ISK has a total population of 60 students and for this study, the researcher selected the Grade 6 students since it was the only grade level in the middle school that has two sections from which the researcher can implement the experiment. This also ensured that demographic features such as age are the same for control and experimental group- a factor that

can potentially affect the results of the pre and posttest. There were 20 participants in the study, having 10 participants each for Groups A and B. Both groups are comprised of 90% Russian (9 students) and 10% Foreign (1 student). All participants in the study can understand English. All instruments and mode of instructions used are in the English language. ISK has no labels for sections (i.e. cream class or section A) and all students are all on the same intellectual capacity with regard to this particular topic/subject area.

### **Setting**

This research was conducted in the capital city of Kazan located in Tatarstan, a Republic state in Russia. Kazan means 'cooking pot' in the Tatar native language. The Lonely Planet cites that "It is about 150 years older than Moscow and the capital of the Tatarstan Republic – the land of the Volga Tatars, a Turkic people commonly associated with Chinggis Khan's hordes. Tatar autonomy is strong here and is not just about bilingual street signs. Although Tatar nationalism is strong, it is not radical, and the local version of Sunni Islam is very moderate." Kazan has over one million inhabitants of which roughly half the populations are Muslims while the other half are Slavic Russians. It is also one of the most multicultural of Russian cities. The study was conducted at the International School of Kazan's new Middle School building constructed in 2016 and opened its doors to Middle Schoolers last September 1, 2016.

The study was specifically conducted in the researcher's classroom using all the necessary tools and instruments to carry out the quasi-experiment. The author chose the subject Social Science for the following reasons: 1. It has the most number of VR content available on Google Expeditions. 2. It was the best subject to highlight the experience of being on a virtual tour, which, is something that many schools in the Philippines can offer to students because majority of the general student population cannot even afford to go a real field trip. Students will now have the ability to see old monuments and places and this capability revolutionizes the way Social Studies are taught to students. An example of this is the article written by Reid [12] aptly titled "Virtual Reality Could Bring History to Life in the Classroom," where it was mentioned how VR can help eradicate stereotyping and will let kids be exposed to more

dynamic and diverse communities. Using VR and exposing learners to different types of communities, places, and social groups different from their own, educators are now able to help open minds to being more accepting of other's cultures. Also from the same article, a sixth grade social studies and science teacher using VR in his classes was able to compare score performance on unit tests from his former students vs. current students who were able to use VR [12]. This does not necessarily mean that using virtual reality with the Google Cardboard is limited to this subject only. In fact, there have been many uploads of new content for Science and Math, both of which are core subjects in the Philippine school system.

### **Instruments**

For this study, two written instruments were used. One is the pre-test and posttest questionnaire comprising of 10 multiple choice questions regarding the topic, The New Seven Wonders of the World. The other instrument used was an online participant experience survey on Virtual Reality. The researcher used Google forms to conduct the survey online in order to get real-time tabulation. It was administered to all participants (both controlled and experimental groups) of the study before each session ended. In order to decrease the margin of error for the survey conducted, the researcher decided to let Group B (control group) experience VR technology after the posttest was conducted.

The researcher only did the same VR experience for Group B in order to get more respondents for the participant experience survey that was centered on the virtual reality experience using the Google Cardboard. This does not in any way change the score performance since the post-test for Group B was administered before any VR technology was introduced to the group. All survey questions created pertained to the "VR experience" using Google Cardboard and Google Expeditions. It does not ask anything particular about the lesson itself. The survey had a total of nine questions comprising of one dichotomous question, five rating scale questions, and three open-ended questions. The researcher decided to use a variety of survey questions asked in order to get both quantitative and qualitative data from its participants. The survey questions were kept at a minimum taking into consideration the participants'

age (12 yrs. Old) might not fare well with answering long surveys.

### **Procedure**

It took the researcher several months before all the materials needed for the experiment was delivered. Since the researcher was tasked to head the creation of the virtual lab in this school, he was able to specify the exact items needed. There were five materials utilized for the study. First is the Google cardboard version 2.0 viewer that can accommodate a 5.5-inch screen sized mobile phone. The researcher was aware that there were other viewers available in the market today and ones which are made of plastic and more durable materials as well as more resistant to wear and tear of daily student/teacher use. However, the choice of using the cardboard version is to keep costs low for this particular study and for the students to use the viewer as an inspiration to design their own VR headsets as a separate design-learning unit in the future. Second, the Asus Zenfone 2 was used during the time of the study. With a thorough look at the current mobile phone units available, it was found to be the most cost effective in terms of pricing and at the same time, one that meets all the required specifications (gyroscope and accelerometer – both are important for and orientation in the VR experience, Android 4.4 or later, 1GB ram, WIFI support, 1080p screen resolution) to run VR simulation/apps.

The third item used was an Ipad Air 2, which served as the teacher's tool to have external control over the simulation/app. Android tablets would also work with the application but the researcher used the Ipad since it was already an available resource. Fourth is the WIFI connectivity needed to run the simulation as both teacher and student devices need to be connected to the same network. Fortunately, the school has great wireless connectivity and is available in all areas. Last is the Google Expedition application that was used for the study. Before the start of the experiment, the Google Expeditions App was downloaded on the Ipad and the mobile phones. Google Expeditions allow teachers to take their students on a virtual journey. There are so many virtual trips and subjects covered when one uses Google Expeditions - be it landmarks, museums, underwater, and even outer space. An excerpt from Google summarizes what Google Expeditions is all about: "Expeditions are collections of linked virtual

reality (VR) content and supporting materials that can be used alongside existing curriculum. These trips are collections of virtual reality panoramas — 360° panoramas and 3D images — annotated with details, points of interest, and questions that make them easy to integrate into curriculum already used in schools,” (“What is Expeditions?”, n.d.)

### Ethical Considerations

The researcher obtained all necessary permits from the school’s administration to conduct the experiment and was allowed to use all facilities and equipment for this study. Since the students have been pre-selected for the study, the researcher worked with his Principal with regard to the scheduling of the classes for the experiment in order to avoid disrupting the regular schedule of students. The control group was exposed to the VR technology to provide the same experience as the ones in the experimental group but only after the posttest was administered. Both the experimental and control groups were therefore exposed to using the VR technology so the whole sample population can give the researcher more participant experience data specifically using VR technology for the classroom.

### Data Collection and Data Analysis

Data were obtained from the 20 student participants. The researcher administered a 10-item pre-test and posttest along with a 9-item online survey questionnaire with the aid of a teaching assistant who documented the experiment through pictures. For statistical analysis, the researcher used Intellectus statistics, a user-friendly statistical analysis tool that can be accessed online and similar to SPSS (Statistical Package for the Social Sciences). The researcher uploaded the data online and forms there was able to get the descriptive statistics (mean and standard deviation) as well the t-test value needed to compare both groups’ performance using the pre-test and posttest data.

### RESULTS AND DISCUSSION

The sample population consisted of two groups, with 10 students comprising the experimental group and 10 students in the control group. The age of all participants was 12 years old. Only 10 % of the sample composed Foreign nationals (1 Turkish; 1 Spanish) the rest were Russian nationals. All participants are able to use the English language as

the primary mode of communication for the experiment.

Table 1. Summary Statistics Table for Interval and Ratio Variables of Group A

Variable	M	SD	n	Min.	Max.
PRETEST	41.00	17.92	10	0.00	60.00
POSTTEST	80.00	15.63	10	50.00	100.00
DIFFERENCE	39.00	23.31	10	90.00	90.00

Table 2. Summary Statistics Table for Interval and Ratio Variables of Group B

Variable	M	SD	n	Min.	Max.
PRETEST	42.00	16.19	10	0.00	60.00
POSTTEST	64.00	15.06	10	40.00	100.00
DIFFERENCE	22.00	17.51	10	0.00	60.00

Table 3. Comparative Findings between the experimental and control groups

SAMPLE	PRETEST		POSTTEST		Paired t-test		
	Mean	SD	Mean	SD	<i>t</i>	<i>p</i>	<i>d</i>
GROUP A	41.00	17.92	80.00	15.63	-5.29	< .001	2.32
GROUP B	42.00	16.19	64.00	15.06	-3.97	.003	1.41

Note. Degrees of Freedom for the *t*-statistic = 9. *d* represents Cohen's *d*.

Table 1 shows the experimental group’s pre-test scores had an average of 41% with a standard deviation of 17.92, while the pre-test scores of the control group in table 1.1 indicates an average of 42% and a standard deviation of 16.19. With these values, we can infer that there is not much difference in the performance of both groups during the pre-test. The sample is small, yet it does signify that the population had almost the same level of knowledge on the topic at hand before any intervention is implemented.

The post-test scores show an average of 80% and standard deviation of 15.63 for the experimental group while the control group had an average score of 64% and a standard deviation of 15.06. Tables 1 and 2 also show the difference in the pre-test and posttest scores for Group A with 39 percent and Group B having 22 percent. Using these two values, there is a difference of 17 percent more from the experimental group with which VR was used than the control group in which no VR segment was used in the lesson plan.

Using the Intellectus Statistics software, the researcher conducted a paired samples *t*-test to check whether the difference between PRETEST and

POSTTEST was significant. Table 3 shows the summary of results for the *t*-test for both groups. The result of the paired samples *t*-test for Group A was significant,  $t(9) = -5.29, p < .001$ , suggesting that the true difference in the means of PRETEST and POSTTEST was significantly different from zero. The mean of PRETEST ( $M = 41.00$ ) was significantly lower than the mean of POSTTEST ( $M = 80.00$ ). For Group B (control group) the result of the paired samples *t*-test indicated on table 3 was significant as well,  $t(9) = -3.97, p = .003$ , suggesting that the true difference in the means of PRETEST and POSTTEST was significantly different from zero. The mean of PRETEST ( $M = 42.00$ ) was significantly lower than the mean of POSTTEST ( $M = 64.00$ ).

Even though the sample population used by the researcher was relatively small compared to other studies on VR in education, the researcher is confident that the values obtained are indicative of the assumption that VR can be used as a tool for students to learn concepts and subjects better. The results of this study can be compared to some VR related studies done by Lee, Wong and Fung [13], Passig [14], Cho, Kim, Lee H., and Lee [15], where participants in the experimental VR group performed better to a certain degree compared to that of the control group.

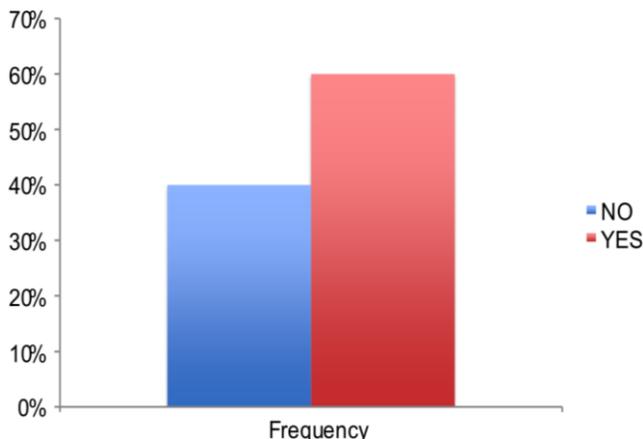


Figure 1. Survey Response to the question (Q1), Have you used anything similar to Google Cardboard or anything related to Virtual Reality?

Fig. 1 shows the responses of the sample population to the first question ‘Have you used anything similar to Google Cardboard or anything related to Virtual Reality?’. The researcher formulated the question to get an overview of how many students

are familiar or have used any materials pertaining to virtual reality. Out of the 20 participants, about 60 percent or the majority responded YES while 40 percent said NO.

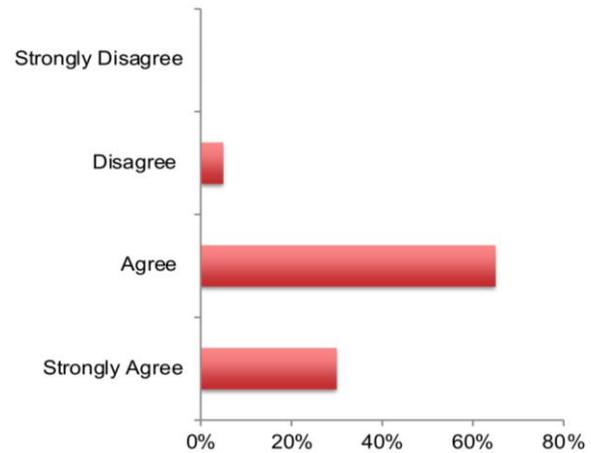


Figure 2. Survey Response to the statement (Q2), By using virtual reality, I became more interested in the topic.

Statement number two, ‘By using virtual reality, I became more interested in the topic.’ was a question pertaining to the degree or level of interest of the participants in the chosen topic when virtual reality was embedded in the lesson. About 65 percent or a majority of the students agreed that they became more interested in the topic when virtual reality was used. This was followed by 35 percent who said that they strongly agree and about 5 percent said they did not become more interested.

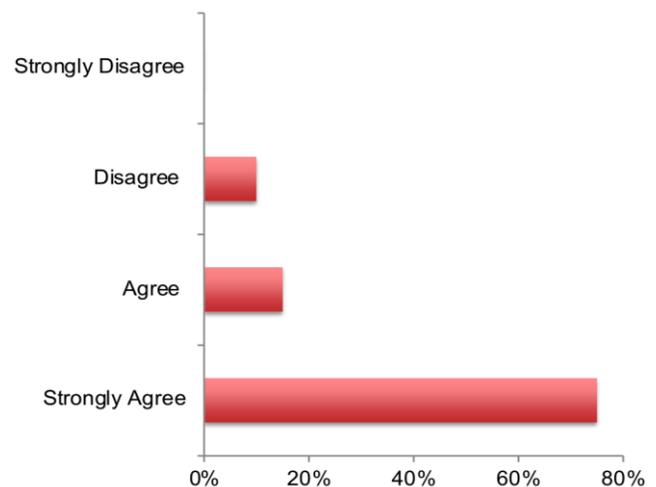


Figure 3. Survey Response to the statement (Q3), I would like to go on more Virtual Field trips.

The statement ‘I would like to go on more Virtual Field trips.’ pertains to students’ interest in using more virtual technology apps such as Google Expeditions. A great majority of the students or about seventy-five (75%) strongly agree with the statement. Fifteen percent (15%) said they agree with the statement while 10 percent disagrees with the statement. Some statements from participants after the session:

“It was fun!”  
 “It felt real.”  
 “It is very interesting and we can learn about another country.”  
 “There was good graphics.”

The majority’s response to wanting to go on another expeditions can be attributed to the interactive and fun component of the VR experience using GCB and Expeditions. Learning about historical landmarks and sites can be boring for many kids but by using a tool such as the GCB and Expeditions, the learning is transformed into one that is fun and interesting at the same time.

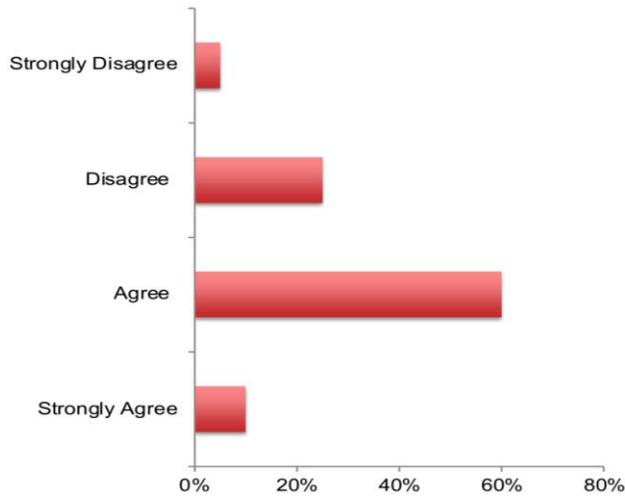


Figure 4. Survey Response to the statement (Q4), I felt comfortable using cardboard headset and the virtual reality experience.

This statement pertains to the experience of using the particular virtual reality gadget (Google Cardboard) and application (Google Expeditions) used during the experiment. About 60 percent or majority of the respondents agree with the statement ‘I felt comfortable using cardboard headset and the virtual reality experience’ while twenty-five percent (25%)

disagree with the statement. Only ten (10) percent strongly agree and 5 percent strongly agree.

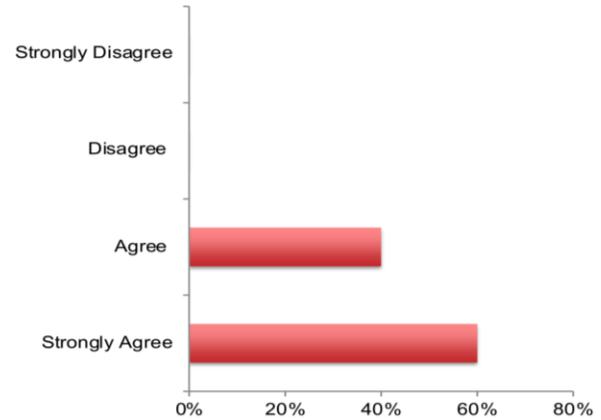


Figure 5. Survey Response to the statement (Q5), I would like to use Google Expeditions field trips in my other subjects.

This is a follow-up statement to the previous one on using Google Expeditions. The researcher was interested to know if students are open and interested in using more Google expeditions in their other subjects. A majority or 60 percent strongly agree with the statement while the rest agrees with the statement (40%). No participant marked the scales disagree and strongly disagree. This is a great indication of interest in using virtual technology as a tool that they can use for other subjects other than the one used for the experiment.

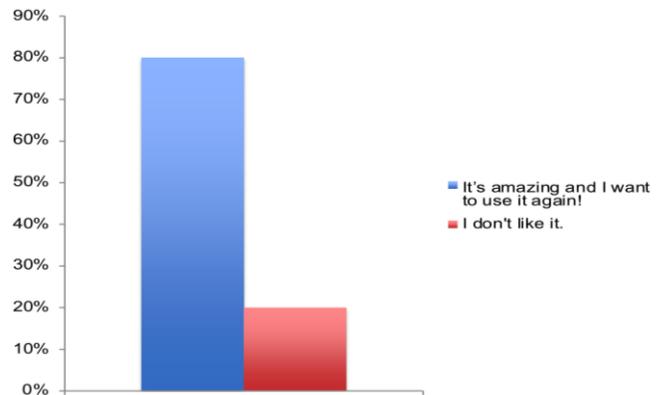


Figure 6. Survey Response to the question (Q6), What is your overall reaction to using the Google Cardboard headset?

The question pertains to the general reaction of whether the participant liked or did not like using the Google Cardboard headset. The researcher was interested to know if the sample population was generally okay with using the low-cost gadget.

Around 80 percent would want to use the headset again while 20 percent do not like the gadget at all.

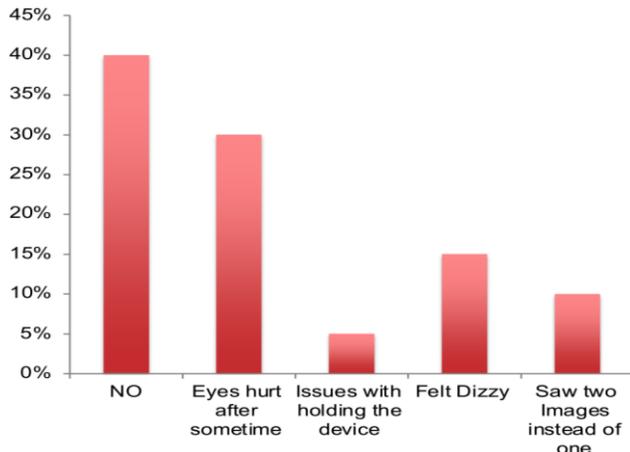


Figure 7. Survey Response to the question (Q7), Did you have any problems using the Google Cardboard?

The researcher was interested to know what problems the users or participants encountered while using the Google Cardboard. Although this was an open-ended question, the researcher was able to narrow down similar responses to five reasons. While the plurality or 40 percent said they didn't have any issues with it, about 30 percent experienced their eyes getting hurt after some time while using the gadget. Fifteen percent (15%) felt dizzy while ten (10) percent admitted seeing two images instead of one and some (5%) experienced difficulty holding the device. Consistent with other user experiences, Hussein & Natterdal [1] mentions that one of the main concerns using the GCB was that it triggered many users to get motion sickness or headaches.

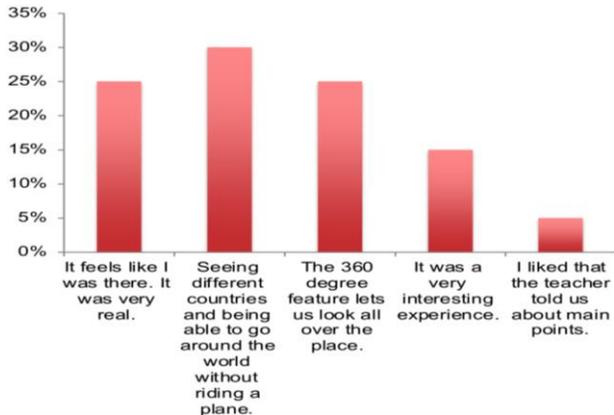


Figure 8. Survey Response to the question (Q8), What did you like about the virtual reality experience?

This too was an open-ended question with a variety of responses, but the researcher was able to narrow down similar responses to five categories. About thirty percent (30%) of the sample population said that they liked the VR experience because it allowed them to see other countries without actually riding a plane while twenty-five percent (25%) said that the experience felt very real. Also twenty-five (25%) commented that 360 degrees feature allowed them to look around the whole place while some (15%) said that it was interesting and one (5%) said that he liked the VR experience because the teacher mentioned the main points of interest while they are on the tour. Some excerpts from student responses with regard to liking the VR experience:

*"It was like I was there."*  
*"We were able to see other countries."*  
*"It is very real."*  
*"It was very interesting and scary."*  
*"You can look everywhere from the top."*



Figure 9. Survey Response to the question (Q9), What did you NOT like about the virtual reality experience?

Similar to survey question number 8, this item explores the reasons of the participants for not liking the virtual reality experience using GCB and expeditions. The top answer was about their eyes hurting after some time (30%) while twenty-five (25%) said they don't like the fact that you can't really do the actual walking to explore. About twenty percent (20%) said nothing and that they liked the experience, also twenty percent (20%) said that the experience was uncomfortable for them while five percent (5%) said it was boring. Excerpts from student responses in the survey with regard to reasons for not liking the VR experience point mostly to the

motion sickness felt after using the GCB for quite some time:

*"I feel dizzy."*

*"My eyes got very tired."*

*"Images started to duplicate and become double..."*

*"Eyes were hurting, bad feeling in the neck."*

While some said:

*"It was difficult to hold."*

*"My arms hurt while holding for a long time."*

*"GCB not very comfortable to use."*

*"I wish we could walk around."*

*"It was boring."*

### **CONCLUSION AND RECOMMENDATION**

Based on statistical tests conducted, both groups have shown an increase in performance. However, the experimental VR group fared better by 17% more in score performance. While this indicates that VR technology and VR applications embedded within a lesson plan can benefit students, the researcher is careful to draw a definite conclusion since the sample size for the quasi-experiment was relatively small compared to the general public. Yet, the results seem to be very positive for virtual reality in education. Schools that intend to use VR (specifically Google Expeditions) in their Social Science lessons can look forward to seeing improvements in test scores of students. The result also affirms the notion of constructivist theory and how knowledge is facilitated when a student is able to learn by doing.

There was a general positive experience of the participants while using the Google Cardboard, a low-cost VR tool, which means that it is a valuable opportunity for many educational institutions with a limited budget and capacity to take advantage of this technology for learning. It is now very easy to set up a VR Lab and let students experience what it is like to really learn in the 21<sup>st</sup> century- an inclusive learning with no boundaries and exceptions.

This research examined the use of virtual reality in one subject and has not made an assessment for all subjects that virtual reality can be used for. It is therefore the recommendation of the researcher that those who are working in the educational technology field should further carry out additional studies involving a bigger sample size for surveys and with a much wider range of subjects to be covered. Using

this low cost virtual reality technology on more subjects can validate VR's capacity to improve learning. Furthermore, it will also convince educational institutions to use this instrument for learning. In the case of public schools in the Philippines where a majority of learners do not have the capacity and financial means to go on real educational field trips, these studies can be used to get the government to fund virtual reality laboratories. Perhaps other researchers can focus their study on how to effectively integrate VR technology in standard curriculums across all subjects where it is applicable. Given the advances in VR technology and accessibility, it is still only just an optional tool that educators can use for their classes.

The Google Cardboard definitely has its flaws. Survey participants for this study noted a feeling of motion sickness or headache after using the device. Research by Hussein and Natterdal [1] supports concerns and attributes them to the use of the built-in accelerometer of mobile phones that causes headaches or motion sickness. Google can take a look at the design components and make improvements in its design of the GCB including perhaps developing software that can minimize these concerns. Furthermore, it is recommended that the GCB be used for a maximum of five minutes at a time in order to ensure safety.

Today, Google works with a lot of partner companies in creating more content for Google Expeditions and the likes of Samsung are also developing better VR technologies and applications. Hopefully, improvements in the technology can make VR more accessible to learners in terms of pricing and available content. With all of these efforts in making virtual reality take center stage in education, the goal of using virtual reality for the enhanced learning experience of all learners can be achieved in the near future.

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