Impact of Google Earth on Student Learning

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Abstract

Virtual globes provide multiple opportunities for educators to build spatial understanding among students and bridge the gap between students and teachers and the less interactive paper map. Google Earth has been shown to support student learning and to increase levels of interactivity and user experience. The purpose of this study is to determine the impact of Google Earth on student learning. The key question that is addressed is: Does incorporating Google Earth into the content of the social studies classroom impact student learning? The research was conducted among 102 students in the sixth grade and tenth grade from three different schools in southeast Ohio, United States. The research design used in this study is experimental research using post-test only control group design. This study indicates that the average grades in social studies in the class using Google Earth were higher than those using a printed map.

Key Words: Google Earth, Social Studies, Student learning, India, GIS

1. Introduction

From the beginning of organized education, different technologieshave been used to help people to learn better, faster, and in a less expensive manner. In the 18th century,teachers started to usemaps and globes as educational tools. In the 19th century the chalk blackboardextended teachers' capabilities to communicate with a large group by writing or drawing (Molenda, 2008). The debate on whether educational media influences students' learning is escalating. Clark (1983, 1994)argues in hiseducational media research studies that students learned equally well regardless of media use: "media are mere vehicles that deliver instruction but do not influence student achievement" (Clark, 1983, p. 445). On the other hand,Kozma (1994)claims the processing capabilities of educational media to enhance student learning. New educational literature supports the fact that the integration of technology in instruction can improve student performance(Molenda & Pershing, 2008). For example, a report based on 20 years of research outcomes by the International Society for Technology Education (ISTE) concludes "integration of technology into instruction has a positive outcome on student achievement"(ISTE, 2008, p. 3).Though the literature supports the positive impact of technology in the classrooms,Anderson and Becker (2001)found that social studies teachers were least likely to integrate technology in their curriculum.The main purpose of this study is to understand the impact on learning when Google Earth-mediated instruction and traditional map-mediated instruction are used in a social studies classroom.

Several studies have looked into the attributes of the media in instruction and its influence on the cognitive development of the learners (Molenda & Boling, 2008; Salomon, 1994).For example, attributes such as zooming in and three-dimensional viewing experiences help learners (Salomon, 1994). Graphical User Interface (GUI) helps teachers and novice users to create a learning and instructional environment (Molenda & Boling, 2008). Since 1994, GIS has become a part of various educational curricula particularly in social studies (Alibrandi & Baker, 2008). In addition, national standards on science, geography and technology demand inquiry-based instructional models in K-12 education. To support standards Baker (2005) acknowledges that, "GIS is emerging as an instructional technology for supporting contextually rich student learning" (p. 44). In the 1990s, several studies looked into the potentials of the digital atlas (Rystedt, 1995; Thomas, Mitchell, Scott, & Cutter, 1999). Rystedt (1995) argues that the interactive opportunities in the digital atlas cannot be found in the printed maps. Thomas et al., (1999)note the demand from schools for electronic teaching materials, which drive more opportunities for using the digital atlas in science and social studies classrooms.

1.2The Virtual Globe - Google Earth

Since 2000, several web-based virtual globes have been used for various purposes. Major virtual globes are: World Wind,ArcGIS Explorer, TerraExplorer and Google Earth. According to Schultz, Kerski and Patterson (2008), "Virtual globes are so named because their approach to visualizing the Earth as a three-dimensional globe that one can 'fly' above" (p. 28). In October 2004, Google Inc. acquired technology fromKeyhole; this technology later became the Google Earth application (Google, 2004). Since 2004, the impact of Google Earth has been studied by different disciplines particularly in geography (Butler, 2006; Goodchild, 2008; Lisle, 2006; Phadke, 2010). *Nature* magazine reports, "the appeal of Google Earth is the ease with which you can zoom from space right down to street level, with images that in some places are sharp enough to show individual people" (Butler, 2006, p. 776). Sheppard and Cizek (2009) outline the advantages of Google Earth for an individual user:

[S]atisfaction and enjoyment of the experience; ease of use; free, convenient, and rapid access to massive amounts of previously proprietary information; the ability to put information into perspective (literally); and improving their grasp of spatial, reference, or scientific information by contextualizing it in the user's local, real world conditions (p. 2106).

Though visualization by Google Earth increases trust and credibility,Phadke (2010) argues, "there are important risks and costs involved in investing in the use of Google Earth imagery for rhetorical communication" (p. 286). Sheppard and Cizek (2009) point out the potential risks of using Google Earth by experts and lay people are the low resolution and discrepancies in 3D models create a distraction and confuses. Additionally, when natural calamities occur, news media exaggerates incidents by using Google Earth images without accuracy and realities on the ground. Next, technical issues presented by the experts like the screen size andimage resolution can misguide the viewer. Finally, lay people upload pictures in Google Earth and that information can be used by anyone which creates a risk of credibility of the images and location labels. Sheppard and Cizek (2009)emphasize, "The risk of misinformation or biased responses with virtual globes would seem to increase with data creation by those outside of scientific or professional organizations which are bound by their own general codes of practice" (p. 2110). This attempt to provide biased visualization could be used to achieve political or personal goals. Untrained users may use this biased information in their decision-making process.

1.3 Google Earth in Education

Since 2005, educators have integrated Google Earth into their classrooms (Britt & LaFontaine, 2009; Patterson, 2007; Schultz et al., 2008; Siegle, 2007). Siegle (2007) exploredfunctionality and resources of Google Earth for classroom activities. Britt and LaFontaine (2009) shared their experience of incorporating Google Earth in an elementary school geography lesson plan. After a four-day geography unit called *Learning about Landforms with Google Earth,* they assessed the student knowledge of major landforms with multiple-choice questions. The results from the study showed that students easily understood the questions and displayed confidence in answers. An activity combining a Global Positioning System (GPS) and Google Earth created an exciting learning experience for seventh grade science students. The activity improved practical skills in technology and enhanced students' skills in map reading and interpretation(Martinez, Williams, Metoyer, Morris, & Berhane, 2009).

Similarly, a study by Patterson (2007)acknowledged that spatially-oriented learning was promoted by Google Earth. The real life experiments with Google Earth created motivation and enthusiasm among students. When using Google Earth in a science club experiment, Bodzin (2008) concluded, "Students gained unique perspectives of their geographic area by using Google Earth" (p. 54). Bodzin and Cirucci (2009)developed a four-week land use lesson plan called Land Use Change (LUC) for the eighth grade science curriculum. In this plan, students used their geospatial information technology tool (Google Earth) to analyze present day land use and how it changes over a period of time. This simulation-planning group work helped the students to better understand environmental changes influenced by land use.According to Patterson (2007), "Google Earth supports a student's learning because it also can serve as an entertainment venue. The incorporation of affective components, or visual and emotional images to communicate and motivate, helps make Google Earth a powerful classroom tool" (p. 146). Schultz et al. (2008) point out, "the easeof use, low cost, burgeoning availability of data sets, and extremely engaging, and often addictive, nature of virtual globes merit their consideration for use in the geography classroom at all levels"(p. 28).

Though Google Earth allows students to explore the Earth in more dynamic and interactive ways, there are some limitations in educational settings such as high bandwidth demand, and need for training to understand the Google Earth interface(Patterson, 2007; Schultz et al., 2008). Though it opens doors to understanding basic concepts of geography,Patterson (2007) statesthat "Google Earth has limited capabilities and tools to support true spatial analytical operations. The tool does not have a query capability or the functionality to perform complex spatial operations" (p. 146). The lack of spatial analysis tools and remote sensing software are other disadvantages of virtual globes like Google Earth. Errors in Google Earth data among students might create a negative attitude towards spatial data (Schultz et al., 2008). The present study was designed to understand the impact on students learning in a social studies classroom with Google Earth mediated instruction.

2. Method

2.1 Participants

The participants of this study included 102 sixth-grade and tenth-grade social studies students from three different schools in southeast Ohio, United States. The school selection was a convenience sampling. School A had two sixth-grade classrooms, one class with 26 students and the other class with 20 students. School B had two tenth-grade classrooms, one with 15 and the other with 18 students. The treatment groups in schools A and B were selected based on the availability of classrooms. School C had only one classroom with 23 students randomly divided into two groups, the control group and treatment group. Both groups received a lesson about India, but the treatment group usedGoogle Earth while the control group received the instruction by printed map.

2.3 Research Design

The research design we used in this study is an experimental research, posttest-only control group design (Johnson & Christensen, 2010). In this design, after administrating the independent variable, then the dependent variable is measured both in the controll and experimental groups. The post-test score will be used to compare the effect both in the control and experimental groups. The control group did not receive the experimental treatment (Google Earth-mediated instruction).

The hypothesis of this study is: Average grades in social studies classrooms using Google Earth are higher than those using traditional printed maps. The independent variable is Google Earth and a printed map, and the dependent variable is the gain score in the post-lesson quiz. Some of the possible moderator (uncontrollable) variables were the teaching style, the student learning style, and the scholastic ability of the students.

2.4 Procedure

Two groups from each school were selected, the control group and the treatment group. The treatment group received the instruction through Google Earth and the control group received the instruction by printed map. The topic 'Facts about India' were taught for thirty minutes for both groups. After the instruction, there was a standardized test for both groups to test their knowledge on the topic. The researchers, with teacher input on the content, designeda post-lesson quiz, which had15 multiple-choice questions to test the students'knowledgeon India. Table 1 shows the questions extracted from the post-lesson quiz.

The questions were based on the topics discussed in the class;for example, to show the capital of India in the classroom with a printed map students pointed the name 'New Delhi' on the map. In Google Earth, students typed the name 'New Delhi' in the designated field of the Google Earth application and zoomed into the city of New Delhi. As part of the post-lesson quiz, School A and B used a paper pencil format and School C used a Google document form after the lesson. The last question in the quiz was 'I learned these facts by using'with the options Google Earth and Printed Map.

Table 1: Extract from the multiple-choice post-lesson quiz.

Questions	Multiple choice answers
Capital city of India	☐Mumbai ☐Bangalore ☐New Delhi ☐Chennai
The largest mangrove forest in the world	☐New Guinea ☐Sunderbans ☐Rhizophora mangle ☐KienGiang
A mountain range to the North of India	☐Everest ☐Himalayas ☐Alaska Range ☐Elbrus
The longest river in India	☐Godavari River ☐Ganges River ☐Nile River ☐Tigris River
I learned these facts by using	☐Google Earth ☐Printed Map

3. Results

It is clear from the histogram in Figure 1 that the instruction with Google Earth increased the student learning and achievement. In the figure, only four students achieved a high score of 15 usingthe printed map, while there were 11 students who obtained the high scoreof 15, in the class that had used Google Earth. In addition, 29 students earned higher scores (13 and 14), respectively, in classes using Google Earth. However, 13 students earned the average score (10) in the class that used printed map.

Figure 1.Histogram for the frequency distribution of the student score in Social Studies classes using a printed map and Google Earth.

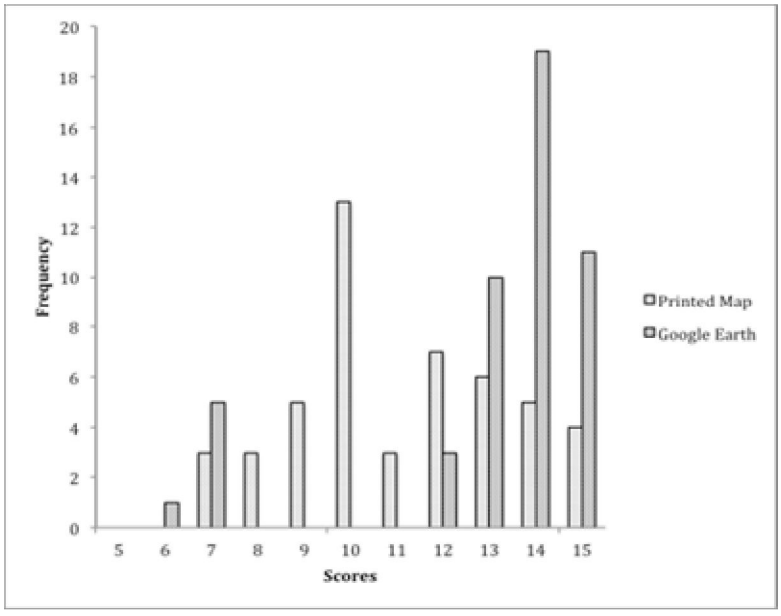


Table 2 shows the mean score (*M*), standard deviation (*SD*), schools, and number of participants (*N*) in the study. It is evident from Table 2 that the mean score of the students using Google Earth is greater than the mean score of the students using a printed map. The overall mean score is *M* = 10.93, *SD*= 2.24 in the atlas-using classrooms, but at the same time the mean score in the Google Earth classroom is *M*= 13.22, *SD*= 2.02. Among the three schools, the tenth graders using Google Earth in school B has the highest average score of 14.2. It is clear from Table 2 that there is a difference in the average score of the sixth graders using Google Earth and theprinted map; the mean score of the printed map-using classroom is *M* = 9.54; however, the mean score of the Google Earth classroom is *M* = 12.55.

Table 2: Mean and Standard Deviation of Social Studies class test score in schools by using a Printed Map and Google Earth

	School and Class	Mean	Std. Deviation	N
Atlas	School A - 6th Grade	9.54	1.363	26
	School B - 10th Grade	11.69	2.250	13
	School C - 10th Grade	12.67	2.024	15
	Total	10.93	2.247	54
Google Earth	School A- 6th Grade	12.55	2.395	20
	School B - 10th Grade	14.20	.789	10
	School C - 10th Grade	13.44	1.854	18
	Total	13.23	2.024	48
Total	School A - 6th Grade	10.85	2.394	46
	School B - 10th Grade	12.78	2.152	23
	School C - 10th Grade	13.09	1.942	33
	Total	12.01	2.427	102

An ANOVA was performed to test difference between instructional media and student scores. Table 3 shows that a significant main effect was obtained for the program, $F(1,96) = 29.094$, $P<.001$. The program effect was quite large (Partial Ets Squared= .233). A significant main effect was also obtained for all the schools, $F(2, 96)= 13.708$.

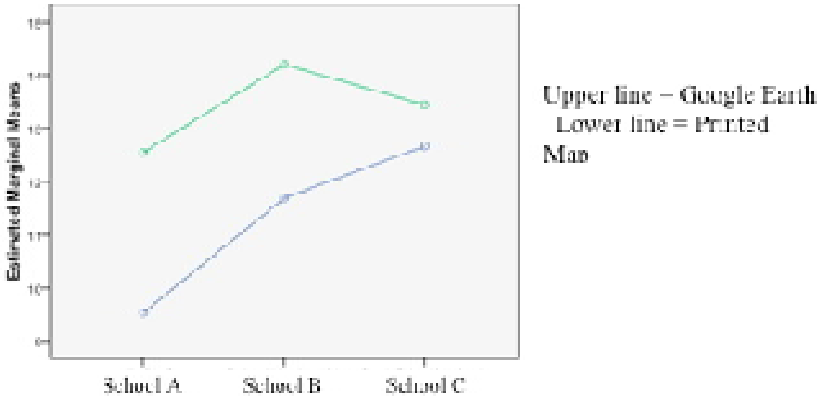
Table 3: ANOVA for Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	257.432a	5	51.486	14.642	.000	.433
Intercept	14162.822	1	14162.822	4027.837	.000	.977
GoEr_Map	102.300	1	102.300	29.094	.000	.233
Sch_Clas	96.401	2	48.201	13.708	.000	.222
GoEr_Map * Sch_Clas	24.509	2	12.254	3.485	.035	.068
Error	337.559	96	3.516			
Total	15307.000	102				
Corrected Total	594.990	101				

a. R Squared = .433 (Adjusted R Squared = .403)

Figure 2 shows the estimated marginal means of score. The upper line shows a significant benefit to use Google Earth. The lines also show the interaction between the program and school. As shown in the figure the lines are not parallel. That meansthat benefit to Google Earth was rather large and uniform for School A and School B, but quite small for School C.

Figure 2. Estimated Marginal Means of Score



4. Discussion and Conclusion

This study added to the literature base in that the integration of technology to teaching and learning can improve the performance of students' learning (Baker, 2005; Britt & LaFontaine, 2009; Goodchild, 2008; Kerski, 2008; Molenda & Pershing, 2008; Patterson, 2007).This study indicates that mean score in social studies classroomsusing Google Earth are higher than those using aprinted map.

The use of Google Earth in the classroom will increase the attention of the students particularly among the elementary students. During the study, through the classroom observation, the researchers noticed more attention being paid to the lesson among elementary school students than the high school students when Google Earth was being used.

This may be because of the novelty effects (Clark, 1983)of Google Earth in the classroom. If a detailed analysis is conducted in the overall frequency score of the sixth graders, it is seen that no student received the highest range score 14 -15 in the classroom using theprinted map. However, seven students (*N*=21) using Google Earth had a score of 14 and two obtainedthe highest score of15. The scores are, therefore, skewed towards the lower score end and many students have higher scores if they learn the content with the help of Google Earth. There is a statistically significant difference for both program and school. The limitations of the study are possible moderator (uncontrollable) variables such as the teaching style and the student learning style and the scholastic ability of the students. Future research will be focused on the potential of incorporating Google Earth in other subject areas to create more meaningful learning. In his concluding remarks,Patterson (2007) states "Technology by itself is worthless, but as a tool technology offers enormous potential to extend our capabilities" (p.146). We believe the potential of Google Earth will extend educators capabilities and enhance students' learning.

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