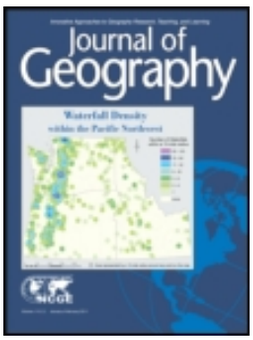

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Evaluating Educational Computer Games in Geography: What is the Relationship to Curriculum Requirements?

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Abstract
Computer games, whether accessed online or through commercial software, have learning potential in educational settings. However, alignment with national, state, or local curriculum requirements can create a barrier. The purpose of this study was to conduct a content analysis of selected games that could be used in a sixth grade geography or social studies classroom. Analysis showed that the content of the games align with curriculum requirements set forth in the sixth grade social studies Texas Essential Knowledge and Skills (TEKS) as well as Geography for Life: National Standards in Geography (1994). This study also highlights implementation strategies that could be used with the games. With proper implementation, it is possible that the learning potential of games can be achieved in a formal classroom. Further studies should be undertaken to demonstrate this notion.

Key Words: *educational games, geography computer games, geography education, curriculum requirements*

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Introduction

Computer games, whether accessed online or through commercial software, have learning potential in educational settings and are continuing to make their appearance in classrooms (Green and McNeese 2007), but questions concerning their suitability for classroom use and student learning are debated by teachers, administrators, and parents (Virvou, Katsionis, and Manos 2005; Green and McNeese 2007). Several other classroom implementation barriers exist. One barrier is curriculum requirements alignment, a critical point as teachers must justify what instructional strategies they use and the content they teach.

The purpose of this study was to conduct a content analysis of games designed for use by middle school level students in social studies classrooms. Specifically we investigated if the games Where in the World is Carmen Sandiego?, Quest Atlantis, and GeoNet align with curriculum requirements proposed by the Texas Education Agency's (TEA), Texas Essential Knowledge and Skills (TEKS) for sixth grade contemporary world cultures, and *Geography for Life* (the National Geography Standards).

This preliminary analysis cannot determine if enhanced student learning occurs as a result of game use. Importantly, however, supplemental student learning with games also cannot occur if teachers do not use them. We suggest here that an important first step is to assess the correlation between the games and the standards. We begin this article with a review of the literature on game use in education and more specifically geography education. Next, we identify the methods used to evaluate the games and discuss their alignment with the standards. Finally, we close with the implication these findings have for geography education and make suggestions for game use.

Literature Review

Games have long been used to enhance student learning (Dempsey *et al.* 2002) but it was not until the 1960s and 1970s that teachers began using games for educational purposes on a widespread basis (Conolly 1982; Wiebe and Martin 1994; Green and McNeese 2007). A review of the literature has revealed a number of games used across all academic subjects in the K–12 classroom (see Duchastel 1988; Barab *et al.* 2005; Fuhrmann *et al.* 2005; Ke 2008; Akkerman, Admiraal, and Huizenga 2009; Papastergiou 2009; Tuzun *et al.* 2009). For geography education, Conolly (1982) found that soon after the *Journal of Geography* emerged as a separate publication in 1902 articles detailing games began to appear (examples include Hidden Countries and Geography Games).

Due to an increasingly structured and mandated teaching load, teachers across the country must identify how games are related to content knowledge and curriculum requirements before embedding them into lessons (Wiebe and Martin 1994; Deubel 2002; McFarlane, Sparrowhawk, and Heald 2002; O'Neil, Wainess, and Baker 2005; Sandford *et al.* 2006; Baek 2008). Tetiwat and Huff's (2002, 449) study surveyed thirty-two teachers regarding their adoption of Web-based educational technology and found that the "second most influential factor" was "compatibility with [student] work, and suitability to subject" or put another way, curriculum requirements. Sandford *et al.* (2006) found that teachers often adopt the games on their own after aligning the games with curriculum requirements; this takes considerable time and it can be a barrier to incorporation. Additionally, Rice (2007, 257) states that "if a video game is to find widespread adoption

within classrooms as an instructional component, each teacher adopting the game must be able to adapt it to his or her specific state and local standards." Therefore, "standards alignment will remain a barrier" (Rice 2007, 258). According to de Freitas and Oliver (2006), when teachers are deciding on whether or not to introduce games into the classroom, their decision hinges on whether the game is appropriate for the specific learning context and aligns with curriculum requirements. Teachers have to figure out how games can form "part of [the] curricula" (de Freitas and Oliver 2006, 251; Baek 2008). In sum, one of the greatest concerns among K–12 educators continues to be aligning the games to curriculum requirements (Gros 2003; Rosas *et al.* 2003; Squire *et al.* 2005; Baek 2008; Kebritchi 2010). Therefore, teachers are often hesitant to select commercial software or Internet games for classroom use (Hill and Solem 1999; Sardone and Devlin-Scherer 2009).

While some studies have examined how games meet state curriculum requirements in general, a significant gap on the "effectiveness of games for concrete educational purposes" exists (Papastergiou 2009, 2). Current studies tend to focus on the motivational aspects of games rather than whether or not they fulfill curricular requirements (Papastergiou 2009). The first aspect is important toward accomplishing motivational and skills-based learning requirements (Conolly 1982; Deubel 2002; O'Neil, Wainess, and Baker 2005; Dondlinger 2007; Sardone and Devlin-Scherer 2009). In particular, scholastically poor students benefit the most from a gaming environment because of an increase in motivation; this has been achieved through virtual reality games as well as other online games (Virvou, Katsionis, and Manos 2005; Clark and Ernst 2009). Researchers argue that games often motivate learners through experiential, problem-based learning and active learning and that motivation cannot be separated from learning (Maushak, Chen, and Lai 2001; Rieber 2001; Oblinger 2004; Green and McNeese 2007; Ang and Rao 2008). Educational computer games have the potential to strengthen and improve the American educational system (Kebritchi 2010) especially when they can "resemble classic world problems, where students are invited to separate the data they need from a much more complex field of information and then apply it toward specific tasks" (Squire and Jenkins 2003, 15). Squire and Jenkins further add that games are often more than fact recall; they are about "asking questions and engaging in inquiry" (29).

While the use of educational games is seen by many as beneficial and a novel way to enhance student learning, skeptics question the actual impact of games on student engagement and the ability to produce an effective learning environment, regardless of subject matter (Ke 2008; Kebritchi *et al.* 2009). Other researchers state that research regarding the educational effectiveness of games continues to be limited and ambiguous (Virvou, Katsionis, and Manos 2005; Papastergiou 2009).

Over the past several years, Internet-based games have garnered serious attention because of their potential for learning (Prensky 2001; Gee 2003; Ma *et al.* 2007; Sardone and Devlin-Scherer 2009; Paraskeva, Mysirlaki, and Papagianni 2010). Hill and Solem (1999) make the case for using the Internet as a teaching tool in the geography classroom when they state:

> Clearly, teaching with the Internet represents another frontier for geography education. In practice, the Internet provides instructors with new options for course content and management, creating instructional materials, evaluating students, and delivering learning experiences. (106).

Many studies have shown how the implementation and utilization of the Internet as a teaching tool has had a positive impact on student learning in the subject (Ke 2008; Papastergiou 2009; Paraskeva, Mysirlaki, and Papagianni 2010). Since the Internet is an important tool for teaching geography, Internet-based games can be used for geography learning. As we argued earlier, game implementation is prefaced by alignment with state and national standards.

Methods

We identified three games based on the following: they had to be interactive, problem-based in nature, have questions and topics related to geography, and target middle school students. Our content analysis was conducted in two phases. The first phase determined the alignment rate of each individual TEKS (Texas Essential Knowledge and Skills) and national standards with the content of each game. In the second phase, the total number of marks or counts for each TEKS standard was summed to identify the top five TEKS aligned with each game.

Game Selection

We first selected a familiar game, Where in the World Is Carmen Sandiego? Treasures of Knowledge (hereafter CS), and purchased the game inexpensively online. We identified two other games via an Internet search. These two games, Quest Atlantis (QA) and GeoNet,were available for free online when the study took place. Game availability is provided in the notes section that concludes this article.[1]

Carmen Sandiego (CS) consists of eight missions. Players travel the world, going to many different cities and up to six continents, searching for clues in order to catch Carmen Sandiego within a certain timeframe. Players must use prior knowledge, maps, and information obtained on the missions in order to complete the game. Students are exposed to a wide range of subjects including geography, history, and math. In the second game, Quest Atlantis (QA), the player has the choice of three different games: one focused on writing, one on math, and one on science. We selected the science game as its progression largely mirrors the steps of geographic inquiry outlined in *Geography For Life*. QA involves traveling around a virtual 3D environment to determine who is contaminating a river. In

the game students use maps and form their own mental maps to navigate the virtual town. Specific tasks involve testing fish tanks for pH level, turbidity, dissolved oxygen, and temperature as well as interviewing stakeholders. In order to complete the quest and move on, reports have to be submitted about the problem. Students must create hypotheses, analyze information, draw conclusions, and make decisions.

The final game, GeoNet, has the player select the United States or a world map as their play area. We selected the world map as this is the content focus area (world regions) in the sixth grade social studies course. The world map is divided into "clickable" regions that include North America, South America, Europe, Africa, Asia, Oceania, and polar regions. The player chooses a region and then chooses among the six different essential elements from the national standards (the world in spatial terms, places and regions, physical systems, human systems, environment and society, and the uses of geography). Each essential element contains five multiple questions that must be answered before going on to another element. The player uses the information, map, chart, or graph given to answer each question.

Table 1. Sixth Grade Social Studies Texas Essential Knowledge and Skills (TEKS) (Texas Education Agency 1998).

1	History. The student understands that historical events influence contemporary events.
2	History. The student understands the contributions of individuals and groups from various cultures to selected historical and contemporary societies.
3	Geography. The student uses maps, globes, graphs, charts, models, and databases to answer geographic questions.
4	Geography. The student understands the characteristics and relative locations of major historical and contemporary societies.
5	Geography. The student understands how geographic factors influence the economic development, political relationships, and policies of societies.
6	Geography. The student understands the impact of physical processes on patterns in the environment.
7	Geography. The student understands the impact of interactions between people and the physical environment on the development of places and regions.
8	Economics. The student understands the various ways in which people organize economic systems.
9	Economics. The student understands the role factors of production play in a society's economy.
10	Economics. The student understands categories of economic activities and the means used to measure a society's economic level.
11	Government. The student understands the concepts of limited governments, such as constitutional and democratic governments, and unlimited governments, such as totalitarian and nondemocratic governments.
12	Government. The student understands alternative ways of organizing governments.
13	Citizenship. The student understands that the nature of citizenship varies among societies.
14	Citizenship. The student understands the relationship among individual rights, responsibilities, and freedoms in democratic societies.
15	Culture. The student understands the similarities and differences within and among cultures in different societies.
16	Culture. The student understands that certain institutions are basic to all societies, but characteristics of these institutions may vary from one society to another.
17	Culture. The student understands relationships that exist among world cultures.
18	Culture. The student understands the relationship that exists between artistic, creative, and literary expressions and the societies that produce them.
19	Culture. The student understands the relationships among religion, philosophy, and culture.
20	Science, technology, and society. The student understands the relationships among science and technology and political, economic, and social issues and events.
21	Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology.
22	Social studies skills. The student communicates in written, oral, and visual forms.
23	Social studies skills. The student uses problem-solving and decision-making skills, working independently and with others, in a variety of settings.

Evaluation

We used the sixth grade social studies TEKS (Table 1) to evaluate the games. The TEKS are divided into eight different strands: history; geography; economics; government; citizenship; culture; science, technology, and society; and social studies skills. The TEKS were chosen because the main author has a significant background and familiarity with using them. The sixth grade course was selected as it focuses on world regions and the three games claim to be designed for middle school students. The sixth grade course, Contemporary World Cultures, is summarized as the

> study of people and places of the contemporary world. Societies selected for study are chosen from the following regions of the world: Europe, Russia and the Eurasian republics, North America, Middle America, South America, Southwest Asia-North Africa, Sub-Saharan Africa, South Asia, East Asia, Southeast Asia, Australia, and the Pacific Realm. (Texas Education Agency 1998)

Recent revisions to the TEKS (2011–2012 implementation), do not affect this analysis as the main ideas and student expectations have largely remained the

Table 2. National Standards in Geography (Geography Education Standards Project 1994).

1. How to Use Maps and Other Geographic Representations, Tools, and Technologies to Acquire, Process, and Report Information From a Spatial Perspective
2. How to Use Mental Maps to Organize Information About People, Places, and Environments in a Spatial Context
3. How to Analyze the Spatial Organization of People, Places, and Environments on Earth's Surface
4. The Physical and Human Characteristics of Places
5. That People Create Regions to Interpret Earth's Complexity
6. How Culture and Experience Influence People's Perceptions of Places and Regions
7. The Physical Processes That Shape the Patterns of Earth's Surface
8. The Characteristics and Spatial Distribution of Ecosystems on Earth's Surface
9. The Characteristics, Distribution, and Migration of Human Population on Earth's Surface
10. The Characteristics, Distribution, and Complexity of Earth's Cultural Mosaics
11. The Patterns and Networks of Economic Interdependence on Earth's Surface
12. The Processes, Patterns, and Functions of Human Settlement
13. How the Forces of Cooperation and Conflict Among People Influence the Division and Control of Earth's Surface
14. How Human Actions Modify the Physical Environment
15. How Physical Systems Affect Human Systems
16. The Changes That Occur in the Meaning, Use, Distribution, and Importance of Resources
17. How to Apply Geography to Interpret the Past
18. How to Apply Geography to Interpret the Present and Plan for the Future

same. We also evaluated the games against the eighteen national geography standards (Table 2). The current sixth grade social studies TEKS correlate to content in *Geography For Life* (Bednarz 1997; Boehm and Rutherford 2004; Rutherford and Boehm 2004). For example, TEKS 15 and National Standard 10 focus on the student being able to understand Earth's cultural mosaics.

Phase 1 Evaluation

The evaluation using the TEKS and national geography standards occurred simultaneously. Each game was played in an afternoon resulting in all games being played over a three-day period. The first game evaluated was CS; all eight missions were played. QA and GeoNet were evaluated in turn. All seven GeoNet regions were played. While the games were played the first author was simultaneously listening and looking for information that corresponded with the individual TEKS and national geography standards. A count was kept that identified how many times this occurred for each TEKS and national geography standard. For example, TEKS 3 and National Geography Standard 1 focus on the student being able to use maps and other geographic tools to answer geographic questions (Geography Education Standards Project 1994; Texas Education Agency 1998). Therefore, any time a map was used by the player to travel around the world or to answer a question, a mark was given on the list for TEKS 3 and National Standard 1. The use of a map involved the student either using the map to answer a question or to navigate in the game environment. A static, unused map, such as a background image, was not counted. In another example, TEKS 11 states that "the student understands the concepts of limited governments, such as constitutional and democratic governments, and unlimited governments, such as totalitarian and nondemocratic governments" (Texas Education Agency 1998). One particular mission in CS involved traveling to Russia. The game discusses Lenin and communist governments. Players can also look up more information in the game's database, which includes a wealth of information (map, name, capital, currency, official language, and area) on fifty countries. This

Table 3. Percent of top five TEKS marks compared to total number of marks for each game.

Game	Top Five TEKS Fulfilled	Number of Marks	Percent of Total Marks
Carmen Sandiego	18 - Culture	128	20.4%
N = 627 total marks	2 - History	67	11.0%
	3 - Geography	44	7.0%
	10 - Economics	42	6.7%
	9 - Economics	33	5.3%
Quest Atlantis	3 – Geography	32	23.9%
N = 134 total marks	23 – Social Studies Skills	23	17.2%
	7 – Geography	18	13.4%
	9 – Economics	12	9.0%
	15 – Culture	8	6.0%
GeoNet	23 – Social Studies Skills	210	31.2%
N = 674 total marks	7 – Geography	64	9.5%
	5 – Geography	62	9.2%
	21 – Social Studies Skills	56	8.3%
	2 - History	53	7.9%

Table 4. Examples of results from content analysis for CS.

TEKS Strand	Examples
18 Culture: The student understands the relationship that exists between artistic, creative, and literary expressions and the societies that produce them.	• Travels of Marco Polo 1298, the famous Venetian traveler, the tales of his travels had a tremendous impact on European thought. • Many Japanese participate in Shinto rituals like festivals or leading prayers at a shrine, Buddhism and Confucianism are some of the other religions practiced in Japan.
2 History: The student understands the contributions of individuals and groups from various cultures to selected historical and contemporary societies.	• Many Cubans trace their ancestors to Spain and Africa. These counties have influenced the culture, art, music, dance, and food of Cuba. • There are some very old Roman Catholic churches in Rio de Janeiro; the Portuguese settlers brought that religion to Brazil.
3 Geography: The student uses maps, globes, graphs, charts, models, and databases to answer geographic questions.	• Look up Havana and sugar cane fields in the database based on the *World Factbook*. • Choose which country to travel to next from the world map based on the clues (multiple occurrences).
10 Economics: The student understands categories of economic activities and the means used to measure a society's economic level.	• Salvador de Bahia, Brazil's east coast, was the first capital city of Brazil. In the 1500s and 1600s, Portuguese colonists established sugar plantations in the region, building magnificent buildings with their wealth. • Sugar is Cuba's chief export. • Japan's fishing fleet is one of the largest in the world.
9 Economics: The student understands the role factors of production play in a society's economy.	• Premium arabica coffee from the world's largest producer of coffee. . . Brazil! • New Zealand is the world's leading exporter of wool. There are about twenty times as many sheep and cattle as people.

would count as TEKS 11. A statement or clue in the games could also count under multiple TEKS or national standards. For example, one question in GeoNet asks what the grassy plains in Africa are called and then describes the climate, animal, and plant life in the savanna. This question would fall under National Standards 4 and 7. In another example, when trying to figure out who polluted the river in QA, an understanding of the impact of physical processes on the environment (TEKS 6) and the role factors of production play in a society's economy (TEKS 9) would both be given a mark.

After each multiple-choice question was answered in GeoNet, supplemental information about that question was provided. The question and information given was evaluated on the basis of whether or not it aligned with one of the TEKS or national geography standards. For example, one question in the North American category asked where the Republic of Haiti was located. After answering Hispaniola, a box popped up and discussed the island and Christopher Columbus. This question would fall under TEKS 2 and also received a mark for National Standard 9.

The same evaluation methods were applied to all three games by the main author. This author worked extensively with the TEKS and national geography standards teaching world geography in the state of Texas. A portion of the games was played by the third author in order to account for consistency with the content analysis evaluation results.

Phase 2 Evaluation

After each game was played the number of marks for each individual TEKS for all of the games were summed individually and then added up to get the total number of marks that each game received. For example, there were 627 total marks unevenly divided between the 23 TEKS for CS. Each individual TEKS marks were summed and the top five TEKS with the most marks were identified.

RESULTS

Phase 1 Evaluation

After completing all eight missions, the results showed that CS aligns with all twenty-three (100%) of the sixth grade social studies TEKS. Upon completion, QA aligned with seventeen of the twenty-three (74%) sixth grade social studies TEKS. Finally, GeoNet aligns with twenty-one of the twenty-three (91%) sixth grade social studies TEKS. The results also show that CS and GeoNet align with all eighteen (100%) of the national geography standards. QA aligns with fifteen of the eighteen (83%) national geography standards.

Phase 2 Evaluation

In order to analyze the number of marks each game received, the top five TEKS were identified. The counts were then summed to determine which TEKS made up what percent of the total number of counts for each of the games (Table 3). CS emphasized TEKS 18, 2, 3, 10, and 9. The results showed that this game emphasizes culture, history, geography, and economics. QA stressed TEKS 3, 23, 7, 9, and 15 for an emphasis on geography, social studies skills, economics, and culture. Game three, GeoNet,

stressed TEKS 23, 7, 5, 21, and 2. These emphasize social studies skills, geography, and history. It is important to note the disproportionately high percentage of marks for social studies skills for GeoNet. The game is in a multiple-choice format and virtually every question was counted under the social studies skills TEKS for problem solving and decision making. Additional examples from each game are presented in Tables 4 (CS), 5 (QA), and 6 (GeoNet).

Discussion

Phase 1 Evaluation

Phase 1 of the content analysis showed that CS aligns with all TEKS requirements in the sixth grade social studies curriculum and all eighteen national geography standards. Therefore, CS could be used by teachers to complement material learned in a geography classroom and strengthen students' "problem solving and critical thinking skills" (Mayland 1990, 5). For example, CS is appropriate for use in the classroom after discussing most units in world geography.

QA's content aligns with seventeen of the twenty-three TEKS and fifteen of the eighteen national geography standards. QA's commitment to experiential and inquiry-based learning (Barab *et al.* 2005) supports students' application of geographic inquiry to investigate spatial questions and propose solutions. Inquiry-based learning and problem-based learning allow students to partake in activities and learning opportunities that pose real-world problems and these situations can be powerful in the classroom (Naish, Rawling, and Hart 2002; Spronken-Smith 2005; Schrader, Zheng, and Young 2006). QA could be used in the classroom as a follow-up to studying about human environment interaction, to reinforce map reading and interpretation skills, or as a way to develop geographic inquiry skills (Robinson and Schonborn 1991; Carroll, Knight, and Hutchinson. 1995).

Table 5. Examples of results from content analysis for QA.

TEKS Strand	Examples
3 Geography: The student uses maps, globes, graphs, charts, models, and databases to answer geographic questions.	• In multiple instances the latitude and longitude coordinates at the top of the screen were used to navigate in the virtual environment. • Students must read results from the tests of pH, turbidity, dissolved oxygen, and temperature.
23 Social Studies Skills: The student uses problem-solving and decision-making skills, working independently and with others, in a variety of settings.	• "Use information they learn as a tool they can use to make good decisions." • Develop a hypothesis and record in a journal or field book the reasons why the fish are dying, use information on quests to develop and test the hypothesis, come up with a possible solution.
7 Geography: The student understands the impact of interactions between people and the physical environment on the development of places and regions.	• "See how easily people can affect the ecosystem, for good or ill." • "I am sure you are aware that the water, the bugs, the fish, the birds, and even we humans are all connected."
9 Economics: The student understands the role factors of production play in a society's economy.	• "Help us learn how to balance the needs of everyone who uses the park." • The Lumbar Company chops down trees only in the licensed areas of the park, and they replant trees after they finish logging in an area.
15 Culture: The student understands the similarities and differences within and among cultures in different societies.	• A part of the park is owned by an indigenous group, the Mulu. They have rights to the animals and fish on their land. They support their people with the food they grow, as well as the produce they sell to local markets. Their hunting, fishing, and trapping activities have not been a problem in the past. • The Mulu feel like this is their forest and the river is a part of the soul of their people.

GeoNet's content aligns with twenty-one of the twenty-three TEKS and all eighteen of the national geography standards. The game could be used in multiple ways by either playing the game without consulting any other resources to help answer the questions; or accessing resource materials to help answer the questions either online, with the textbook, or some other form of reference material. For example, after a unit on Europe, GeoNet, has the potential to reinforce specific vocabulary, concepts, and topics discussed in class. The games can also reinforce geographic concepts and skills studied in a formal education setting.

The content to curriculum alignment rates of these games leads us to conclude that CS and GeoNet are more closely aligned with the TEKS and national standards than QA. This, however, does not mean that QA's value for use in the classroom is less than the other two games. Most Texas teachers design lesson plans using three or four TEKS at most, making QA's TEKS coverage sufficient.

Phase 2 Evaluation

Often geography teachers are expected to incorporate other components of the social studies in their lessons; this is evident throughout

Table 6. Examples of results from content analysis for GeoNet.

TEKS Strand	Example Questions and Answers	Supplemental Information
Social Studies Skills 23: The student uses problem-solving and decision-making skills, working independently and with others, in a variety of settings.	• When it is 5:00 P.M. on Monday, November 27 in Fiji, which is on the western side of the International Date Line, what time and date is it in American Samoa, on the eastern side of the line? (Answer: 6:00 pm on Sunday, November 26) • On Antarctica scientists have found the fossilized remains of a kind of beech tree that could only grow in warmer climate. What explanation is there for this? (Answer: Antarctica was once part of a larger landmass located close to the equator)	• International Date Line marks the beginning of each new calendar day. The date to the west of the line is one day later than the date to its east. • Antarctica was once part of the supercontinent but once it broke apart, Antarctica slowly moved to the much colder South Pole.
Geography 7: The student understands the impact of interactions between people and the physical environment on the development of places and regions.	• Which one of the following uses of the rain forest is helping to cause its destruction? (Answer: grazing beef cattle) • The Chinese government is working on a project that would be the largest construction project undertaken since the Great Wall. The project is very controversial. (Answer: a dam on the Chang Jiang)	• Ranchers and farmers cut down and destroy the rainforest environment. If clearing continues almost all of the rain forests will be gone in 30 to 50 years. • Completion of the construction of the Three Gorges Dam could require the resettlement of almost two million people and the destruction of many archaeological sites.
Geography 5: The student understands how geographic factors influence the economic development, political relationships, and policies of societies.	• What do archaeologists believe paintings of people herding and hunting on rocks and caves in the Sahara tell us? (Answer: The Sahara once received enough rain to allow hunting and herding) • South Africa exports something that is often associated with weddings. What is it? (Answer: diamonds)	• The climate of the Sahara has gotten much drier over the past two thousand years. • Precious metals and minerals like gold and diamonds are important exports for South Africa.
Social Studies Skills 21: The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology.	• What percentage of the world's wool comes from Australia and New Zealand? (Answer: almost 50%) • Dust from the Sahara is sometimes found on ships in the Atlantic Ocean, especially in the winter months. What might explain this? (Answer: A dry wind blows west or southwest and carries dust out to the Atlantic)	• All this wool comes from two countries that had never had a single sheep before 1750! • Cool, extremely dry wind called a 'harmattan' forms over the Sahara. Harmattans can carry great quantities of dust.
History 2: The student understands the contributions of individuals and groups from various cultures to selected historical and contemporary societies.	• Who were the first people to discover and settle Mexico? (Answer: American Indians) • During the 1800s, many European nations claimed colonies in Africa so they could have access to minerals, crops, and other resources from Africa. What clue could you use to determine which African nations were former colonies of Great Britain? (Answer: English is the official language of the government of those former colonies)	• American Indians settled the area before 8000 BCE and were hunters, in 7000 BCE they became farmers, and by 2000 BCE they had settled in villages. • Kenya, Ghana, Nigeria, and South Africa are examples of countries that use English as an official language; these countries were once British colonies.

the different strands in the TEKS. An examination of the top five TEKS stressed by each game gives the teacher an idea of where these games might fit into their lesson plans. Teachers could use any of these games in a sixth grade social studies classroom to emphasize important aspects and topics being discussed and overall, each of these games can be used as an extra credit assignment, chapter assessment, or homework opportunity. For example, games can be utilized as additional learning material, used during recess or free time, or for team-building activities. This supports the work of Wiebe and Martin (1994) who found that CS contains content found in schools, but the content of the

game is specific and must be incorporated appropriately. CS has also been used in an interdisciplinary setting in math, language arts, and fine arts classrooms (Carroll, Knight, and Hutchinson 1995). Thus, using the games in a manner that aligns with the curriculum is critical (Wiebe and Martin 1994; O'Neil, Wainess, and Baker 2005). For example, after multiple units on world regions, CS could be played to reinforce learned concepts. GeoNet may possibly be the easiest to incorporate in the lesson plan because it is divided into regional areas (continents) and focuses on *Geography For Life*. For example, after studying Africa, the Africa region and categories could be played by students.

It is possible that these games could be used to incorporate problem-based learning, experiential learning, active learning, cooperative learning, and collaboration (Squire and Jenkins 2003; Barab *et al.* 2005) because each of these games could be used by the students for individual or group work. In these constructivist learning environments, knowledge is constructed through play, exploration, and social discourse (Amory and Seagram 2003). Ultimately, this research shows that these games align with curriculum requirements, one of the many factors that hinder implementation of games in the classroom. The use of games can also create a more student-centered as opposed to teacher-centered learning environment (Watson, Mong, and Harris 2011). Therefore, if teachers appropriately and effectively implement these games into their instructional strategies there is a possibility that increased student learning could occur. Explicitly stated learning objectives tied to the games will determine whether or not the TEKS are fulfilled.

Other Barriers

The games were interesting and engaging, but additional barriers exist. An older version of CS is freely available online, but the newer version is available for purchase (less than US$10). Some teachers may choose not to use this game due to its cost and online-only availability. For QA, users can request a guest account that limits interaction with other QA participants, or in order to get the full experience, teachers can sign up and have access for a small fee. For the purposes of this research, the guest user account option was chosen. This option requires limited personal information and an e-mail address to create a login and a password; account access was available within one day. The guest account expires after six months but it is possible to reapply for another guest account. QA also requires software updates; the latest updates occurred in 2010. This may also be a barrier due to the increasing demand in system requirements that may not be available at all schools. Another drawback to a guest account was that a game being played could not be saved and continued to play at a later time. For GeoNet, the multiple-choice approach may not be suitable for teachers wanting an alternative instructional strategy.

Another area where problems may arise regarding whether or not teachers will be able to incorporate games into the classroom (Maushak, Chen, and Lai 2001) include the hardware, software, and teacher training needed for the use of computer games in education (Kebritchi 2010). Hardware refers to access and availability of computers in the schools; currently, schools have more access to computers than ever before (U.S. Department of Education 2006; Rice 2007). Nevertheless, the level of accessibility continues to vary across schools throughout the nation. Most classrooms still have a limited number of computers or require reserving computer lab time. Software refers to the games that must be either purchased or accessed online to play. Teachers and school districts may not have the necessary resources to purchase software (Maushak, Chen, and Lai 2001). Last, teacher training to effectively use new technology in the classroom has been slow and the results are disappointing (Maushak, Chen, and Lai 2001; Kebritchi 2010).

Conclusion

We began this study asking whether three educational computer games could be used in a geography or sixth grade social studies classroom. A content analysis showed that Carmen Sandiego aligns with all curriculum requirements set forth in the sixth grade social studies TEKS. Quest Atlantis aligns with seventeen of the twenty-three sixth grade social studies TEKS and GeoNet aligns with twenty-one of the twenty-three TEKS. The content analysis using the national standards revealed that Carmen Sandiego and GeoNet align with all eighteen of the national standards in geography and Quest Atlantis aligns with fifteen of the eighteen national standards. These findings then eliminate one barrier to classroom implementation, game, and curriculum alignment (Deubel 2002). While this study showed that Carmen Sandiego and GeoNet are more closely aligned with the TEKS than Quest Atlantis, this does not mean that QA's value for use in the classroom is less than the other two games. QA has important value for its problem-based learning approach.

Emerging research studies are beginning to show that games can enhance student learning in geography (Virvou, Katsionis, and Manos 2005; Tuzun *et al.* 2009). Thus, the use of these games in geography courses should be considered. This research adds to current geographic education literature and found that these games align with curriculum requirements laid out by the TEKS in Texas and the national geography standards. Future work should investigate the teacher as well as student reception of game use and whether student learning is enhanced as a result of game exposure.

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Note

1. Carmen Sandiego is produced by the Learning Company and is available for online purchase. Quest Atlantis is produced by Indiana University's College of Education's Center for Research on Learning and Technology and is available at *http://atlantis.crlt.indiana.edu*; the full game is available for a fee. GeoNet is produced by Houghton Mifflin Social Studies and is available at *http://www.eduplace.com/geonet/*.

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