Game Play Time and Learning Outcomes of Boys and Girls in a Social Studies Mobile Game-Based Learning Curriculum

Susan Gwee, Yam-San Chee, Ek-Ming Tan
Nanyang Technological University
1 Nanyang Walk Singapore 637616

susan.gwee@nie.edu.sg

Abstract

In this paper, we report on the enactment of an innovative social studies intervention program based on the *Statecraft X* game-based curriculum. This curriculum involved 41 ninth graders, 17 boys and 24 girls, using a mobile learning game *Statecraft X* on Apple iPhones to enact governorship in the game world of Velar. This paper seeks to investigate whether this mobile game-based curriculum favors boys rather than girls. The data suggest that boys spent significantly more time playing the *Statecraft X* mobile game compared to girls. However, there were no significant differences in their scores in an essay question that assessed their learning of governorship in terms of criteria of relevance of content, perspective, and personal voice. There was also no significant correlation between game play time and essay scores. Thus, the results indicate that boys are not favored in the *Statecraft X* mobile game-base curriculum although they were more engaged in the game play. We will discuss the factors that gave rise to these results.

Keywords

Mobile, game, gender, content, perspective, voice

1. INTRODUCTION

Boys are thought to have an unfair advantage in game-based learning environments because gaming is established as a male activity and more males spend more time playing computer games than females (Bertozzi & Lee 2007; Buchman & Funk 1996; Chou & Tsai 2007; Green & McNeese 2008; Solomonidou & Mitsaki 2009, Winn & Heeter 2009). In a review of digital games, Dickey (2006) noted that game content traditionally suited males better, and that there was more male access and control over public leisure spaces such as video arcades, pubs, and bars, and domestic spaces such as television sets and computers in the living room in the past. Marsh (2010) also underscored the privileging of boys' interests in the selection of internet sites by educators to promote learning. Pre-school girls were offered access to websites that did not correspond to their stated interests and preferences. Marsh (2010) noted that educators did not adopt technologies such as dance mats and karaoke machines and digital literacy practices adopted by girls in curriculum planning. Thus, the fear is that girls will not perform as well as boys in a game-based learning environment because they have less access and control over gaming spaces and that non-educational game content has traditionally catered to male interests. However, Papasterigou (2009) investigated the learning effectiveness of a educational computer game for learning computer memory concepts in 88 16- to 17-year-

old students in two Greek high schools and found that there were no significant differences in learning gains between boys and girls despite boys' greater involvement and experience with computer gaming. Since the students in her study played the computer game in the school computer laboratories, she did not investigate the time spent in playing the specific computer game investigated. Her study did not involve a mobile game that may provide girls with more control over and access to computer games. With the proliferation of mobile learning in the work place and in schools (De Freitas & Griffiths 2008; Facer *et al.* 2004; Klopfer *et al.* 2005; Norris & Soloway 2009; Pachler 2010; Petrova & Li 2009; Sharples 2006; Squire & Jan 2007; Squire & Klopfer 2007), it becomes easier for games to be installed in mobile devices and males no longer have primary access to and control over public and domestic leisure spaces. Game content can be changed to cater to both male and female interests. Thus, girls may spend as much time as boys since game content is modified and they have more control over their game space. The present study thus addressed the following research questions:

(1) Are there gender differences in game play time if game content and game spaces were designed not to privilege males?

(2) Are there gender differences in game-based learning outcomes in favor of females if game content and game spaces were designed to be more balanced between males and females?

(3) Is there a significant correlation between game play time and learning outcomes?

2. METHODOLOGY
2.1 Participants

Seventeen boys and twenty-four girls participated in the present study. They were from a high-ability ninth-grade class in the Express Academic track. They were divided into two groups: Games 1 and 2. There were twenty-one students in Game 1 and twenty students in Game 2. Students in each game were assigned to four factions for game play: one all boys' faction (Dragon), one all girls' faction (Phoenix), and two mixed group factions (Griffin and Pegasus). One student was absent during the administration of the post-intervention survey.

Two female social studies teachers were involved in the study. The lead teacher observed a four-day pilot study

which took place in October 2009 in the same school. In November 2009, the two teachers participated in a two-day professional development workshop with the research team. During the intervention period from 18 January to 3 February 2010, the first author also had discussions with the two teachers regarding lesson plans.

2.2 Materials

Statecraft X is a social studies mobile game designed for this study. It is based on principles of governance in the Social Studies curriculum for ninth-graders in Singapore. The four principles of governance found in the Singapore's ninth-grade Social Studies textbook are:

 (1) Leadership is key;

 (2) Anticipate change and stay relevant;

 (3) Reward for work, and work for reward;

 (4) A stake for everyone, opportunities for all.

At the start of the six one-hour lessons which took place during the intervention period of 18 January to 3 February 2010, each student was loaned an Apple iPhone with the *Statecraft X* game installed in it. In this multi-player strategy game, factions competed against one another to rule the fantasy kingdom of Velar populated by four races of sentient beings: humans, dwarfs, elves, and trolls. The back-story of the game is that King Topez of Velar passed away without leaving an heir, thus creating a power vacuum. Student governor-led political factions then had to look after their town people and try to take over the capital city in the kingdom. See Figure 1 for a screen shot of the *Statecraft X* game on an Apple iPhone.

Figure 1: Students checking on the well-being of their town people

There were two game objectives. The first objective was for each faction to consolidate its power and position by winning the trust of the towns assigned to them at the beginning of the game, of neutral towns, and also of towns belonging to other factions. Second, all factions must collaborate to ensure that the kingdom of Velar, survives in the face of attackers from other neighboring kingdoms.

During the intervention period, events involving the game world such as health epidemics, refugee influx, famine, and

bandit attacks were triggered by the server. Therefore, in addition to developing towns under their control, student governors also had to cope with these events.

In addition to the *Statecraft X* game, teacher-facilitated activities (e.g., whole class discussion, group discussion, and student presentation), online blogs, and forums supported the learning of the *Statecraft X* curriculum. In the classroom, students were situated in Bellalonia. The teachers role-played as the grand sages of Bellalonia while students role-played as governors of Bellalonia. The third author created this fictional world as a non-threatening space for reflection of events that happened in the real and game worlds. Figure 2 situates the learner at the centre of the three worlds: game, fictional, and real. During in-class discussions and questions posted on the web portal, the first and third authors created questions to reflect on their governing practices in the game world of Velar, and on their knowledge of the real world so that they could solve problems in the fictional world of Bellalonia. At the beginning of the first lesson, the Grand Sages gave them a sheet of paper enumerating the problems student governors had to solve in Bellalonia: (1) high tax rate, (2) high unemployment rate, (3) high emigration, (4) low economic growth due to lack of resources and money, (5) political instability due to the death of the old king of Bellalonia, (6) malaria and tuberculosis health epidemics. The Grand Sages sent student governors to the game world of Velar where they faced challenges in governance so that they could become better governors.

The third author set up a web-portal situated in the fictional world of Bellalonia to provide a space for students to be informed of events happening in the game world of Velar and the fictional world of Bellalonia. The first author provided additional materials from the real world to be uploaded on the web-portal so that students could consider experiences that governors face in the real world countries. These readings provided students with additional perspectives of governance beyond the *Statecraft X* game and the ninth-grade social studies textbook.
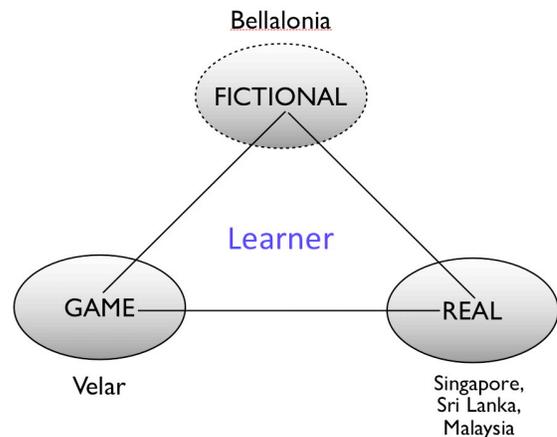

Figure 1: A play-between-worlds curriculum model

All the above materials were tied to the play-between-worlds curriculum model shown in Figure 2. By having the option to move from one world to another, students were not tied to the real world and the game world which were more finite in terms of governing practices. In the fictional world of Bellalonia, students could come up with infinite ways of solving challenges or imagining scenarios. This is more powerful because students could think of problems in potential scenarios and solutions to these problems.

2.3 Procedure

All lessons were video-recorded. In the lead teacher's classroom, one video camera recorded the general classroom, one camera each was focused on three groups in the classroom. In the other teacher's classroom, one video camera recorded classroom activities. During the first lesson, students were given an Apple iPhone with the game *Statecraft X* installed in it. The game designer of *Statecraft X* taught students how to use the game through a tutorial session of learning how to manage towns, trade, move from town to town, etc. Table 1 summarizes the sequence of in-class and out-of-class activities of the *Statecraft X* curriculum.

According to the following schedule that was worked out in consultation with the school, students could play during non-curriculum time: from 6 a.m. to 8 a.m. and from 2 p.m. to 10 p.m. on Mondays to Fridays, and from 6 a.m. to 11 p.m. on Saturdays. No game play was allowed on Sundays. Every hour, students were awarded a fixed number of action points that they could use for various player actions.

The first author administered a post-intervention survey at the end of the last lesson. She also administered an essay a few days after the last intervention lesson during a regular social studies class in the morning. She asked students to complete the essay in thirty minutes. The essay instruction was:

Imagine that you are running for an election to be a member of parliament and that you have to formulate policies to convince the citizens of your country that you are the best candidate. Justify your proposed policies by using examples from what you have learnt, what you have read, and your personal experiences.

The first (Rater A, female) and third authors (Rater B, male) were the assessors of the essays. Both held graduate degrees, had at least eight years of teaching experience in Singapore schools and were part of the *Statecraft X* research team. Rater A also had three years of experience in an improving teachers' assessment literacy project where she trained teachers to assess student work during assessment workshops based on a scoring guide and exemplars of student work. She also acted as an adjudicator during score resolution sessions when two teams of teachers gave different ratings to student work. Raters A and B assigned scores of levels 1 to 4 for the criteria of relevance of content, perspective, and voice to all 41 written scripts (see scoring guide in Appendix 1).

Relevance refers to how relevant the policies proposed by a student were to the social and economic needs of the different segments of a country's population and whether the student had given examples from both traditional and non-traditional sources to support his or her policies. Perspective refers to whether a student could give multiple perspectives to the proposed policies and integrate them or whether he or she could only give the textbook perspective. Personal voice refers to the voice used by a student and whether it matched the situation, how authentic the voice was, whether opinions were well-defined and detailed, whether he or she communicated strong feelings and honest statements, and whether he or she showed that he or she cared for the topic.

Raters A and B then had a morning session of reviewing all scripts together to discuss a final score for each script. When there was a discrepancy, they compared the features of the student's script with the benchmark performance in the scoring guide together again and discussed why the student should be awarded a certain score. They considered any evidence that challenged the original scores and achieved a consensus score. They then assigned a final score or operational score for each criterion. Johnson et al. (2005) recommended the use of discussion to resolving discrepancies and improving score accuracy.

Table 1. Summary of activities

In-class activity	Out-of-class activity
Session 1: Game tutorial, whole class discussion	Game play, reflection blog
Session 2: Whole-class discussion, examination of four case studies in groups, student presentation	Game play, reflection blog, online forum, debate preparation
Session 3: Debate, whole-class discussion	Game play, reflection blog
Session 4: Whole-class discussion, group planning of individual writing assignment	Game play, reflection blog
Session 5: Writing of individual assignment	Preparation for presentation
Session 6: Presentation of final assignment, post-intervention survey	-
Session 7: Written speech	-

2.4 Data sources and data analysis

The data sources used in this paper were the post-intervention survey and the written speech. Table 2 summarizes the data sources, dependent measures, and analysis strategies used to answer the three research questions of this paper. Levene's test was used to test the

assumption of equal variances. To address the first research question of whether there were gender differences in the amount of time spent playing *Statecraft X* per week, a 2-tailed *t*-test was used on the time spent playing the game with gender as the independent variable.

Table 2. Alignment of research questions, data sources, dependent measures, and analysis strategies

Research question	Data source	Dependent measure	Analysis strategy
Are there gender differences in game play time?	Survey	Time spent per week in game play	2-tailed *t*-test
Are there gender differences in learning outcomes?	Written speech	Relevance score, perspective score, and voice score	2-tailed *t*-test
Is there a significant correlation between game play time and learning outcomes?	Survey, written speech	Time spent per week in game play, relevance score, perspective score, and voice score	2-tailed non-parametric Spearman correlation test

To address the second question of whether there were gender differences in learning outcomes, a 2-tailed *t*-test was conducted on the dependent variables of relevance of content, perspective, and personal voice.

Inter-rater exact and adjacent agreement rates were also calculated for the variables of relevance, perspective, and voice. For the scoring of essays, most agencies and educational studies generally accept scores which are at least adjacent (e.g., Brennan 1996; Penny 2003). To address the third question of whether there was a correlation between game play time and learning outcomes, a 2-tailed non-parametric Spearman correlation test was run on the variable of time spent playing *Statecraft X* with the variables relevance, perspective, and voice respectively.

3. RESULTS
3.1 Hours of Game Play Time per Week
Levene's test showed that the assumption that variances were equal was not supported, $F = 5.71$, $p = .02$ (see Table 3). Thus, we used the *t*-values for not assuming equal variances. As shown in Table 4, the results of the study indicate that boys ($M = 19.20$, $SD = 15.25$) spent significantly more time playing the game *Statecraft X* than girls ($M = 7.35$, $SD = 6.87$), $t = 2.76$, $p = .012$, $\alpha = .05$, 95% CI [3.34, 20.35]. The mean difference in game play time between boys and girls was 11.84. Figure 3 shows the distribution of game play time across boys and girls. The

majority of the girls (75%) reported spending less than 10 hours per week playing *Statecraft X* compared to 31% of the boys. Except for one girl who reported spending 32 hours a week playing *Statecraft X*, the rest reported spending 15 or fewer hours a week in game play time. On the other hand, ten boys out of sixteen reported spending more than 15 hours a week in game play time. One boy even reported spending 62 hours a week in game play time.

Table 3. Levene's test for equal variances

	F	p
Game play time	5.71	.02
Relevance	.91	.35
Perspective	.91	.34
Voice	.35	.56

Table 4. Gender differences in hours of game play time per week

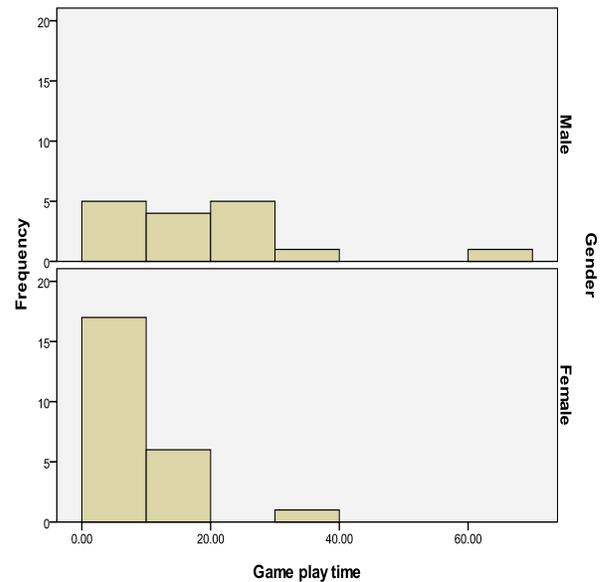|	Gender		t	p
	Male ($N = 16$)	Female ($N = 24$)		
Mean	19.20	7.35	2.92	.009
SD	15.25	6.87		

Figure 3: Distribution of game play time across boys and girls

3.2 Learning Outcomes
The reliability data for exact and adjacent agreement is shown in Table 5. As can be seen in Table 5, the percentages of exact and adjacent score agreement were 92%, 100%, and 78% for the essay criteria of relevance, perspective, and voice respectively.

19

Table 6 shows the descriptive statistics of boys and girls for learning outcomes. Levene's test indicates that the variances for relevance, perspective, and voice can be assumed to be equal (see Table 3). The *t*-values reported reflect that. The results of the present study suggest that there were no significant differences in learning outcomes between boys and girls (see Table 7).

Table 5. Exact and adjacent score agreement between raters A and B for relevance, perspective, and voice

Agreement	Relevance	Perspective	Voice
Exact	24	22	15
Adjacent	14	19	17
Exact and adjacent	38	41	32
% exact and adjacent	92%	100%	78%

First, the relevance scores of boys ($M = 2.65$, $SD = 1.06$) and girls ($M = 2.58$, $SD = .83$) were not significantly different, $t(39) = .22$, $p = .83$, $\alpha = .05$. Second the perspectives scores of boys ($M = 2.76$, $SD = .75$) and girls ($M = 2.58$, $SD = .83$) were also not significantly different, $t(39) = .72$, $p = .48$, $\alpha = .05$. Third, the differences between the voice scores of boys ($M = 3.65$, $SD = .61$) and girls ($M = 3.25$, $SD = .68$) were not statistically significant, $t(39) = 1.93$, $p = .06$, $\alpha = .05$. However, in every criterion, the mean scores for boys were slightly higher than those for girls.

Table 6. Descriptive statistics of learning outcomes

	Gender	*N*	Mean	*SD*	*SE* Mean
Relevance	Male	17	2.65	1.06	.26
	Female	24	2.58	.83	.17
Perspective	Male	17	2.76	.75	.18
	Female	24	2.58	.83	.17
Voice	Male	17	3.65	.61	.15
	Female	24	3.25	.68	.14

Note. N = sample size; SD = standard deviation; SE = standard error.

Table 7. Gender differences in learning outcomes

					95% CI	
	t	*p*	Mean Diff.	*SE*	LL	UP
Relevance	.22	.83	.06	.29	-.53	.66
Perspective	.72	.48	.18	.25	-.33	.69
Voice	1.93	.06	.40	.21	-.02	.81

Note. CI = confidence interval; Diff = difference; LL = lower limit; SE; standard error; UP = upper limit.

3.3 Correlation between Game Play Time and Learning Outcomes

The correlation between time spent playing *Statecraft X* and relevance, perspective, and voice were all non-significant. The results indicate that there were no significant associations between the time boys and girls spent playing *Statecraft X* game and the learning outcomes of relevance, perspective, and voice (see Table 8). The Spearman correlation rank coefficients were -.073 ($p = .64$), -.094 ($p = .57$), and .19 ($p = .24$) for relevance, perspective, and voice respectively.

Table 8. Correlation between game play time and learning outcomes

	Game play time per week	
	Spearman rho	*p*
Relevance	-.073	.64
Perspective	-.094	.57
Voice	.19	.24

In other words, the learning outcomes of students did not have a statistically reliable relationship with game play time. A student could spend little time playing the *Statecraft X* game and yet achieve high scores in the written task. In Figures 4, 5, and 6, scatter plots show that students achieved high scores on relevance, perspective, and voice of 3 and 4 despite having reported spending little time in game play.
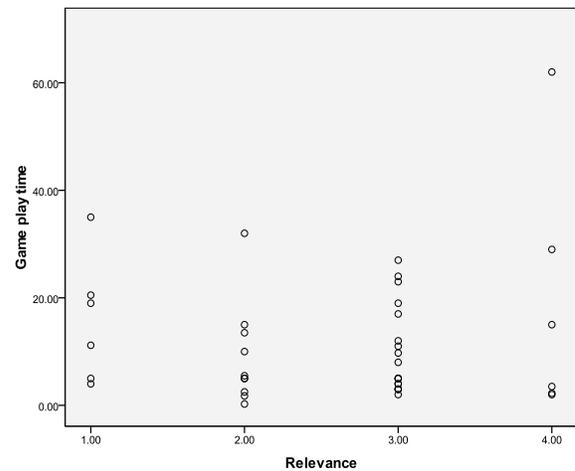

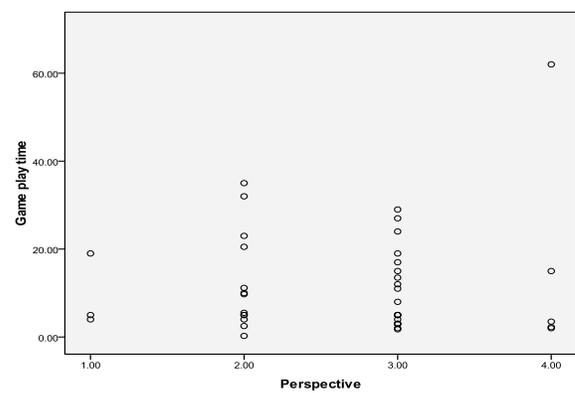**Figure 4: Distribution of relevance scores and game play time**

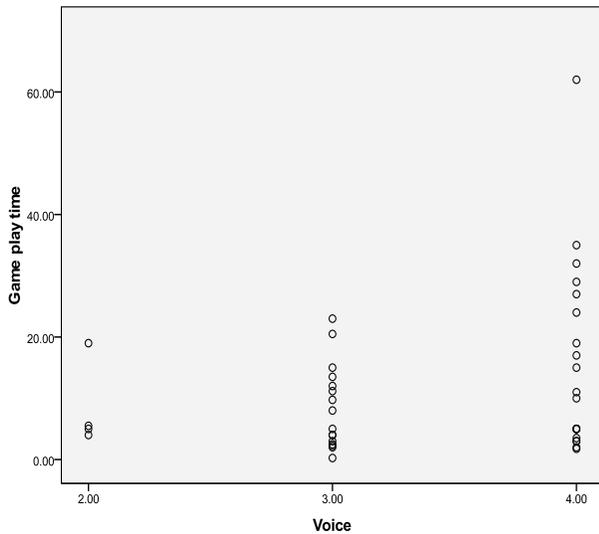**Figure 5: Distribution of perspective scores and game play time**

Figure 6: Distribution of voice scores and game play time

4. DISCUSSION

The objectives of the present study were (1) to investigate whether there were gender differences in game play time, (2) to investigate whether there were gender differences in learning outcomes, and (3) to investigate whether there was a significant correlation between game play time and learning outcomes in ninth-grade students who participated in the *Statecraft X* game-based curriculum. Previous studies have not compared gender differences in game play time if game content and access and control over game devices did not favor males. This study is also a first attempt to look at game play time and its effect on learning outcomes. Consistent with previous studies (Buchman & Funk 1996; Bertozzi & Lee 2007; Chou & Tsai 2007; Green & McNeese 2008; Solomonidou & Mitsaki 2009; Winn & Heeter 2009), we found that there were significant differences found in game play time between boys and girls. We will now discuss the factors that could have contributed to gender differences in game play time and the factors that could have contributed to no significant differences in learning outcomes and to no significant correlation between game play time and learning outcomes.

4.1 Game Content

One factor that might have contributed to gender differences in game play time was game content. It could be that the game content of *Statecraft X* did not sufficiently appeal to girls because they reported spending less time in game play than boys. In an earlier paper, we reported that the greatest difference in player actions between boys and girls was the category of military actions. Boys took about six times more military actions than girls. This could be due to the fact that in the first lesson, the *Statecraft X* game was positioned in such a way that the winning faction was the faction that captured the capital city. This might have led to the high number of military actions taken by boys in

a bid to win the game. In a subsequent intervention, the first author, a female researcher, advocated a change in the positioning of the game. The winning faction would be positioned as the faction that had the highest composite score of happiness, profit, and population levels in the towns under their charge. With this shift, girls might engage in more game play. This change was instituted in a subsequent intervention but the investigation of this hypothesis is still pending.

Another reason could be that girls were more thoughtful in their game play. They might strategize more before engaging in game play after reading blogs and listening to class discussions. They also might think that the game was the point of departure for the curriculum rather than the major part of the curriculum and therefore prioritized their time accordingly.

4.2 Access to and Control over Game Space

Given that all students in this study were loaned each an Apple iPhone, there should be equal access to control over game space. However, the gender differences in game play time indicate that boys still played the *Statecraft X* game more frequently than girls. Perhaps, teenage girls wanted some control over their daily lives and did not want game play to intrude too much into their daily lives at home which revolved around homework.

4.3 Learning Outcomes

Consistent with Papasterigou (2009)'s findings, this study found that there were no significant gender differences in the learning outcomes of a game-based curriculum. The non-significant gender differences in learning outcomes could be due to the fact that the first author who is a female designed the lesson plans executed for the study and who designed learning activities that catered to both girls and boys. Having a curriculum model that goes beyond the game world into the fictional and real worlds might have allowed girls and boys who had little time for game play to still benefit from the *Statecraft X* curriculum. Although some students have less first-hand experience with game play, they might have gleaned insights from the blogs of their classmates and from class discussions and student presentations. Another possibility is that although the girls played the *Statecraft X* game less often than boys, they played enough to make meaning of the game play in terms of governance so that they were able to participate in the learning activities designed in the *Statecraft X* curriculum and to achieve desired learning outcomes. That is, even though a boy or a girl were not to spend a lot of time in game play, they could still achieve good learning outcomes.

4.4 Limitations of Present Study

The present study had certain limitations. This study involved a short-term intervention in a high school. It would be interesting to investigate whether there would be long-term learning outcomes in school tests and examinations, and students' interest in social studies as a

result of a social studies game-based curriculum. Another area for future research is to develop a web-based version of the *Statecraft X* game and to investigate game play time and learning outcomes in such a curriculum compared to a mobile version of the game. That is, if girls or boys have to share a computer with other family members in their home to play the web-based version of *Statecraft X*, will there be any difference to their learning outcomes? This will further illuminate the importance of access to and control over game space in game-based learning.

The *Statecraft X* game was also initially designed by a male game designer. However, with the input from female members of the *Statecraft* team, the game content could be modified in such a way that both male and female preferences for game play are paid greater attention in future interventions.

5. CONCLUSION

The results of the study showed that the learning outcomes of a game-based learning curriculum were not solely dependent on the hours students spent on game play. The learning outcomes were also not significantly different between boys and girls although boys reported spending significantly more hours than girls in game play.

Educational games can contribute to learning in both male and female student populations. Future educational games can be produced with greater consideration of the preferences of girls in terms of game content. In this way, these games are less likely to suffer from gender bias and they can also tap on the purchasing power of females.

6. ACKNOWLEDGMENTS

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Appendix 1: Scoring guide for scoring relevance, perspective, and voice in students' essays

Criteria	Level 1	Level 2	Level 3	Level 4
Relevance	Policies proposed are not relevant to the social and economic needs of the country. Most examples given are simplistic. Do not diverge from the textbook.	Examples given may include a non-textbook source or an innovative interpretation. Examples given may include a non-textbook source or an innovative interpretation.	Policies proposed meet the social and economic needs of the majority of the population. Examples given are appropriate and include non-traditional sources.	Policies proposed meet all the social and economic needs of this country. Examples given effectively support all the policies proposed. Examines examples given for its relevance.
Perspective	Offers only the textbook perspective.	Limited discussion of perspectives other than the textbook perspective. Alternatives are not integrated. Treats other viewpoints superficially.	Offers multiple perspectives, but they are integrated in a limited way Attempts to investigate viewpoints.	Integrates diverse multiple relevant perspectives. Multiple viewpoints are thoroughly discussed, explained and qualified.
Voice	Is indifferent towards the topic. Does not communicate feelings. Does not offer any opinion. Writing is phony, stilted or awkward. The reader is clueless about the personality of the writer. Voice used is inappropriate for the situation.	Cares about the topic in a limited way. Communicates feelings as an afterthought. Opinions are emergent in nature. Major inconsistencies cast doubt on the authenticity of the piece. The reader has to examine the piece carefully for an indication of the writer's personality. Voice used matches the situation at times.	Cares about the topic. Communicates feelings. Opinions are outlined. A few inconsistencies in the piece. The reader gets a glimpse of the writer's personality. Voice used largely matches the situation.	Cares deeply about the topic. Communicates strong feelings and honest statements. Only the writer could have written it. Opinions are well-defined and detailed. Writing is authentic. The writer's voice is consistent throughout the essay. The writing sounds real. Displays a well-developed personality. The reader has the impression that he is getting to know the writer very well. Voice used matches the situation very well.