Assessment of Student Outcomes of Mobile Game-Based Learning

Susan GWEE, Yam-San CHEE, Ek-Ming TAN

Learning Sciences Laboratory, Nanyang Technological University

susan.gwee@nie.edu.sg

Abstract: In this paper, we investigate the effect of the mobile game-based social studies curriculum Statecraft X on the quality of student work. This curriculum involved 34 secondary three students using a mobile game played on Apple iPhones— *Statecraft X*—to engage in governorship practices in the game world of Velar. As part of the Play-between-World curriculum, students also construct their ideal practices of governance in the fictional world of Bellalonia through in-class and outside the classroom activities. The control group of 39 students underwent the regular curriculum in the school for the same duration. Students in the intervention group had significantly higher scores for the assessment criteria of relevance, perspective, and personal voice in a writing task than those in the control group.

Keywords: Mobile game, assessment, game-based learning, social studies, perspective, voice, relevance

Introduction

With the proliferation of handheld devices, mobile learning is an emerging field which is rapidly expanding in educational research across schools as handheld devices offer myriad opportunities for mobile learning [10], [14], [16], [17],[18]. Mobile learning is defined as any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies [14]. There are motivational benefits inside and outside the classroom, as well as high levels of engagement [11], [13]. The convergence of games and mobile devices is also becoming a topic of interest in the educational field [3]. With the advent of wireless networks, students can experience new ways of learning through games outside the classroom [4], [7], [19], [20].

Previous work have discussed issues involved in evaluating the observable aspects of learning or game play in mobile devices such as cooperation and competition [6]. This paper attempts to assess the quality of student work arising from a mobile game-based curriculum. Our present study investigates the quality of student work in terms of relevance, perspective, and personal voice in students' essays after they have participated in a mobile game-based curriculum where students learn principles of governance through playing a mobile game *Statecraft X*.

Several studies have suggested the importance of argumentation in science education [1], [19], perspective [2], [5], and personal voice [6], [9]. However, to our knowledge, there is a gap in the assessment of the above three criteria in student work in a mobile game-based social studies curriculum. Thus, we address the following research in this paper: Is there an effect of a mobile game-based curriculum on the quality of student work in terms of relevance, perspective, and personal voice?

1. Method

1.1 Subjects

Thirty-four students (14 boys and 20 girls), aged 15 on average, participated in our study. Thirty-eight students (27 boys and 11 girls), also aged 15 on average, participated as control students. Three social studies teachers participated in our study: two taught the intervention group and one taught the control group.

1.2 Materials

Apple iPhones with the installed *Statecraft X* game were loaned to all students who took part in the Statecraft X curriculum for the duration of the research intervention. *Statecraft X* was designed based on the following principles of governance in the Social Studies curriculum for secondary three students.

Teams competed against one another in this multiplayer strategy game to rule the fantasy kingdom of Velar populated by humans, dwarfs, elves, and trolls. At the beginning of the game, the previous ruler of Velar passed away without leaving an heir, thus setting up the stage for different student governor-led political factions to compete for leadership of the kingdom. The first game objective is that all the teams must collaborate to ensure that their kingdom, Velar, survives in the face of attackers from other kingdoms. Second, individual teams must consolidate their power and position by winning the trust of the people in their own towns and also the people in the towns of other teams. This game aims to allow students to think as governors. To realise these two objectives, faction members must realise short-terms goals such as developing towns under their control, diffusing internal and external threats as well as maintaining diplomatic ties with internal factions.

In addition to the game world of Velar, students were also given materials from the fictional world of Bellalonia. In the classroom, students were situated in Bellalonia. During the first lesson, students were given their final assignment where they, as fictional governors, had to solve problems in Bellalonia. Bellalonia was formed a hundred years ago and was populated by the ethnic group of Solians. Fifty years later, another ethnic group, the Milous, immigrated in search of a better life. The Milous were very hardworking and prospered in Bellalonia. The Solians were unhappy because they felt that they were entitled to the riches arising from the land and thus many Solians emigrated. With the death of the old king, the Grand Sage of Bellalonia had to choose governors in Bellalonia to form a council to help the young king. The sage sent them to the game world of Velar to practise governance.

A web-portal was also set up to provide a space for students to be informed of events happening both in the game world of Velar and the fictional world of Bellalonia. Additional materials from the real world were also provided to help students consider experiences from real world countries. The above materials were tied to the Play-between-Worlds curriculum model. Students learn by "moving" from one world to another, and also by reflecting on their experience in the three worlds: game, fictional, and real.

1.3 Procedure

Prior to the research intervention, all teachers participated in a two-day professional development workshop that was designed to prepare them for the enactment of the *Statecraft X* curriculum. They were given the *Statecraft X* game to play and were shown the *Statecraft X* curriculum. They gave feedback on the lesson plans designed and worked with the research team to finalize the in-class and outside-classroom activities.

The class was divided into two groups for game play as well as whole class discussions. Each teacher was in charge of one group. During the first of six lessons, the teacher explained to the students the Play-between-Worlds curriculum model using the powerpoint slides provided by the research team. She also explained the history of Bellalonia and her current problems. Then, the game designer of *Statecraft X* game also presented the backstory of the game world of Velar, showed students the various actions that they could take in the game, and distributed iPhones to participating students.

During the next four lessons, for the first thirty minutes of the lesson, students responded to questions related to Velar, Bellalonia, and the real world. In the last thirty minutes, the teacher gathered students in a circle and discussed their responses to these questions. During the final lesson, five students from each group presented a speech in front of their groups. The day after the final lesson, the first and third authors administered a 30-minute writing task to both intervention and control groups with these instructions:

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.

1.4 Data Analysis

The first and third authors assessed the three criteria: (1) relevance, (2) perspective, and (3) personal voice in the written student work of both intervention and control groups. Relevance refers to how relevant the policies proposed by a student are to the social and economic needs of the different segments of the country's population and whether this student has given examples from both traditional and non-traditional sources to support his or her proposed policies. Perspective refers to whether a student could give multiple perspectives to the proposed policies and integrate them or whether he 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 she communicated strong feelings and honest statements, and whether she showed that she cared about the topic.

The first and third authors assessed each essay separately and awarded a mark for each criterion. They both hold graduate degrees and have at least eight years of teaching experience in Singapore schools, and are part of the *Statecraft X* research team. After having assessed all essays separately, they came together to moderate the marks for each criterion in each essay. They resolved all differences by re-examining the essay and defending the mark that they gave. Thus, the mark for each criterion for each essay is a moderated mark.

A one-way ANOVA was used to compare differences in the means of each criterion between the intervention and control groups. The percentage of exact and adjacent agreement between the two raters was also calculated. For most agencies and educational studies, agreement also requires ratings to be at least adjacent [8]. One study suggests that when scores differ between two raters, discussion as a core resolution method is the best method compared to the averaging of two scores [8].

2. Results

The exact and adjacent agreement rates between the two raters were 93%, 97%, and 95% for relevance of content, perspective, and personal voice respectively. Table 1 summarises the results of the study for the variables relevance, perspective, and voice. The means of all the variables are two times higher in the intervention group compared to the control group.

Table 1 − Summary of Means, Standard Deviations, 95% Confidence Intervals for Scores on Relevance, Perspective, and Voice in Intervention and Control Groups

| Variable | Intervention (n = 34) | | | | Control (n =38) | | | |
| | M | SD | 95%CI | | M | SD | 95%CI | |
			LL	UP			LL	UP
Relevance	12.09	2.82	11.00	13.07	4.38	3.38	3.29	5.48
Perspective	12.32	2.20	11.56	13.09	4.44	3.38	3.34	5.53
Voice	14.00	2.98	12.96	15.04	6.46	4.94	4.86	8.06

Note. M = mean; SD = standard deviation; CI = confidence interval; LL = lower limit; UL = upper limit.

A further analysis of the data revealed that the mean differences between intervention and control groups in relevance, perspective, and voice were highly significant at $p < 0.001$ (see Table 1). Thus, the quality of students' essays in the intervention group was significantly higher with respect to each criterion of assessment: relevance, perspective, and voice. The effect sizes of the variables of relevance, perspective, and voice were also very large at 0.598, 0.661, and 0.431 respectively. Thus, the differences between students in the intervention and control groups were significantly large.

Table 2 − Summary of the ANOVA Analysis between Intervention and Control Groups.

Variable		Sum of Squares	df	Mean Square	F	p	η^2	Power
Relevance	Between Groups	1077.98	1	1077.98	101.12	< 0.001	0.598	1.000
	Within Groups	695.97	71	9.80				
	Total	1773.95	72					
Perspective	Between Groups	1130.09	1	1130.09	132.78	< 0.001	0.661	1.000
	Within Groups	593.03	71	8.35				
	Total	1723.12	72					
Voice	Between Groups	1032.25	1	1032.25	51.43	< 0.001	0.431	1.000
	Within Groups	1219.69	1	17.18				
	Total	2251.95	72					

Note. df = degree of freedom; η^2 = eta squared or effect size.

3. Discussion and Conclusion

In the *Statecraft X* curriculum, students were engaged in governor practices while playing the game in the game world of Velar and role-playing as governors in the fictional world of Bellalonia. As a result, students were able to incorporate practices of a governor in their daily lives during the duration of the intervention. They were able to discuss their governor practices in and outside of the classroom. All these have contributed to higher scores in personal voice. Adopting the identity of a governor in both game and fictional worlds has also given students the perspective of a governor in addition to that of a citizen rather than solely that of the textbook. This has led to higher scores in perspective compared to students in the control group. Their experience as a governor in the game and fictional worlds has also contributed to the relevance of the policies that students could generate. However, a major limitation of the study is that the students in the control group did not use the

materials for the fictional world of Bellalonia in the classroom. Thus, in future interventions, there should be an additional control group which experiences such in-class activities for the fictional and real worlds.

In conclusion, the *Statecraft X* mobile game-based curriculum had a significantly large effect on the quality of student work. This demonstrates that a mobile game-based curriculum can effectively engage students in learning the practices of governance.

References

[1]   Belland, B. R. (2009). Portraits of middle school students constructing -based arguments during problem-based learning: the impact of computer-based scaffolds. *Educational Technology Research and Development, 58*, 285-309.

[2]   Branson, M. S. (1989). *International and Citizen Education: Need and Nexus*. Paper presented at the International Conference on Constitutional Government and Development of an Enlightened Citizenry.

[3]   de Freitas, S., & Griffiths, M. (2008). The convergence of gaming practices with other media forms: what potential for learning? A review of the literature. *Learning, Media and Technology, 33*(1), 11-20.

[4]   Facer, K., Joiner, R., Stanton, D., Reid, J., Hull, R., & Kirk, D. (2004). Savannah: mobile gaming and learning? *Journal of Computer Assisted Learning, 20*, 339-409.

[5]   Fincham, D. (2007). Citizenship and Personal, Social and Health Education in Catholic Secondary Schools: Stakeholders' Views. *Pastoral Care in Education, June*, 22-30.

[6]   Hiestand, E. (2002). *Writing in a Personal Voice*. Paper presented at the Nieman Narrative Journalism Conference.

[7]   Hildmann, H., & Hildmann, J. (2009). *A Critical Reflection on the Potential of Mobile Device Based Tools to Assist in the Professional Evaluation and Assessment of Observable Aspects of Learning or (Game) Playing*. Paper presented at the European Conference on Games Based Learning.

[8]   Johnson, R.L., Penny, J., Gordon, B., Shumate, S.R., & Fisher, S.P. (2005). Resolving score differences in the rating of writing samples: Does discussion improve the accuracy of scores? *Language Assessment Quarterly, 2*(2), 117-146.

[9]   Kaufman, P. (2008). Teaching Note: Gaining Voice through Silence. *Feminist Teacher, 18*(2), -171.

[10]   Klopfer, E., Perry, J., Squire, K., & Jan, M.-f. (2005). *Collaborative learning through augmented reality role playing*. Paper presented at the Computer Supported Collaborative Learning, Taipei, Taiwan.

[11]   Lambert, N., & McCombs, B. (2000). Introduction: Learner-centered schools and classrooms as a direction for school reform. In N. Lambert & B. McCombs (Eds.), *How students learn* (pp. 1-15). Washington D.C.: American Pyschological Association.

[12]   McLoughlin, C., & Lee, M. J. W. (2008). The Three P's of Pedagogy for the Networked Society: Personalization, Participation, and Productivity. *International Journal of Teaching and Learning in Higher Education, 20*(1).

[13]   Naismith, L., & Corlett, D. (2006). *Reflections on Success: A retrospective of the mLearn conference series 2002-2005*. Paper presented at the mLearn 2006. from http://hal.archives-ouvertes.fr/docs/00/19/73/66/PDF/Naismith-Corlett-2006.pdf

[14]   Norris, C., & Soloway, E. (2009). Leadership + Mobile technologies = Educational benefits: Cell phones in K12 are inevitable. *District Administration, October*, 28-28.

[15]   O'Malley, C., Vavoula, G., Glew, J. P., Taylor, J., Sharples, M., & Lefrere, P. (2003). Guidelines for learning/teaching/tutoring in a mobile environment [Electronic Version], from http://www.mobilearn.org/download/results/guidelines.pdf

[16]   Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile learning: Structures, agency, practices*. New York, NY: Springer.

[17]   Petrova, K., & Li, C. (2009). Focus and Setting in Mobile Learning Research: A Research of the Literature. *Communications of the IBIMA, 10*, 219-226.

[18]   Sharples, M. (2006). Big Issues in Mobile Learning: Report of a workshop by the Kaleidoscope Network of Excellence Mobile Learning Initiative. [Electronic Version], from http://www.lsri.nottingham.ac.uk/msh/Papers/BIG_ISSUES_REPORT_PUBLISHED.pdf

[19]   Squire, K., & Jan, M.-f. (2007). Mad city mystery: Developing scientific argumentation skills with a place-based augmented reality game on handheld computers. *Journal of Science Education and Technology, 16*(1), 5-29.

[20]   Squire, K., & Klopfer, E. (2007). Augmented reality simulations on handheld computers. *Journal of the Learning Sciences, 16*(3), 371-413.