Cultural implications in the acceptability of game-based learning

Supplementary Material

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1   Games and Culture Survey Items

Questions 21-24 are obtained from a Pew Research Center questionnaire (Duggan, 2015). These questions provide a general outlook on how participants view gaming in general. Questions 20, 25, and 45 were created by our research team and were inspired by the subjective norms portion of the technology acceptance model (Davis, 1989). These questions aim to understand how the subjective norms of a culture can impact the adoption and view of gaming. Questions 26-44 and 46-48 are modified from the Bourgonjon et al. (2010) study on student perception of video games in the classroom. These questions provide insight on how students may perceive the ease of use of a serious game; the questions were modified to better suit the target audience of university students. All remaining questions were created by the research team to obtain specific demographic and culturally relevant information.

1.1   Demographics

1. What year were you born? [enter number value]
2. What is your gender?
   - Male
   - Female
   - Non-binary
   - Other
   - Prefer not to disclose
3. What is your level of education?
   - First year
   - Second year
   - Third year
   - Fourth year
   - Post-graduate
   - High-School
   - Other
4. What is your major area of study? [drop-down menu of options offered by University]
5. Were you born in Canada?
   - Yes
   - No
6. If no, in what year did you move to Canada? [enter number value]

   [note that proportion of life lived in Canada was calculated based on #1, 5, and 6]

7. What is the language that you first learned in childhood and still understand?
   - English
   - French
   - Arabic
   - Chinese
   - German
   - Italian
   - Korean
   - Persian (Farsi)
   - Polish
   - Portuguese
   - Punjabi
   - Russian

- Spanish
- Tamil
- Tagalog
- Urdu
- Hindi
- Vietnamese
- Other

8. Do you consider yourself part of Canadian culture?
    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

9. Apart from being Canadian, many of us have a relationship to other communities in which our families once lived. Which, if any, of the following communities do you consider yourself a part of? (Please check all that apply.)
    - English Canadian
    - French Canadian
    - French
    - British/Irish/Scottish/Welsh (UK)
    - American (USA)
    - European (other than French or British)
    - East Asian (Chinese, Korean, Japanese, etc.)
    - South Asian (Indian, Sri Lankan, Pakistani, etc.)
    - African
    - South American/Central American
    - West Indian/Caribbean
    - Middle Eastern (Arab, Israeli, Iranian, Lebanese, etc.)
    - Aboriginal/First Nations
    - Other (please specify): _____
    - Prefer not to answer

10. Do you consider your parents part of Canadian culture?
    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

11. Apart from being Canadian, many of us have a relationship to other communities in which our families once lived. Which, if any, of the following communities do you consider your parents a part of? (Please check all that apply.)
    - English Canadian
    - French Canadian
    - French
    - British/Irish/Scottish/Welsh (UK)
    - American (USA)
    - European (other than French or British)
    - East Asian (Chinese, Korean, Japanese, etc.)
    - South Asian (Indian, Sri Lankan, Pakistani, etc.)
    - African
    - South American/Central American

- West Indian/Caribbean
- Middle Eastern (Arab, Israeli, Iranian, Lebanese, etc.)
- Aboriginal/First Nations
- Other (please specify): _____
- Prefer not to answer

1.2 Exposure to and views on gaming

For the following statements below please select the response that you most agree with.

	Never	Very Seldom	About Once a Month	Several Times a month	About Once a Week	Several Times a Week	Every-day
12. How often do you usually play console or computer games?	1	2	3	4	5	6	7
13. How often do you usually play mobile or social media games (e.g. Farmville, CandyCrush)	1	2	3	4	5	6	7
14. As a child (before the age of 13), how often do you remember playing video/computer/mobil egames?	1	2	3	4	5	6	7
15. As a teenager (13-17 years of age), how often do you remember playing video/computer/mobil e games?	1	2	3	4	5	6	7

16. Are you/were you a member of a gaming club?
   - Yes
   - No
17. Do you prefer to play singe player or multiplayer games?
   - Single Player
   - Multiplayer
   - No Preference
18. Would you rather play a video game that emphasizes exploration or has a clear set of objectives?
   - Exploration
   - Clear set of objectives

- Prefer both equally

How strongly do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
19. I feel lost when directions are not directly accessible in video games.	1	2	3	4	5
20. I am ashamed of playing games	1	2	3	4	5
21. Video games are a waste of time	1	2	3	4	5
22. Video games help develop problem solving skills	1	2	3	4	5
23. Video games promote teamwork and communication	1	2	3	4	5
24. Video games promote violent behaviour	1	2	3	4	5
25. There is a negative stigma surrounding gaming culture	1	2	3	4	5
26. I like playing video games	1	2	3	4	5
27. I often play video games	1	2	3	4	5
28. Compared to people of my age, I play a lot of video games	1	2	3	4	5
29. I play different types of video games	1	2	3	4	5
30. I consider myself to be a gamer	1	2	3	4	5

1.3 Views on Game-Based Learning

How strongly do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
31. Using video games as supplementary material in a course would improve my performance	1	2	3	4	5
32. Using video games as supplementary material in a course would increase my learning productivity	1	2	3	4	5

33. Using video games as supplementary material in a course would enhance my effectiveness	1	2	3	4	5
34. Using video games as supplementary material in a course would help me to achieve better grades	1	2	3	4	5
35. I would know how to handle video games as supplementary material in a course	1	2	3	4	5
36. It would be easy to for me to use video games as supplementary material in a course	1	2	3	4	5
37. My use of video games in the course would be clear and understandable	1	2	3	4	5
38. Video games offer opportunities to experiment with knowledge	1	2	3	4	5
39. Video games offer opportunities to take control over the learning process	1	2	3	4	5
40. Video games offer opportunities to experience things you learn about	1	2	3	4	5
41. Video games offer opportunities to stimulate transfer between various subjects	1	2	3	4	5
42. Video games offer opportunities to interact with other students	1	2	3	4	5
43. Video games offer opportunities to think critically	1	2	3	4	5
44. Video games offer opportunities to motivate students	1	2	3	4	5
45. My parents would approve the use of video games in a course	1	2	3	4	5
46. If I had the choice, I would choose to follow courses in which video games are used	1	2	3	4	5
47. If I had to vote, I would vote in favor of using video games in a course	1	2	3	4	5

48. I am enthusiastic about using video games in a course	1	2	3	4	5

2 CATPCA #1 detailed results

Table SM 1. Component loadings for 1st 2-Dimensional CATPCA.

Variable	Dimension 1	Dimension 2
If I had to vote, I would vote in favor of using video games in a course	.820	-.256
Using video games as a supplementary material in a course could improve my performance	.817	-.280
It would be easy to for me to use video games as a supplementary material in a course	.814	-.171
Using video games as a supplementary material in a course could increase my learning productivity	.813	-.342
Using video games as a supplementary material in a course could help me to achieve better grades	.813	-.355
Using video games as a supplementary material in a course could enhance my learning effectiveness	.811	-.369
I am enthusiastic about using video games in a course	.797	-.253
I would know how to handle video games as a supplementary material in a course	.781	-.189
If I had the choice, I would choose to enroll in courses in which video games are used	.780	-.222
Video games offer opportunities to experience things you learn about	.752	-.214
Video games offer opportunities to take control over the learning process	.752	-.218
Video games offer opportunities to experiment with knowledge	.742	-.075
Video games offer opportunities to stimulate transfer between various subjects	.740	-.190
Video games offer opportunities to motivate students	.737	-.288
I understand how I could use video games as a supplementary material in a course	.734	-.294
Video games offer opportunities to think critically	.682	-.120
Video games offer opportunities to interact with other students	.680	-.109
I like playing video games	.670	.495
I often play video games	.650	.592
I play different types of video games	.587	.485
Video games promote teamwork and communication	.562	.156
As a teenager (13-17 years of age), how often do you remember playing video/computer/mobile games?	.515	.511
Video games help develop problem solving skills	.481	.143
My parents would approve the use of video games in a course	.479	-.214
Video games are a waste of time	-.459	-.384

	Dimension 1	Dimension 2
As a child (before the age of 13), how often do you remember playing video/computer/mobile games?	.385	.292
I am ashamed of playing video games	-.311	-.261
How often do you usually play mobile or social media games (e.g. Candy crush, Farmville)	.303	.160
There is a negative stigma surrounding gaming culture	.198	.001
I consider myself to be a gamer	.579	.627
How often do you usually play console or computer games?	.566	.603
Compared to people of my age, I play a lot of video games	.539	.560
Video games promote violent behaviour	-.335	-.463
I feel lost when directions are not directly accessible in video games.	-.231	-.409
Canadian cultural identity (ordinal)	.209	.230
Proportion of life lived in Canada (Years Lived In Canada/Age*100) %	.045	.199
Canadian cultural identity of parents (ordinal)	.141	.162

Table SM 2. Mean centroid coordinates of variables with values below 0.100 from 1st 2-Dimensional CATPCA, which were then omitted from 2nd 2-Dimensional CATPCA.

	Centroid Coordinates		
Variable	**Dimension 1**	**Dimension 2**	**Mean**
I am ashamed of playing video games	.104	.092	.098
How often do you usually play mobile or social media games (e.g. Candy Crush, Farmville)	.095	.042	.068
There is a negative stigma surrounding gaming culture	.045	.011	.028
Canadian cultural identity (ordinal)	.047	.057	.052
Proportions of life lived in Canada (Years Lived in Canada/Age*100)	.065	.103	.084
Canadian cultural identity of parents (ordinal)	.025	.031	.028

3   CATPCA #2 (final) detailed results

Table SM 3. Final component loadings for 2nd 2-Dimensional CATPCA.

Variable	**Dimension 1**	**Dimension 2**
If I had to vote, I would vote in favor of using video games in a course	.824	-.242
Using video games as a supplementary material in a course could improve my performance	.823	-.258
Using video games as a supplementary material in a course could help me to achieve better grades	.821	-.335
Using video games as a supplementary material in a course could increase my learning productivity	.820	-.321

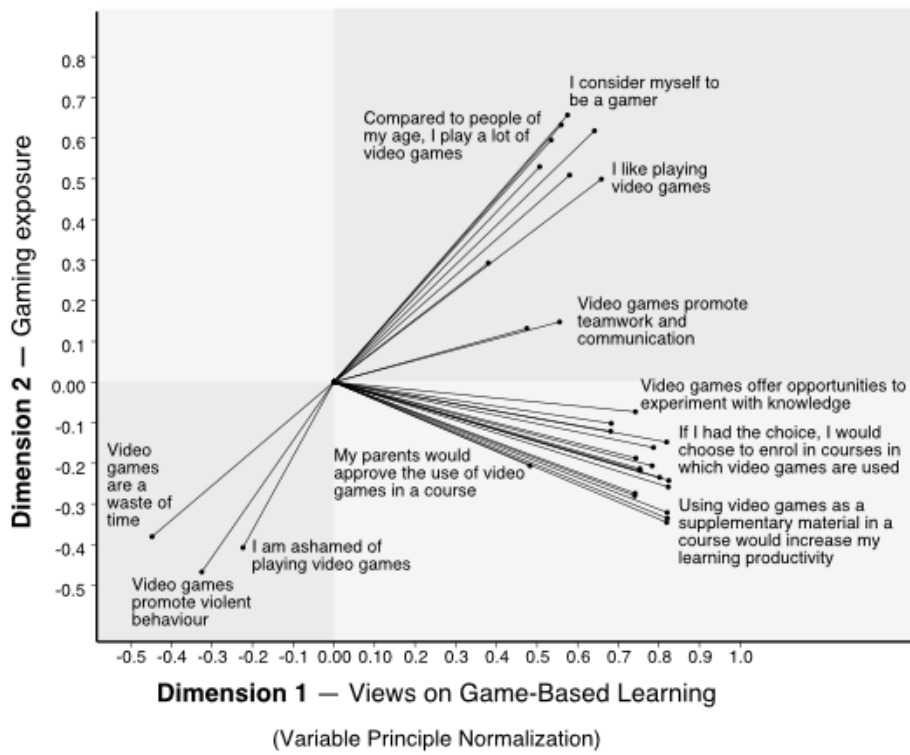|		
It would be easy for me to use video games as a supplementary material in a course	.819	-.147
Using video games as a supplementary material in a course could enhance my learning effectiveness	.819	-.345
I am enthusiastic about using video games in a course	.802	-.234
I would know how to handle video games as a supplementary material in a course	.787	-.161
If I had the choice, I would choose to enroll in courses in which video games are used	.783	-.206
Video games offer opportunities to take control over the learning process	.754	-.218
Video games offer opportunities to experience things you learn about	.753	-.213
Video games offer opportunities to stimulate transfer between various subjects	.743	-.187
Video games offer opportunities to experiment with knowledge	.742	-.073
Video games offer opportunities to motivate students	.741	-.274
I understand how I could use video games as supplementary material in a course	.740	-.280
Video games offer opportunities to interact with other students	.683	-.102
Video games offer opportunities to think critically	.681	-.121
I like playing video games	.659	.499
I often play video games	.641	.618
I play different types of video games	.580	.509
Video games promote teamwork and communication	.556	.148
My parents would approve the use of video games in a course	.483	-.206
Video games help develop problem solving skills	.475	.132
Video games are a waste of time	-.448	-.380
As a child (before the age of 13), how often do you remember playing video/computer/mobile games?	.380	.293
I consider myself to be a gamer	.575	.657
How often do you usually play console or computer games	.560	.633
Compared to people of my age, I play a lot of video games	.535	.595
As a teenager (13-17 years of age), how often do you remember playing video/computer/mobile games?	.507	.530
Video games promote violent behaviour	-.325	-.467
I feel lost when directions are not directly accessible in video games.	-.224	-.407

Figure SM 1. Coordinates of Items Relative to Dimension 1 (Views on Game-Based Learning) and Dimension 2 (Gaming Exposure) for Final CATPCA Run.

4 Participant demographics

Table SM 4. Participant Characteristics Related to Cultural Background.

Participant characteristic	N	%
A. Self-identify as "Culturally Canadian"*		
Strongly disagree	13	2.7
Disagree	36	7.4
Neither agree nor disagree	111	22.7
Agree	204	41.7
Strongly agree	125	25.6
B. Identify parents as "Culturally Canadian"		
Strongly disagree	73	14.9
Disagree	143	29.2
Neither agree nor disagree	118	24.1
Agree	104	21.3
Strongly agree	51	10.4
C. English-speaking fluency		
Native English-speakers	325	66.5
Non-native English-speakers (fluent in English)	154	31.5
Non-native English-speakers (not fluent)	10	2.0
D. Cultural group association**		
English Canadian	112	22.9
French Canadian	13	2.7
American	10	2.0
Aboriginal/First Nations	2	0.4
South/central American & Caribbean	53	10.8
French	5	1.0
British/Irish/Scottish/Welsh (UK)	11	2.2
European (other than French or UK)	70	14.3
East Asian	53	10.8
South Asian	193	39.5
Southeast Asian	30	6.1
Middle Eastern	69	14.1
African	26	5.3
E. Identification with one or more cultural groups		
No association	7	1.4
Only one cultural group	339	69.3
Two cultural groups	116	23.7
Three or more cultural groups	24	4.9
Prefer not to disclose	3	0.6

* This variable (#8 in SM Section 1) was chosen to represent the Canadian Cultural Identity dimension in our inferential statistics.

** Participants may associate with more than one cultural group; therefore, the percentages will add to greater than 100%.

5 Median responses to Likert-scale survey items

Table SM 5. Medians and interquartile ranges for Likert-scale survey items used in CATPCA.

Participant characteristic	Median	IQR
12. How often do you usually play console or computer games? *	2	4
13. How often do you usually play mobile or social media games (e.g. Farmville, CandyCrush) *	3	4
14. As a child (before the age of 13), how often do you remember playing video/computer/mobilegames? *	6	3
15. As a teenager (13-17 years of age), how often do you remember playing video/computer/mobile games? *	5	3
19. I feel lost when directions are not directly accessible in video games.	3	2
20. I am ashamed of playing games	2	1
21. Video games are a waste of time	3	1
22. Video games help develop problem solving skills	4	1
23. Video games promote teamwork and communication	4	1
24. Video games promote violent behaviour	3	1
25. There is a negative stigma surrounding gaming culture	4	1
26. I like playing video games	4	2
27. I often play video games	2	2
28. Compared to people of my age, I play a lot of video games	2	2
29. I play different types of video games	3	2
30. I consider myself to be a gamer	2	2
31. Using video games as supplementary material in a course would improve my performance	4	1
32. Using video games as supplementary material in a course would increase my learning productivity	4	1
33. Using video games as supplementary material in a course would enhance my effectiveness	4	1
34. Using video games as supplementary material in a course would help me to achieve better grades	3	1
35. I would know how to handle video games as supplementary material in a course	4	1
36. It would be easy to for me to use video games as supplementary material in a course	4	1
37. My use of video games in the course would be clear and understandable	4	2
38. Video games offer opportunities to experiment with knowledge	4	1
39. Video games offer opportunities to take control over the learning process	4	1
40. Video games offer opportunities to experience things you learn about	4	1
41. Video games offer opportunities to stimulate transfer between various subjects	4	1
42. Video games offer opportunities to interact with other students	4	1
43. Video games offer opportunities to think critically	4	1
44. Video games offer opportunities to motivate students	4	1
45. My parents would approve the use of video games in a course	3	1
46. If I had the choice, I would choose to follow courses in which video games are used	4	1
47. If I had to vote, I would vote in favor of using video games in a course	4	1
48. I am enthusiastic about using video games in a course	4	1

IQR = interquartile range
Median is from a range from 1 (strongly disagree) to 5 (strongly agree), unless *, which range from 1 (never) to 7 (everyday)

6 Regression assumption testing: Analysis 1

Table SM 6. Shapiro-Wilk test of normality on standardised residuals outputted from first hierarchical regression model (manuscript Section 4.2).

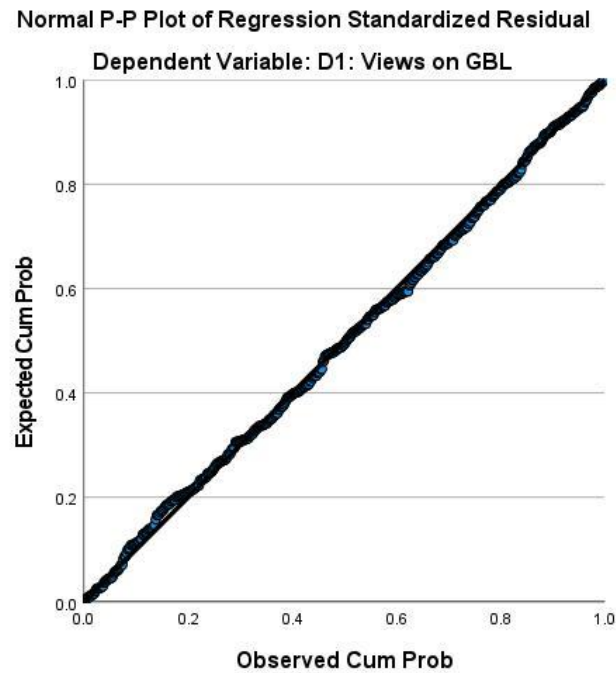|	**Shapiro-Wilk stat**	**df**	**p**
Standardized residual	0.998	483	.767

Figure SM 2. Normality plot outputted from first hierarchical regression model (manuscript Section 4.2).
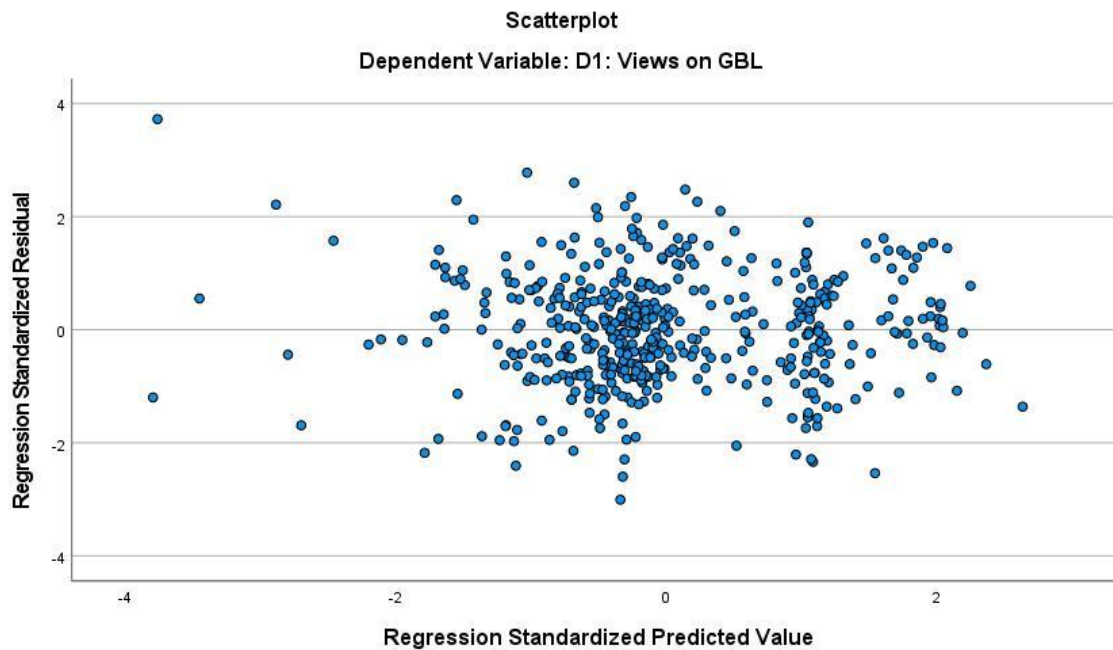

Figure SM 3. Homoscedasticity plot outputted from first hierarchical regression model (manuscript Section 4.2).

7 Regression assumption testing: Analysis 2

Table SM 7. Shapiro-Wilk test of normality on standardised residuals outputted from second hierarchical regression model (manuscript Section 4.3).

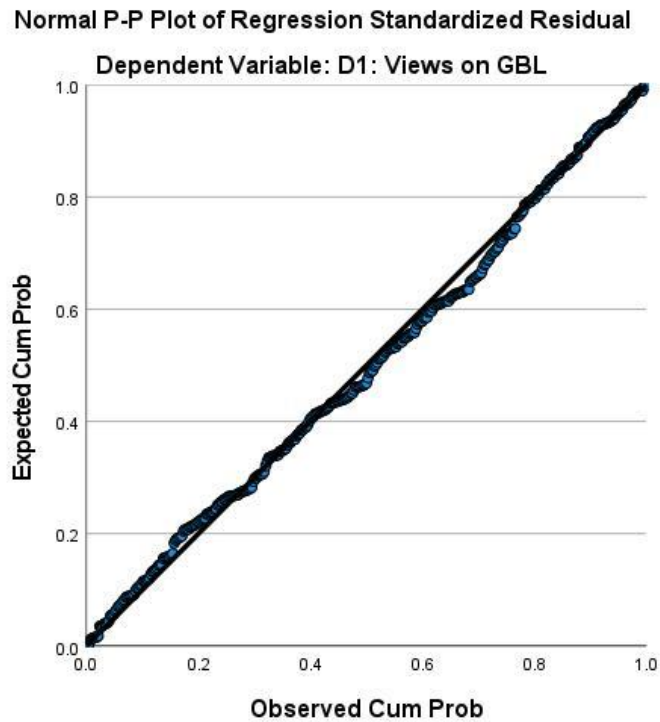|	Shapiro-Wilk stat	df	p
Standardized residual	0.997	361	.704

Figure SM 4. Normality plot outputted from second hierarchical regression model (manuscript Section 4.3).
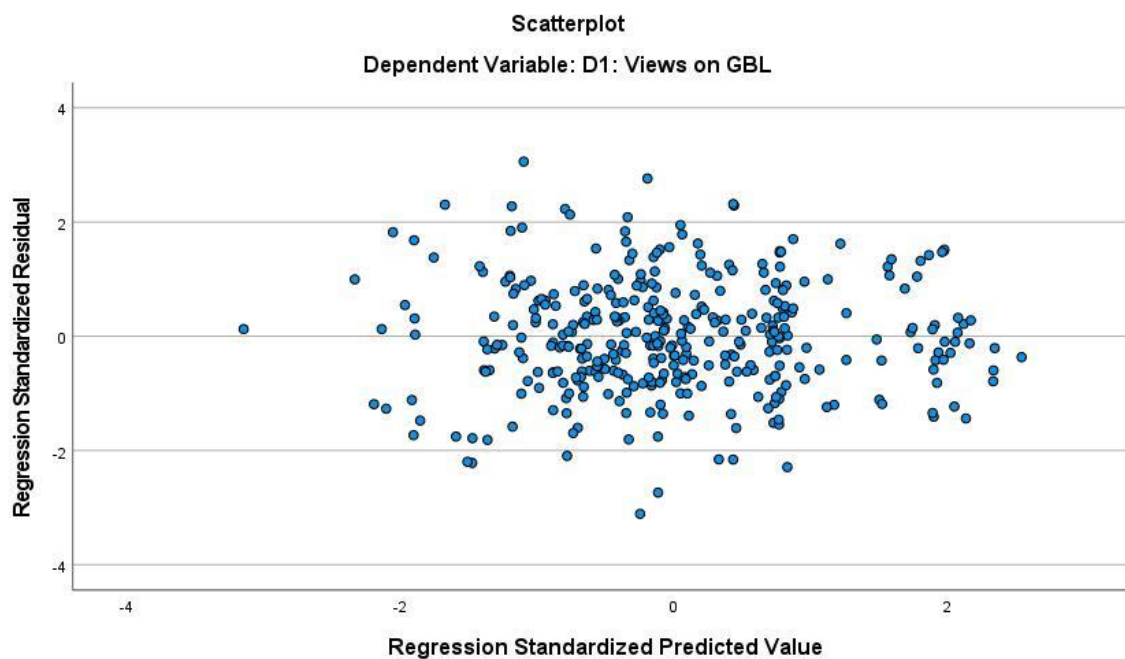

Figure SM 5. Homoscedasticity plot outputted from second hierarchical regression model (manuscript Section 4.3).

8 Pairwyise comparisons (Analysis 2, Part B)

Table SM 8. Estimated marginal mean of views on game-based learning by cultural association.

Cultural Association	Mean	Standard Error	95% CI Lower Bound	95% CI Upper Bound
North American (English, French, Native American, U.S.)	.00	.07	-.13	.14
European and British	-.20	.05	-.29	-.11
East Asian	.37	.06	.26	.48
South Asian	-.10	.03	-.16	-.05
Middle Eastern	-.04	.05	-.15	.07

Table SM 9. Bonferroni-adjusted pairwise comparisons of cultural associations on views of game-based learning.

(I) Cultural Association	(J) Cultural Association	Mean Difference (I-J)	Standard Error	Sig[b]	95% CI Lower Bound	95% CI Upper Bound
North American (English, French, Native American, U.S.)	European and British	.20	.08	.167	-.03	.43
	East Asian	-.37*	.09	.000	-.62	-.12
	South Asian	.10	.07	1.000	-.11	.31
	Middle Eastern	.04	.09	1.000	-.20	.29
European and British	North American	-.20	.08	.167	-.43	.03
	East Asian	-.57*	.07	.000	-.77	-.36
	South Asian	-.10	.05	.808	-.25	.06
	Middle Eastern	-.16	.07	.306	-.36	.05
East Asian	North American	.37*	.09	.000	.12	.62
	European and British	.57*	.07	.000	.36	.77
	South Asian	.47*	.06	.000	.29	.65
	Middle Eastern	.41*	.08	.000	.19	.63
South Asian	North American	-.10	.07	1.000	-.31	.11
	European and British	.10	.05	.808	-.06	.25
	East Asian	-.47*	.06	.000	-.65	-.29
	Middle Eastern	-.06	.06	1.000	-.24	.11
Middle Eastern	North American	-.04	.09	1.000	-.29	.20
	European and British	.16	.07	.306	-.05	.36
	East Asian	-.41*	.08	.000	-.63	-.19
	South Asian	.06	.06	1.000	-.11	.24

*The mean difference is significant at the .05 level.
b. Adjusted for multiple comparisons: Bonferroni

9 References

Bourgonjon, J., Valcke, M., Soetaert, R., & Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. *Computers & Education*, *54*(4), 1145–1156. https://doi.org/10.1016/j.compedu.2009.10.022

Davis, F. (1989). Perceived Usefulness, Perceived Ease Of Use, And User Accep. *MIS Quarterly*, *13*(3), 319. https://doi.org/10.2307/249008

Duggan, M. (2015). Gaming and Gamers. *Pew Research Center*, (December), 1–22.