

Gamification of Online Education: Graduate Level Course in Health Informatics

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ABSTRACT

Objective: This pilot project experimented with using a gamified learning experience (video game) to measure graduate health informatics students' understanding of primary and secondary sources after completion of online, video instruction and Blackboard discussion board activities.

Methods: The research team focused on a single, course learning objective: identifying primary and secondary sources. Students in an online, informatics course completed a Pre-Test, learning module consisting of a video and discussion boards, educational game, qualitative survey, and a Post-Test.

Results: Students showed significant improvement from Pre-Test to Post-Test. The game scoring proved to be difficult to analyze precisely as an assessment tool, but the qualitative survey on students' experience with the embedded librarian and the game was positive and provided the authors with valuable input on improving the course content and game experience.

Conclusion: Librarians with complimentary skill sets embedded in online courses can assist professors with bringing new teaching methods and technology to engage students. Our students appreciated the teaching module in video format and thought that the game enhanced their learning experience. The authors learned that the students were the most highly motivated by the competition aspect of the game including the ability to improve their score and to compete against a time limit.

Keywords: Video Games, Embedded Librarians, Gamification, Assessment, Distance Learning, Informatics Education, Medical School Education, Higher Education

INTRODUCTION

The use of video games to enhance student learning has been widely accepted in primary and secondary schools. However, higher education environments have been slow in adopting video games and gamification elements into course content. Numerous studies have measured the empirical evidence to show that games improve primary school student learning (1).

METHODS

The University of Tennessee Health Science Center in Memphis includes six colleges: Medicine, Nursing, Dentistry, Pharmacy,

Graduate Health Sciences, and Health Professions. The College of Health Professions includes the Health Informatics and Information Management (HIIM) Department which provides graduate, CAHIIM-accredited health informatics programs taught completely online via the Blackboard learning management system. The participants of this study were 24 students enrolled in Dr. Sajeesh Kumar's *Concepts of Research Methodology* class during the Fall semester 2016. Students completed learning modules and played the video game, which consisted of 15% of their overall grade in the course. The authors, two librarians in the Research & Learning Department, and the

informatics professor, collaborated over several months and had five meetings to discuss course content, learning assessments, and the focus of the course module and game. The authors decided to create a module on identifying primary and secondary sources and to utilize a video game to assess students' learning after an initial lesson on primary and secondary sources. An IRB proposal was submitted to our institution's IRB committee and was approved.

The students in the course were asked to complete a Pre- and Post-Test measuring both their knowledge of the meaning of primary and secondary sources and their ability to determine whether a source is a primary or secondary one. The pre- and post-tests consisted of ten multiple choice questions. The majority of the test questions provided the students with part of an article abstract, and based on the information given, the student had to determine whether the source was primary or secondary.

Lesson Modules

After completing the pre-test, students viewed the *Primary and Secondary Sources in Science Research* video embedded in a course-level Lib Guide during Weeks One to Two of the course. The video created by the embedded librarian, consisted of definitions and examples of primary and secondary sources, an introduction to the hierarchy of evidence, and then provided tips on identifying primary and secondary sources by examining examples in the form of PubMed article abstracts.

Students then completed a discussion board task that asked them to find a primary source using PubMed and to explain how they knew the article was a primary source using evidence from the video lecture. During Week 3, students were given an article on an informatics topic and were asked to determine whether the article was a primary or secondary source. They were asked to identify the part of the article that helped them make the primary or second determination and to explain their answer by citing evidence from the provided article. The embedded librarian provided students with individual feedback on their responses within the discussion board modules.

Video Game Creation and Implementation

My librarian co-author created a video game titled *Pub Wizard Episode 1: Quest for the Source Type* using C# programming in the Unity game development environment. Additionally, they created the game graphics and animation using Photoshop and Spriter Pro., . Students

played the game during Week Six after completion of the Primary and Secondary learning modules and before taking the Post-Test. The game has two modules. Module 1 gave students a source type and asked them whether it was primary or secondary. Module 2 gave them a source citation and asked them whether it was primary or secondary. In order to complete the game students were asked to play both modules until they got enough correct answers to fill an in-game progress bar up to five and received a "green check" for both modules. These instructions were included within Blackboard as well as in the game itself. Students were also told that they could play the game as much as they wanted. Upon completion, the game directed students to a short, anonymous, Qualtrics qualitative survey. Students then completed the ten-question Primary & Secondary Post-Test.

RESULTS

Pre- and Post-Test

Of 18 students who completed both the Pre- and Post-Tests, the average score on the Pre-Test was seven out of ten. Six of 24 students' scores were not included in the results because 6 students did not complete both the pre- and post-tests.

The analysis of 18 individual, student scores showed that 13 of 18 students improved their scores from Pre- to Post-Test. Seven students improved their score by one or two points, and five students improved their score by three or four points. One student improved from a three out of ten to a nine out of ten, showing a significant 6-point improvement after completion of the learning modules. Finally, two students got the same score on both tests and only one student had a lower score of minus one.

Qualitative Survey

The qualitative survey was designed to measure students' experiences with playing the game and with their overall satisfaction with their experiences with having a librarian embedded in their course. This survey was completed by 19 of 24 students. Most students reported that they had at least some experience with playing videogames with only 26% describing themselves as regular recreational video game players. The majority of students (63%) responded that they "played video games occasionally but not regularly (Figure 1)." The authors asked students to rank online learning methods in order of their preferences (Figure 2).

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By “learning methods” in this scenario, the authors are referring to the students’ online learning preference as far as the delivery or format of course content. The online informatics course did not include Power Points with audio

or live videoconferencing. YouTube videos, like the Primary and Secondary video created by the embedded librarian, were ranked as the most preferred learning method by the students.

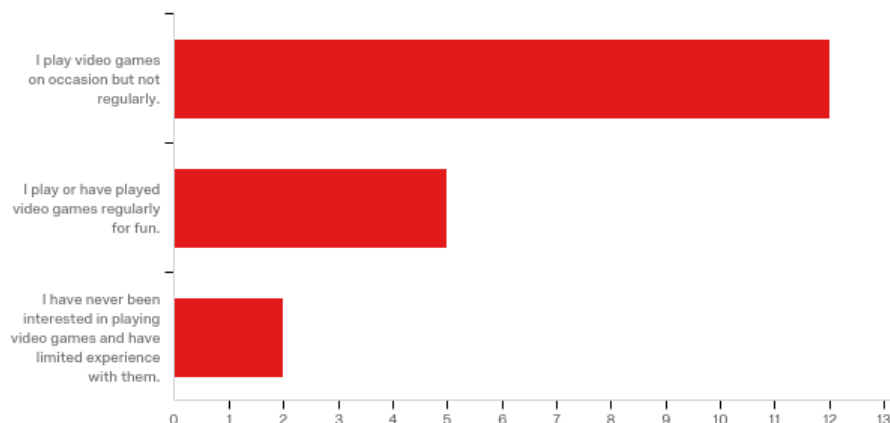


Figure 1. Which of these choices best describes your video game experience?

Video games and simulations were ranked as the preferred online learning method by 26% of the respondents. It is notable that students appear to prefer online learning methods that are both visual and auditory since 62% of the students chose either *YouTube videos* or *Power Points with audio* as their second favorite online learning modality. *PowerPoint slides only* was the least favorite online learning method

although students may have interpreted this response to mean that the online environment would *only* consist of Power Points with no other options or that *PowerPoint Slides only* meant slides without any audio/other enhancements. No matter how this wording was interpreted by the students, it suggests that students would prefer more engaging content than the “static” nature of PowerPoint slides.

Table 1. Rank these in the order (1-6) of your online learning preferences (1 most preferred learning method to 6 least preferred learning method).

LEARNING METHODS	1		2		3		4		5		6		Total
PowerPoint slides only	10.53%	2	10.53%	2	15.79%	3	10.53%	2	10.53%	2	42.11%	8	19
PowerPoint with audio	15.00%	3	30.00%	6	25.00%	5	5.00%	1	20.00%	4	5.00%	1	20
discussion boards	5.26%	1	0.00%	0	15.79%	3	36.84%	7	21.05%	4	21.05%	4	19
YouTube videos	36.84%	7	31.58%	6	15.79%	3	10.53%	2	5.26%	1	0.00%	0	19
video games or simulations	26.32%	5	10.53%	2	15.79%	3	10.53%	2	21.05%	4	15.79%	3	19
videoconferences (live or archived group audio/video meetings)	15.79%	3	10.53%	2	21.05%	4	21.05%	4	21.05%	4	10.53%	2	19

Students also provided feedback related to online learning preferences (format) in an open-ended question asking about whether or not the librarian’s role was helpful:

“The videos were extremely helpful! I don’t think I had as great use of her [the embedded librarian] as I should have, but her videos were very, very good and informative.”

“The videos introducing Primary and Secondary sources were extremely helpful.”

The authors were interested in learning which aspects of the game that students found most

engaging and ways the game could be made more engaging for future students. Students ranked *improving your score* as the most engaging aspect of the game followed by: *use of humor, time limit, sound effects/music, graphics/images, and game mechanics (drag & drop interface)*. The least engaging aspect was the *story/narrative* which consisted of a wizard/doctor character who needed certain types of sources to defend himself against an evil skeleton monster. Students were also asked how the game could be more engaging or

relevant. Four students responded “none” or the equivalent, and one student responded, “I think it is very engaging!” Students provided the following ways to make the game more engaging:

“Make it easier to view the available Runes [answer choices]. Clicking and closing each one became repetitive.”

“Different levels and different obstacles you'd have to face in order to win”

“I think the game could give a brief narrative as to why the answer was wrong. Even though I may get quite a few incorrect, seeing a pop up of why my selection was incorrect will help me remember and learn more.”

“More examples rather than the same ones over and over.”

“Less annoying audio”

“Give a little more time to read the citations.”

Embedded Librarian Feedback

Students provided more praise than criticism of the embedded librarian's role in the course. Student were asked:

Was the librarian's role (mainly the discussion boards and primary/secondary lesson) in this course helpful? Please provide your honest feedback and suggestions for the embedded librarian.

Praise for the embedded librarian consisted of the following comments:

“Yes, I appreciate all of the information the librarian has provided. It has helped a lot!”

“Yes. I loved our librarian!”

“Yes, it is great to have a librarian in the course. She provided so much information and has been very resourceful.”

Students also provided some constructive criticism for the embedded librarian. Although all assignments and due dates were noted in the course syllabus, some students were confused as to where to find assignments because assignments were also listed in online format within course tabs:

“Her involvement was very helpful. I found the discussion boards and searches beneficial. The only negative feedback was that having two different people assigning things made it difficult to know where to look for all assignments.”

One student commented on the timing of the primary and secondary sources lesson:

“Yes, I think it would be more applicable earlier in the semester [program?], though. It would be nice to have that reinforcement right after studying it.”

The students enrolled in this particular course were at all different stages of the informatics program from just getting started with their degree to being almost finished with the program and in the process of writing their master's thesis. Since the primary/secondary modules started during Week 1 of the online course, the authors may speculate that the student meant “program” instead of “semester.”

Game Scores

Twenty-five students were given access to the Pub Wizard game in order to assess their knowledge of primary and secondary Sources. The game statistics module recorded 27 unique play sessions of the game during the time period it was made available. This shows that at least two students came back and played the game a second time after their initial play through. Since each play through was anonymous, it is difficult to determine how many sessions were repeat sessions.

A successful game session included the completion of both the Source Type (ST) module and the Citation Identification (CI) module. The Source Type module gave the students three different source types (e.g. a case study, literature review, and treatment guidelines) and then asked them to choose either a primary or a secondary source from these 3 choices. For example in round 1 of the ST module the “doctor wizard” character needed a primary source to avoid falling victim to the antagonist, an evil skull monster, that would destroy the amiable wizard if the timer ran out before the player dragged and dropped the correct source (e.g. case study, in this scenario) into the “magic spell” book and then clicked cast spell. The Citation Identification module was essentially the same except it gave students 3 real citation abstracts to identify as either primary or secondary sources, rather than just source types.

The Source type module was played 35 times. The citation identification module was played 26 times. The ST module was located on the left-hand side of the screen so it may have been perceived as the first module so that may be the reason it was played more times than the CI module. Of those who played the game, on

average they played 2.26 modules. (Students were allowed to repeat modules to try to improve your score). On the high end, one user played seven modules and on the low end four

users only played one module. Not surprisingly, the students scored better on the Source Type module than the Citation Identification module.



Figure 2. *Pub Wizard Episode 1: Quest for the Source Type*

A progress meter appeared to players to show them whether or not the module was completed. They had to fill the progress meter to five by answering questions correctly to progress. Each correct answer added one point to the progress meter, and each wrong answer subtracted one from the progress meter.

The average completion score for all modules was 40. The average ST score was 50 (-39 low and 203 high) and the average PS score was 28 (-90 low and 225 high). Aside from the progress meter, the user was also scored on each question. A correct answer was worth 10 points and an incorrect answer was worth -11 points.

A timer was used to determine how fast the question was answered. If the question was answered quickly a five-point bonus was added, but if it was answered too slowly, a minus five-point penalty accrued.

A perfect score would be 75 if the player got 5 right answers in a row and did it quickly, and only one student earned a perfect score.

This would also mean that the user was only shown 5 questions. If students answered incorrectly, then they would have to keep answering more questions until the progress meter was filled up to five. This allowed players to get negative scores if they consistently answered incorrectly, and four negative scores were reported. Scores higher than 75 (a perfect score) resulted when players answered some questions incorrectly but then learned from their mistakes to answer more questions correctly. Six scores reflected this scenario. The average time a student played each module was 159 seconds (2.65 minutes). The average amount of time playing the ST module was 127 seconds and the average time playing the CI module was 197 seconds. In most cases, the more time it took a student to complete the module, the lower his or her score. It was possible for players to extend their playtime by getting half the answers wrong and half the answers right. This scenario allowed players to exploit the system to keep scoring without filling the progress bar to full. The librarian/game designer knew this was

possible and left in the exploit to see if it would happen. Since six students scored over 75 (the perfect score) it can be confirmed that it did

happen, but whether it was intentional or not, can only be known by asking the students/players.

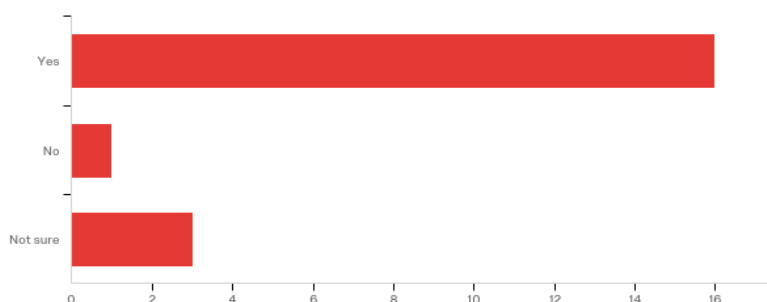


Figure 3. Did the PubWizard game help you to learn about (or reinforce your knowledge of) primary and secondary sources?

CONCLUSIONS

Use of technology in the higher education classroom can be a great way to engage students. In online learning environments, use of technology is a given, but professors often do not always have the time, technology skills, or course design skills to create the best experience for their students. Librarians, who have strong technology and course/lesson design experience, can be a great resource for professors who are looking to easily enhance their students' learning experiences. The intended purpose of this study was to use a video game to assess students' learning, but the game scoring mechanism made this a difficult, inconclusive task. However, the authors gained invaluable knowledge from the overall experience of this project and from the students' responses in the qualitative survey. Most importantly, 80% of the students of the students felt that the game helped them learn about (or reinforce their knowledge of) primary and secondary sources (Figure 4). One student also provided the following response when asked for overall feedback:

"Yes, this course has been very helpful, especially this game. This game helps reinforce the knowledge learned."

Video games are currently an under-utilized technology in higher education. , With the sheer volume of information and concepts that medical school students are required to learn,

the utilization of visual and audio engagement platforms and technologies such as YouTube, video games and gamification elements may prove beneficial, especially in relation to online medical school learning environments.

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Citation: Dr. Sajeesh Kumar et al. "Gamification of Online Education: Graduate Level Course in Health Informatics." *Research Journal of Library and Information Science*, 2(4), pp.26-31

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