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Article

Far from a Trivial Pursuit: Assessing the Effectiveness of Games in Information Literacy Instruction

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Abstract

Objective – To determine whether playing library-related online games during information literacy instruction sessions improves student performance on questionnaires pertaining to selected research practices: identifying citation types and keyword and synonym development.

Methods – 86 students in seven introductory English composition classes at a large urban university in the northeastern United States served as participants. Each class visited the library for library instruction twice during a given semester. In the experimental group students received information literacy instruction that incorporated two online games, and the control group received the same lesson plan with the exception of a lecture in place of playing games. A six-item pre- and posttest questionnaire was developed and administered at the outset and conclusion of the two-session classes. The 172 individual tests were coded, graded, and analyzed using SPSS.

Results – A paired sample t-test comparing the control and experimental groups determined that that there was a statistically significant difference between scores on pre-tests and post-tests in the experimental group but not the control group.

Conclusion – Students who played the online games improved significantly more from pre-test to post-test than students who received a lecture in lieu of playing online games, suggesting that participating in games related to the instruction they received resulted in an improved ability to select appropriate keywords and ascertain citation formats. These findings contribute to the evidence that online games concerning two frequently challenging research practices can be successfully applied to library instruction sessions to improve student comprehension of such skills.

Introduction

Information literacy instruction plays a key role in the educational mission of many academic libraries. Librarians employ a wide range of strategies for teaching members of their community regarding the many dimensions of information access and use. One such method of teaching draws upon games-based learning to achieve the fulfillment of learning outcomes and increase student engagement and motivation. In practice, games-based learning frequently consists of librarians either creating their own games, adapting existing games used by other libraries, or designing class sessions using gaming principles (gamification). As opposed to traditional instruction, games may provide students with opportunities to meaningfully engage with classmates and the instructor, participate in hands-on activities, and learn new skills using their preexisting knowledge as a basis.

Despite the ongoing popularity of games in library instruction, little research has been done on whether playing games in academic library settings may in fact translate into learning. In the present study, the authors predicted that students in the classes that incorporated games would score higher on the pre-/posttest assessment tool than students in the classes without games. In contrast, the null hypothesis was that there would be no significant differences in scores between the two groups. Using two games whose efficacy has been previously tested by their developers, this study seeks to build on this existing evidence and provide insight into the question of whether online games are a preferable method of instruction compared to lectures in terms of student comprehension of targeted concepts.

Literature Review

A review of the literature reveals that using games for information literacy instruction is increasing in terms of acceptance and popularity, but in many cases assessment beyond student interest has yet to be explored. The scholarly discourse on games as tools to improve literacy began in 2003, when Arizona State University professor James Paul Gee published his seminal monograph on games-based learning titled *What Video Games Have to Teach Us about Learning and Literacy*. Gee expounds upon the many ways in which games facilitate learning through his 36 Video Game Learning Principles, including critical learning, encouraging exploration and discovery, just-in-time learning, and utilizing active learning methods (2007). Regarding information literacy specifically, Gumulak and Webber (2011) found that the video game-playing activities of 28 teenagers closely corresponded to established information literacy models.

Gaming in libraries made a national debut at the 2005 Gaming, Learning and Libraries Symposium, where presenters from various library settings discussed how and why games

were being used in libraries (Doshi, 2006). Since the mid-2000s a significant amount of literature has been generated on the subject of games in library instruction. Though gaming-related topics such as developing video game collections and providing outreach through gaming events appear with regularity, this review will focus on games-based learning for information literacy instruction. Also important to note is that the educational literature contains a great number of studies regarding the use of educational games, and non-library educators have incorporated games into their pedagogy for a far longer time than librarians. However, for the purposes of considering only the most applicable research in terms of setting, class content, and other contextual factors, this literature review focuses on non-digital and digital game initiatives at academic libraries.

Non-Digital Games

Non-digital games have been implemented at a number of college and university libraries due to their easy-to-play nature and inherent capacity for personal engagement with others in the class. Though the authors selected to use online, digital games for the research at hand, a brief review of the use of non-digital games will help provide additional context on game-based learning in academic libraries. Leach and Sugarman (2005) note that the success of a library instruction game is dependent upon several factors, including the type of game played, the incorporation of learning outcomes, and the instructor's flexibility. The authors present best practices for designing games using their activity based on the quiz-show *Jeopardy!* as a case study. Similarly, Walker (2008) used the *Jeopardy!* format in eight one-shot sessions to reinforce concepts learned earlier in the class, reporting that students responded positively to the game. Both articles suggest that the game's highly familiar format is an important factor in student receptivity. Smith (2007) developed games such as tic-tac-toe, word searches, and crossword puzzles that used library-based terms and concepts.

Many non-digital games are developed in order to supplement or enhance library orientation sessions. Being a type of information literacy instruction that typically occurs in the first semester of a student's higher education enrolment and focuses on basic research practices, the research into the use of games in academic library orientation sessions provides useful related evidence to consider and build upon. Marcus and Beck (2003) compared a traditional orientation to one that sent freshmen on a library treasure hunt that required locating a series of clues. By conducting a brief post-orientation test the authors found that the treasure hunt received more positive student feedback than the traditional orientation and held increased educational benefits (p. 31). Thorough reviews of the many types of information literacy games, including in-person and virtual games, have been conducted by Margino (2013) and Smale (2011). Smale (2012) developed the internet resource evaluation game *Quality Counts* wherein students search for and critically evaluate websites. Survey responses indicated that players enjoyed the game and felt that their skills levels increased (p. 140).

Digital Games

Digital and online games to teach college and university students library skills appeared in the literature at an early juncture with Koelewyn and Corby's 1982 report on a computer game requiring students to use the *Reader's Guide to Periodical Literature*. In the arcade-inspired game *Citation* students were randomly assigned one of ten topics and then must construct a bibliography of a predetermined number of sources as quickly as possible using the *Reader's Guide* (p. 171). A great deal has changed technologically since Koelewyn and Corby's study, but the reasons for incorporating digital games into instruction remain the same. While at least one academic library has opted to modify an existing commercial videogame to tailor its learning objectives to their needs (Clyde & Thomas, 2008), the vast majority of libraries using digital games have developed

their own. The online board game *The Information Literacy Game* (Rice, 2008) was received positively by students, who played the game by rolling a digital die and correctly answering questions to move ahead on the board. Gallegos and Allgood (2008) describe a process that began with a board game and led to development of an online game, which ultimately indicated student receptivity to playing information literacy games.

Librarians at James Madison University created two online games to serve two distinct purposes (McCabe & Wise, 2009). Citation Tic-Tac-Toe asks players to identify the type of a given citation while playing tic-tac-toe, and Magnetic Keyword uses virtual refrigerator magnets to help students practise identifying keywords. The authors assessed each game differently, using quantitative methods for Citation Tic Tac Toe and qualitative methods for Magnetic Keyword, finding that in both cases students had increased their skill levels (p. 13). Armstrong and Georgas (2006) developed and assessed an interactive tutorial titled "Doing Research" and discerned a statistically significant difference in university student skills using a pre- and posttest questionnaire. Smith and Baker (2011) describe the impetus and development of two online games at Utah Valley University. The authors surveyed 52 students, who responded to the games' informative and entertaining nature (p. 638).

Mary Broussard (2010), a prominent researcher in games-based learning, created the online game Secret Agents in the Library as an alternative to a traditional library orientation. Groups work in teams to answer a series of questions requiring use of the library's website and locating materials in the stacks. Additionally, Broussard (2012) reviewed 17 online library games and analyzed the traits of successful games, offering six suggestions for libraries seeking to develop their own digital games. Most recently Broussard (2014) makes a case for games as tools for conducting formative assessment in the classroom, arguing that both

games and assessment of student learning during a session share significant synchronicities.

The literature demonstrates that librarians have considered it worthwhile to incorporate games for the purposes of library orientations, engagement in one-shot sessions, practising specific library skills, and more. Because a wide variety of games exist in terms of format and objectives, generalizing research findings is challenging. A vast majority of researchers measured student receptivity to a particular game instead of whether playing a game contributed to student learning. Furthermore, reviewing the literature of games in library instruction presented difficulties in that digital games have a lifespan that can be as brief as one semester. Bibliobouts, one of the most promising research-oriented games in terms of gameplay and adaptability by other institutions, is no longer available due to its four-year grant funding reaching its end (University of Michigan School of Information, 2012), though the BiblioBouts team completed a book on designing effective online information literacy games (Markey, Leeder & Rieh, 2014).. Gaming expectations and technologies change rapidly, and as such it is difficult to determine which games are being used or are available. After a review of the literature, the authors were prepared to select the games most appropriate to their setting and learning outcomes.

Methodology

Research Design and Participants

The study was a quasi-experiment, as the requests for library instruction by teaching faculty at Long Island University did not permit random assignment of the university's undergraduate population. The specific design was two groups/nonrandom selection/pretest posttest. Pretest/posttest models are commonly employed by educational researchers to investigate effects of a particular treatment on learning (Freed, Hess & Ryan, 2002).

Eighty-six students enrolled in introductory English composition classes at a large, urban university in the northeast served as participants. The sampling technique employed was convenience, a type of nonprobability sampling frequently used in research involving college students. The participants comprised seven English classes in total. Professors of these classes contacted the library of their own accord to request instruction for their students. All seven classes visited the library for group information literacy instruction (ILI) classes at two points during the semester. The researchers were the sole ILI instructors included in this study.

Participant ages ranged from 16 to 40, with an average age of 19. Thirty participants identified as male and 56 participants identified as female. Participants were divided into two groups prior to instruction: a control group of 43 students and an experimental group of 43 students.

Instruments and Procedure

Before beginning the experiment the researchers needed to secure Institutional Review Board (IRB) approval, The researchers were granted an exemption from formal review as this study qualified as "research conducted in established or commonly accepted educational settings, involving normal educational practices" (Long Island University, n.d.).

The researchers informed their coordinator of instruction that they would like to teach seven sessions of English composition classes, and were thus assigned all classes requested by faculty desiring two ILI sessions. Three of the sessions were taught in fall 2014 and four were taught in spring 2014. The seven classes were divided into two groups prior to the instruction: the control group and the experimental group. One researcher taught four classes in the experimental condition and the other researcher taught three classes in the control condition. There was a total of 43 students in the experimental classes and 43 students in the

control classes. Each researcher selected the classes which fit best into his or her schedule. Students in the control group would not play any educational games, while students in the experimental group played a keyword development game in the first ILI session and a citing game in the second ILI session. The sessions were all one hour and fifteen minutes long and there was an average of three weeks between the first and second sessions.

Lesson plans were created for first and second sessions of both the control and the experimental classes. The lesson plans were identical with the exception that students in the experimental condition played a game (see Appendix A for a detailed lesson plan). Apart from the games, the researchers collaboratively developed all classroom materials utilized in this study. At the very beginning of the first session each student was administered a six-question multiple-choice-paper pretest developed collaboratively by the two researchers and adapted from Beile's Test of Information Literacy for Education (Beile O'Neil, 2005). Students were given five minutes to complete the quiz, and all participants finished on time. This instrument assessed their knowledge of basic keyword development and citing skills (see Appendix B).

Both groups of students were then given a presentation on basic keyword development and database strategy skills. Afterwards the experimental groups were asked to play a freely available game called Doing Research, created by librarians at the University of Illinois at Chicago and available at: www.uic.edu/depts/lib/reference/services/tutorials/DoingResearch.shtml (Armstrong & Georgas, 2006). Players are presented with a topic, the representation of women in film, and asked to choose certain keywords that represent the topic before moving forward. In the next step several synonyms for the terms "women" and "film" must be selected. Students were allowed fifteen minutes to play the game. Both sessions concluded with the distribution to

students of an activity in which they explored a research paper topic and located one article in an academic database.

For the second session, both classes began with a presentation on citing in both MLA and APA formats. Librarians then gave students a demonstration of ProQuest Databases. The experimental group subsequently played a game created by James Madison University librarians called Citation Tic-Tac-Toe, available at: www.lib.jmu.edu/tictactoe/ (McCabe & Wise, 2009). Citation Tic-Tac-Toe asks players to correctly identify a format when presented with a citation, such as articles, book chapters, and website domains. Students were given ten minutes to play the game. Next, both groups were provided with a worksheet that entailed locating an article on their research paper topic and the documentation of this article in APA and MLA Styles. Before the second session ended students were given a posttest, which presented them with the same questions as the pretest ordered differently to discourage memorization. Therefore, the independent variable in this project was the online games, while the dependent variable was the measures of achievement on the assessment tool.

Once all of the classes were taught the pretests and posttests were graded by the researchers. The standard 100 percentile grading method was employed, with each of the six questions representing 17 percentage points (rounded up from 16.66). If students skipped a question the item was automatically counted as incorrect.

Data Collection and Analysis

All pretests and posttests were coded using a simple numerical coding system. Although all of the tests were anonymous this system was used to keep track of the artifacts. Participants in the experimental group received a number ranging

from 1-43 and participants in the control group received a number ranging from 44-86. The pretests and posttests were then coded accordingly. Statistical analysis was used to determine if there was any significant difference between scores on the pretests and posttests in both groups. A one-tailed paired (dependent) t-test was chosen to analyze the data. Descriptive statistics were also generated to ascertain group means and standard deviations. These statistics provide average scores on the pretests and posttests in the experimental and control groups. Individual pre- and posttest scores were not compared, as the researchers focused on assessment at the class (group) level.

Results

A paired sample t-test comparing the control and experimental groups determined that that there was a statistically significant difference between scores on pretests and posttests in the experimental (games) condition: $t(42)=-3.056$, $p = 0.002$. There was not a significant difference between scores on pretests and posttests in the control (no games) condition: $t(42)=-.506$, $p = 0.308$. Table 1 provides the full statistical breakdown of the t-test's output.

Additionally, descriptive statistics for the scores on the pretests and posttests in both the experimental and control groups were calculated (see Table 2).

Although both conditions saw students improve their scores over time, the experimental group experienced a much larger improvement, as scores improved by around two percentage points in the control condition and around ten points in the experimental condition. The standard deviations were very similar, with the greatest deviation occurring in the pretest experimental condition and the lowest deviation occurring in the posttest control condition.

Table 1
Output for Paired Samples t-test

Pair	Condition	Mean	Std. Dev.	Std. Error Mean	t	df	Sig. (1-tailed)
Pair 1	Pre No Games-Post No Games	-2.326	30.138	4.596	-.506	42	.308
Pair 2	Pre Games-Post Games	-10.488	22.508	3.432	-3.056	42	.002

Table 2
Means for Pretest and Posttest Scores in Games and No Games Conditions

Pair	Condition	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest No Games	60.30	43	24.657	3.76
Pair 1	Posttest No Games	62.63	43	23.815	3.632
Pair 2	Pretest Games	58.33	43	25.735	3.924
Pair 2	Posttest Games	68.81	43	25.057	3.821

Discussion

Statistical analysis revealed that the null hypothesis, which proposed there would not be a significant difference between test scores in the experimental and control groups, can confidently be overturned. The alternative hypothesis, which predicted that students taught with games would outperform students in a control group on a library skills test, was confirmed. These findings suggest that the trend within academic librarianship of incorporating games into instruction has not been in vain; rather, the present study offers educators evidence that games may have the potential to positively impact information literacy skill development.

Currently, there is very little research within LIS literature employing a two group pretest/posttest design to assess the effectiveness of games. McCabe and Wise (2009) are an exception, as they piloted their game Citation-Tic-Tac-Toe with both a control and experimental group. Similar to the present study, McCabe and Wise learned that students who played the game performed better on a posttest than students in a control group who took an online citation tutorial instead. When combined with the findings of the present study there now exists increasing evidence that games can enhance the development of information literacy skills, most demonstrably of citing.

Two additional empirical articles mentioned in the literature review support the findings that games can increase information literacy knowledge. Armstrong and Georgas (2006), creators of the Doing Research tutorial used in the present study, found that students scored significantly higher on a posttest following participation in this game than on a pretest. Although the lack of a control group prevented valuable comparative opportunities, the

experiences of the students in Armstrong and Georgas's project fared similarly to the students in the present study's experimental group. Both initiatives demonstrated the ability of interactive computer activities to boost scores on information literacy tests.

Marcus and Beck (2003) conducted an innovative study which compared the learning outcomes and attitudes of first year students in two different ILI groups: a self-guided treasure hunt orientation or a traditional library tour. The treasure hunt can certainly be considered an educational game, as students adventured around the facility completing interactive library-related tasks and were awarded prizes. All students were given a library skills multiple-choice quiz following the treasure hunt, and statistical analysis showed that students in the treasure hunt (experimental) group performed better than students in the traditional tour (control) group.

What all of these studies share in common is empirical evidence that games can play a part in helping students sharpen their IL skills. The positive statistical results support greater inclusion of games into active learning pedagogies within the academic library classroom, as well as potentially increasing the allocation of additional time and money for the development of educational games.

Limitations and Future Directions

Despite the concerted effort of the researchers to control variables in the quasi-experiment there are several limitations deserving of attention, including: researcher assignment to classes; students receiving insufficient time to complete the questionnaires; and the potential for student skills gained independent of library instruction between classes. First, instead of assigning one researcher to teach all of the games classes and the other researcher all of the control classes, a future study would entail both researchers teaching both types of classes. This measure would maximize the potential of the treatment

(games) to affect learning and to minimize possible confounding influences of individualized instruction techniques of the two researchers.

Another limitation of this project is the potential for participants to have experienced procedural bias. In brief, this bias occurs when participants are given an instrument to complete in a set time limit under close supervision of the researcher(s). In this study students were administered the pretests and posttests with the knowledge that they had five minutes to fill out each questionnaire. Some participants could have felt pressured and rushed through the questions, making mistakes that might have been prevented by allowing them additional time. A small body of psychological research spanning nearly fifty years indicates the negative impact that timed tests can have on some individuals. Morris and Liebert (1969) empirically demonstrated that college students who showed high levels of worry on a questionnaire performed worse on an intelligence test than both high-worry students in an untimed condition and low-worry students. Many years later Onwuegbuzie and Daley (1996) conducted a study which measured the performance of graduate students on a statistics examination in both timed and untimed conditions. Analysis revealed that on average students in the untimed conditions received higher scores. Another study focused on a community college population, noting that untimed tests can be particularly beneficial to older and nontraditional students (Hodges & Kennedy, 2004).

A third limit worth noting is that the passage of time in between completion of the pretests and posttests in both groups could have caused an extraneous time-related variable. Students in the first session did not return to the library for at least two weeks subsequent to the second session; therefore, during this time they ostensibly could have gained some information literacy skills outside of the classes taught by the researchers. For example, a student could have

visited the reference desk for keyword development or citation help, or consulted with a librarian for a one-on-one tutorial. Therefore, it is a possibility that some students scored higher on the posttests than the pretests not because of the incorporation of games into instruction (i.e. the treatment), but because they improved their research skills in other ways during the period between the two sessions.

Future research could adopt a methodology similar to the study at hand by examining the educational impact of games-based teaching interventions using pre- and posttests, but might do so using a longitudinal analysis conducted over the course of multiple academic years or with the addition of a qualitative measure to expand upon the dimensions of the evidence being presented. Additionally, the wide variety of game formats and their different educational capacities should be considered, including medium (in-person, digital, and hybrid) and duration (from part of a standalone instruction session to integration throughout a semester-long course). Evaluating the effects of information literacy gameplay when practised individually versus in small groups would be another beneficial avenue for research and would contribute much needed research to the area of games and learning in the context of library instruction.

Conclusion

The results of this study suggest that, when implemented in information literacy instruction sessions, brief online games addressing two common research processes—identifying keywords and synonyms in addition to categorizing citation types—can be successfully utilized to improve student comprehension of these skills. The instruction containing games was compared with instruction with additional lecture, the latter being a type of teaching that can be considered "traditional" information literacy instruction. These games represent a modest change to the content addressed in the instructors' ILI sessions, and as such might

easily be adopted by other librarians interested in using participatory, game-driven methods to encourage engagement with information literacy practices. The effective use of games will vary according to student backgrounds, desired learning outcomes, and other classroom factors, but in the appropriate circumstances games-based learning may have the potential to enhance student engagement and learning in regards to instructional content.

An additional advantage to games-based learning, noted by several researchers but outside of this study's scope, is the role of gameplay in affective elements that contribute to learning, such as student enjoyment of the session and intrinsic motivation. The authors have found anecdotally in their experiences as instructors that the elements of engagement and motivation can be greatly improved when games are a part of student learning experiences. It is the authors' hope that this research adds to the evidence base concerning the efficacy of games in the library classroom, and will encourage additional research and reflection on games-based learning and other popular teaching methods to ensure that our practices as information literacy instructors are grounded in effective pedagogy, and in turn, instruction that places learners first and foremost.

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Appendix A
Lesson Plans

Lesson Plans for Session #1

Experimental Group

1. Introduction and overview of class content (5 minutes)
2. Students take pretest (5 minutes)
3. Prezi presentation on keyword development and topic formulation (10 minutes)
4. Students play keyword game (15 minutes)
5. Demonstrate Gale Virtual Reference Library and Points of View Reference Center (15 minutes)
6. Students complete keyword worksheet activity (25 minutes)

Control Group

1. Introduction and overview of class content (5 minutes)
2. Students take pretest (5 minutes)
3. Prezi presentation on keyword development and topic formulation (10 minutes)
4. Brief lecture on keyword selection (15 minutes)
5. Demonstrate Gale Virtual Reference Library and Points of View Reference Center (15 minutes)
6. Students complete keyword worksheet activity (25 minutes)

Lesson Plans for Session #2

Experimental Group

1. Introduction and overview of class content (5 minutes)
2. Prezi presentation on citing in APA and MLA formats (15 minutes)
3. Students play Citation Tic-Tac-Toe (10 minutes)
4. Demonstrate ProQuest Databases (10 minutes)
5. Students complete citation and database searching worksheet activity (25 minutes)
6. Students take posttest (5 minutes)
7. Concluding remarks (5 minutes)

Control Group

1. Introduction and overview of class content (5 minutes)
2. Prezi presentation on citing in APA and MLA formats (15 minutes)
3. Brief lecture on citation styles (10 minutes)
4. Demonstrate ProQuest Databases (10 minutes)
5. Students complete citation and database searching activity (25 minutes)
6. Students take posttest (5 minutes)
7. Concluding remarks (5 minutes)

Appendix B
Assessment Quiz

1. Using the citation below, what does the item in **bold** text represent?

Szajnberg, N. (2012). Zombies, Vampires, Werewolves: An Adolescent's Developmental System for the Undead and Their Ambivalent Dependence on the Living, and Technical Implications. *Psychoanalytic Review*, *99*(6), 897-910. doi:10.1521/prev.2012.99.6.897

a. Article Title
b. Volume
c. Author
d. Journal Title

2. You have a class assignment to investigate Americans' attitudes towards the Iraq War. A keyword search in the library catalog on "Iraq War" returns over 700 items. Which of the following steps would give you the best search results?

a. change search to "What are some of the most popular American attitudes on the Iraq War?"
b. add "American attitudes" to your search
c. search by Author using the same keywords
d. search by Title using the same keywords

3. Which is the **article title** in the following MLA citation?
Bray, Kate. "A Week in the Life of Jay-Z." *The Independent* [London] 25 Sept. 2009: 20. *ProQuest Databases*. Web. 10 Sept. 2013.

a. The Independent
b. ProQuest Databases
c. There is no title provided
d. A Week in the Life of Jay-Z

4. Select the keywords that best represent synonyms for the concept "college students."

a. colleges, universities, community colleges
b. millennials, generation Y, generation X
c. graduate students, freshmen, sophomores
d. midterms, finals, break

5. The following citation is for:
Orians, Gordon, and Gene Christman. *A Comparative Study of the Behavior of Red-Winged, Tricolored, and Yellow-Headed Blackbirds*. Berkeley: University of California Press, 1968. Print.

a. a book
b. a chapter in a book
c. a journal article
d. none of the above

6. Select the set of keywords that would provide the best search results for the following question:
What incentives do people have to use Facebook or other social media?

a. Facebook, Twitter, Instagram
b. Facebook, social media, motivation
c. Facebook, psychology, friends
d. incentives, choices, motives