Wiki Fever! Building a Collaborative Exam Study Guide to Promote Student Success in the College Classroom

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Previous research indicates well-structured collaborative projects help students think more deeply and retain information longer when compared to direct instructional methods. This difference may occur for two reasons: (1) Unlike instructors, who are often experts in their field, students are frequently novices, who must build understanding as they add ideas to limited prior knowledge and make connections between concepts to construct a robust knowledge structure, (2) Novice learners may be overwhelmed as they expend their limited capacity in working memory (their thinking space) to process incoming information, make connections between concepts, and build upon prior knowledge. The present case study examined the possible benefits of having students work collaboratively to build an exam study guide in pbworks (formerly pbwiki) to explore possible improvement in exam scores and increased success in an Adulthood and Aging psychology class. Twenty-six students participated in building the collaborative wiki study guide or to study on their own with no access to the wiki. A third group developed when a few students committed to building the collaborative study guide (gained access to the wiki), but did not contribute to the collaborative effort. Results suggest that students benefited from the collaborative effort as the course progressed. Students who gained access to the wiki study guide but did not contribute to the collaborative effort did not benefit more than students who studied alone. The collaborative process facilitated active engagement of new information and knowledge building by offering a collective workspace for students to build a deeper understanding and improved knowledge structure.

Students achieve some of their greatest learning experiences and understanding while collaborating with other students to complete a specific task (Barkley, Cross, & Major, 2005; West & West, 2009). Collaborative projects have been found to support learning and to help students to think more deeply about and retain information longer when compared to direct instruction methods. Positive outcomes are strongest

for collaborative learning environments where students are bound by clear rules and formats that help students know what they have to do and how to communicate during the collaborative effort (Kischner, Paas, & Kischner, 2009).

Cognitive research attempts to explain how learning takes place and how collaborative projects affect learning. Several classic studies in learning theory indicate that students build knowledge into an organized mental network through deliberate practice or by exposure to increasingly complex ideas (McClelland, 1994; Rodgers & McClelland, 2005). In the classroom, collaborative projects might influence learning by increasing students' opportunities to encode, or add, new information. Thus, it is important to offer a number of instructional strategies that might facilitate collaborative learning. Research in cognitive psychology and learning theory also suggests collaborative learning activities surpass direct methods of instruction.

Collaborative learning strategies may increase students' ability to encode new knowledge for two reasons. First, instructors who are often experts in their field are not able to pass knowledge directly to students who are less likely to have well-developed knowledge structures. Instead, students must actively engage the material through a process of knowledge construction (Bowman, Frame, & Kennette, 2013). The construction of knowledge occurs when students add ideas to what they already know and when students make connections between concepts to build a well-structured knowledge network (McClelland, 1994; Rogers & McClelland, 2005). Collaborative projects offer students the opportunity to construct knowledge on their own, but also to build upon other students' knowledge. The cooperative process appears to support meaningful elaboration and deeper processing instead of direct input and simple rehearsal (Bowman & Frame, 2008).

A second reason collaborative learning projects may surpass direct methods of instruction is that learners, especially novice learners, may be overwhelmed when it comes to dealing with large amounts of new material (Bowman & Frame, 2008, September; Seery & Donnelly, 2012). Students use working memory as a *thinking* workspace for learning (Lustig & Hasher, 2002), where students process incoming information, make connections between concepts, and build upon prior knowledge (Baddeley & Hitch, 1974; Cowan, 2001). Collaborative projects may reduce stress on working memory capacity because group members may be able to share the mental effort (working memory capacity) to accomplish a task and to build higher

quality knowledge networks. Kischner, Paas, and Kischner (2009; 2011) found support for this proposal. Overall, their research findings suggested that students were able to learn more information with less mental effort (less strain on working memory) when learning in collaborative groups rather than on their own. Kischner et al. suggest collaborative learning projects help to overcome working memory capacity limitations by serving as a collective workspace, especially when learners focus on greater amounts of information and material that is more complex.

Although research in learning theory suggests advantages for collaboration to build well-structured knowledge networks, I have found barriers to including collaborative projects when designing my courses. Most importantly, there never seems to be enough time for students to complete in-class collaborative projects. When I include collaborative projects outside of class, students are without my guidance and they struggle to schedule outside meeting times that conflict with family and work responsibilities. One alternative to these barriers may be to offer collaborative learning opportunities using wiki technology. Although I used a closed wiki space, which was only open to my students, a wiki can be defined as a "collaborative web space where anyone can add content and anyone can edit content that has already been published" (Richardson, 2006, p. 8). Wiki collaboration allows for asynchronous online interactions between students and me on a more flexible schedule. Wikis are free (or low cost) collaborative learning tools that offer students an opportunity to build their understating and knowledge under the instructor's support and guidance while using online technology outside of class (Engstrom & Jewett, 2005; Wheeler, Yeomans, & Wheeler, 2008).

The purpose of this observational case study was to investigate the effectiveness of having students build a collaborative exam study guide using wiki technology for my psychology course in Adulthood and Aging. More specifically, I investigated whether having students collaboratively, build an exam study guide using an online wiki contributed to higher exam scores and greater success in my course.

Method

Participants

Twenty-six undergraduate students (20 female, 6 male) and one female graduate student from my Winter Quarter 2009, PSYC207 Adulthood

and Aging psychology course were eligible to participate in this classroom case study. Exam 1 participation (n = 21) included 12 Wiki Users (who accessed and contributed to the creating the exam study guide), nine Non-Wiki Users (who decided to study on their own with no access and no contribution to the wiki study guide), and four Wiki Access Only participants (who had access to the wiki study guide, but did not contribute to building the study guide). Exam 2 (n = 20) results included nine Wiki Users, seven Non-Wiki Users, and four Wiki Access Only participants. Although the number of Wiki Access Only users was the same for both exams, the individuals in this group varied. Six students were excluded from the study because they did not take at least one of the two in-class exams and ultimately withdrew from the course. Finally, one student was included in the Exam 1 analyses, but was excluded from Exam 2 analyses because the student took a different exam (make-up) to earn credit for the second exam.

Class Activities and Procedure

At the beginning of the course, I provided all students with a list of 40 essay questions (20 questions for each exam). I explained that they could answer the questions to generate their own individual exam study guide or they could choose to participate in the building of a collaborative exam study guide using an online wiki. Questions were broad, yet detailed with multiple elements to lead students to make connections between course concepts and prior learning material. I also attempted to guide students through the collaborative process, and to address common mistakes or misunderstandings. Furthermore, I challenged students to think deeply about the material and to build connections between concepts. For example, one question was "Name and describe each of the three metatheories. In your description, explain how each metatheory answers the four fundamental developmental questions; for example, does the metatheory suggest that development is continuous or discontinuous (in stages), is development qualitative or quantitative, and so on? Give at least one example theory for each metatheory."

Four weeks prior to each of the two exams, students were encouraged to participate in the collaborative project and were awarded 10 points of extra credit (1.6% of the overall course grade) for their participation. Alternatively, if students did not want to participate in building the collaborative study guide, they could study on their own from

the questions that were provided at the beginning of the course. Additionally, students who did not want to participate in building the collaborative study guide were able to complete an alternate paper assignment to earn 10 points extra credit. Though there were students who elected to study on their own, perhaps completing their own study guide, no student took advantage of the opportunity to write a paper for 10 extra credit points.

Students who decided to participate in building the wiki study guide were awarded full participation when they posted at least five substantial responses that answered at least one element but not the entirety of any essay question. Over the first few weeks of the course, I provided examples of substantial postings several times and I revisited this idea until students had a complete understanding of what was expected and were easily able to contribute substantial postings. Additionally, I reviewed wiki contributions weekly. If a student contributed a posting that did not meet the criteria, he or she was notified and given another chance to answer a different question on the wiki. Although some Wiki Users posted more than five contributions to the wiki, no student answered one whole question. Instead, students commonly answered one element and waited for other students to add, edit, or comment on the material.

To discourage freeloading, students who signed up for the wiki, but did not contribute at least five substantial postings (Wiki Access Only users) had 10 points deducted from their overall course credit. Although a small portion of the grade (1.6% of the overall course grade), the deduction seemed to discourage students from signing up for the collaborative exam study guide in order to benefit from other students' work.

Two private pbWorks (previously known as pdWiki) wikis were created, one for each of the exams. pbWorks software was chosen because it was easy to use and was easily accessible from most computer systems. I incorporated a weblink tab from my Blackboard course management system to the wiki for easy access. The tab took students directly to the *FrontPage* of the wiki where students found the essay questions that were identified by chapter and question number, for example, Chapter 1, Question 1. Students were able to answer any question; however, once I determined an answer to be complete with a high-quality answer, I marked the question *accomplished* and students were required to contribute to other questions.

At first, students were concerned that they would make a mistake by deleting another student's answer. However, students soon learned that

the wiki saved the last draft of the collaborative study guide and that the wiki provided a history of all work by automatically saving each change. This seemed to calm everyone's fears about deleting and losing information. The auto saving feature also allowed students to do more than answer the questions. Instead, I encouraged a collaborative effort and found that students responded to this encouragement by using the wiki as a collective workspace where they manipulated and edited their own as well as other students' work. At the end of the collaborative effort (about five days prior to each exam), students with access to the wiki (Wiki Users and Wiki Access Only users) were able to print all 20 questions with high-quality answers one page at a time.

Administration was ongoing and I monitored the wiki for contributions, misunderstandings, and sometimes, but rarely, I contributed to the wiki material. I was notified daily via a rich site summary email (RSS web feed) when students changed or added text to the wiki. The email summaries were organized by way of student email addresses, time of posting, and highlighted text changes as each student made them. Thus, I could track when students entered the wiki along with the number and quality of each of their contributions. Once the first wiki was up and running for about one week, there were very few technology issues throughout the 10-week course.

Measures

Exams were given during Week 5 and Week 11 (finals week) of the 10-week course. Each exam was worth 150 points, including a combination of multiple-choice (50 questions, 2 points each) and short answer essay questions (two 10-point questions and four 5-point questions). Exams were a substantial proportion of students overall course grade (300 out of 600 possible points, or 50%). Exam questions were a combination of factual, application, and conceptual queries. Students could answer all exam questions (both multiple choice and essay) based upon answers to the questions that were given to all students at the beginning of the 10-week course. Therefore, every student in the class should have been able to create an exam study guide that would lead to success on the exams and in the course regardless of his or her wiki participation whether they were Wiki User, Non-Wiki User, or a Wiki Access Only user.

Results

Independent *t*-tests were used to look at the difference in exam scores between the users and non-users of the online wiki option, with the hypothesis that using this option to generate a study guide would lead to higher exam scores. It is also important to note that neither extra credit nor deduction points were included in the statistical calculations for this study.

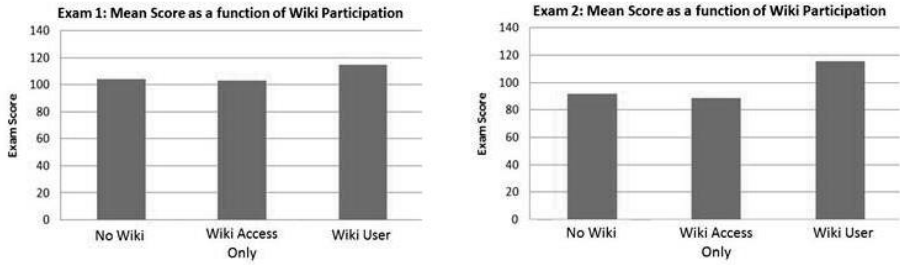

Figure 1. Raw scores (Y-axis) out of 150 points earned on the exam for Exam 1 and Exam 2 as a function of Wiki Group Participation (X-axis).

Although Non-Wiki users (*M* = 104.06; *SD* = 15.33) scored lower than the Wiki Users (*M* = 114.58; *SD* = 14.95) on Exam 1, the difference was not significant, *t*(19) = 1.73, *p* = .07. However, Non-Wiki users did score significantly lower (*M* = 92.00; *SD* = 15.81) than Wiki Users (*M* = 115.65; *SD* = 15.15) on Exam 2, *t*(18) = 1.73, *p* = .002. These results suggest that Wiki Users appear to benefit from collaboratively creating the exam study guide, at least as the course progressed (see Figure 1).

A small number of students signed up for the wiki, but did not fully participate in building the collaborative exam study guide. Perhaps they signed up with the intent of having access to the answers to the essay questions without contributing to the collaborative work. To look at this possibility, I compared exam scores for four students who signed up to participate in building the wiki exam study guides, but did not contribute to the collaborative effort. I termed these students Wiki Access Only users and compared them to both Wiki Users and Non-Wiki Users.

A similar trend was found for Exam 1, the Wiki Access Only students scored lower (*M* = 102.88, *SD* = 7.11) than Wiki Users (*M* = 114.58; *SD* = 14.95), but the difference was not significant, *t*(14) = 1.49, *p* =.08. There was also no significant difference, *t*(11) = 2.20, *p* = .89, between Wiki Access Only Users and Non-Wiki Users (*M* = 104.06, *SD* = 15.33). Similar to the previous Exam 2 comparison, Wiki Access Only students (*M* = 88.88, *SD* =

21.23) scored significantly lower than Wiki Users (M = 115.65; SD = 15.15) on Exam 2, $t(15) = 2.83$, $p = .006$, but scored similar to the Non-Wiki Users (M = 92.00, SD = 15.81), $t(9) = 2.26$, $p = .79$. Thus, while there may be additional factors, such as the types and difficulty of questions asked on each exam, the statistical difference between Wiki Users and Wiki Access Only users appears to support the act of collaboration where students who did not participate in the collaborative effort seemed to benefit in only a limited manner from having a complete study guide that was created by the collaborative effort of other students.

Discussion

The purpose of this observational case study was to examine the possible benefits in having students collaborate via an online wiki to create an exam study guide that would improve exam scores and increase success in an Adulthood and Aging psychology class. Based on overall student performance, results suggest there may be a slight benefit of wiki collaboration when measured by student exam scores where Wiki Users scored slightly higher than Non-Users on Exam 1, and where Wiki Users scored significantly higher than Non-Wiki Users on Exam 2.

Support for the benefit of collaboration in building an exam study guide seems to strengthen when considering the results for the students who had access to the completed exam study guides, but who did not contribute to the collaborative effort (Wiki Access Only participants). These Wiki Access Only students should have been able to benefit from having the exam study guides even though they did not fully participate by contributing five significant postings. After all, they had a complete study guide with high-quality answers even though they made few or no contributions. Instead, their scores were lower but not significantly different from Non-Wiki Users who may have worked alone to create their study guide. Although few in number, these Wiki Access Only users gained only limited benefit from studying other students' work on either Exam 1 or Exam 2.

Generally, results of this observational case study suggest that fully participating in building a collaborative wiki study guide contributed to learners' success on exams and in the course. The collaborative process, not mere access to the answers, appears to have facilitated active engagement of new information and building of knowledge by offering students a collective workspace where they could manipulate and edit their own as well as other students' work (Engstrom & Jewett, 2005; Wheeler, et al.,

2008). Collaborating to build complete and higher quality answers appears to support the handling of large amounts of new material. Wiki Users seemed to become more familiar with the material and appeared to develop a deeper level of understanding. On the wiki, they were quick to comment on other students' ideas and often edited their own and other students' postings to build knowledge in a way that other students may have been unable to do when creating an individual study guide or by reviewing other students' work. While there may be additional factors, this interpretation is consistent with prior research examining well-constructed collaborative projects as a way to reduce the capacity limitations of working memory (Kischner et al., 2009; 2011).

At least part of the Wiki Users' success may have been due to the flexibility of the online wiki, which gave Wiki Users a way to collaborate outside the college classroom, regardless of their (and my) varying schedules. Additionally, the online nature of the wiki allowed me flexibility and access to monitor Wiki Users' understanding of course concepts, level of comprehension, and ongoing knowledge construction at various levels even though collaboration occurred outside the classroom in an asynchronous manner. When wiki postings included misunderstandings or misinformation, I was able to develop an activity or assignment to correct the misconception. Later, I was able to view students' wiki postings to ensure that they made changes or corrections to the wiki. This level of guidance also seemed to help clarify and improve the collaborative learning environment, leading to enhanced in-class discussions and more, followed by even more elaborative answers posted to the wiki.

In addition to enhanced in-class discussion, there seemed to be additional benefits associated with using wiki technology. For example, I found that students became more comfortable with the use of technology and collaborative learning as a way to connect with others. This was indicated by the way Wiki Users approached the Exam 2 wiki; for example, students began to sign their own work with their initials. Wiki Users also increasingly used color to show where they added new information or to request that other Wiki Users step in to add to the collaborative answer. Over the course of the quarter, there was evidence of increased student-faculty contact, increased cooperation among students, and a greater amount of interest in collaborative peer-to-peer support and active learning. Students seem excited to participate and to collaborate; for example, during class students made comments like, "We should post it on

the wiki so that everyone knows" or, "Can we have a wiki page for that?" Thus, the collaborative experience seemed to encourage at least some students to become more active in their own learning and, perhaps, more community focused with respect to learning. Although these general benefits are consistent results of Tsai, Li, Elston, and Chen (2011), they need further examination.

There are limitations to this study that may influence interpretation of the results. First, participation in the study was voluntary; thus, it may be that only students who were more motivated to learn the course material signed up and fully participated in building the collaborative wiki study guide. Brooks and Shell (2006) suggest that motivation is critical for the allocation of working memory processing. From this perspective, students have limited working memory capacity, but it is motivation that focuses the direction of students' limited resources (attention). Thus, there may be additional factors to consider, such as motivation, attention, and even prior learning, that were not considered in this case study.

The second limitation to this study is that there was a small number of students in the class and therefore in this study (N = 27). If the study were repeated with a larger number of participants, it is possible that there would be different results; it is presumed based on the non-significant results surrounding Exam 1 that if the number of students were greater (i.e. a larger sample size), those differences in Exam 1 scores would reach significance.

Finally, this study did not include a measure for students' prior knowledge of course concepts. While is it highly unlikely that Wiki Users were the only students in the course with or without prior knowledge regarding course concepts in Adult Development and Aging, prior knowledge should be considered separately from the collaborative aspects of this study.

Conclusion

Learning theory suggests students who participate in collaborative projects are better able to build well-structured knowledge networks and to help students to think more deeply about and retain information longer (McClelland, 1994; Rogers & McClelland, 2005). Because there never seems to be enough time for students to complete collaborative projects during class, I completed an observational case study to examine possible benefits of having students build a collaborative exam study guide using an online

wiki in an Adulthood and Aging psychology class. Based on overall student performance, results suggest there may be a slight benefit of wiki collaboration when measured by student exam scores. However, because this was an observational case study of a single classroom there are limitations that may influence interpretation and final conclusions. Therefore, further examinations of collaborative projects to control for instructional strategies, classroom variables, student motivation, and prior learning are suggested.

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