Evaluation of the Effectiveness of Augmenting Traditional Classroom Instruction with an Asynchronous Learning Network

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Abstract

The purpose of this study was to determine whether the use of an online discussion forum would facilitate student understanding of course material, decrease student reliance on instructor assistance and increase peer collaboration. Our results, obtained from survey statistics, student assignment and major event grade averages, and additional instruction time tracking, suggest that augmenting the traditional classroom environment with out-of-class use of computer mediated communication decreases student reliance on out-of-class instructor assistance and increases student connectivity with both peers and resources outside of the classroom; while student performance remained comparable to that of the traditional classroom without augmentation of an asynchronous learning network.

Introduction

Technology in the classroom may encompass many different tools to include utilizing real-time student feedback devices, such as IPads or clickers, to audiovisual equipment providing real-world examples of classroom concepts. Multiple advantages to utilizing technology exist. According to Zhu and Kaplan, technology can afford new opportunities for enhancing student education, address specific learning outcomes more successfully, take advantage of the plethora of knowledge available online, and get students ready for the technology-mediated collaborative atmosphere of the 21st century. (Zhu, 2011) Perhaps one of the most beneficial advancements to classroom technology is the ability for the Internet to expand learning beyond the classroom into a student’s home or dormitory. Not only is there a plethora of information available online but
more and more classrooms have been converted to asynchronous learning networks (ALNs) or virtual classrooms.

According to Hiltz and Wellman, one of the primary advantages to ALNs are their ability to foster collaboration by creating camaraderie through a common connection to a particular class. (Hiltz, Communication of the ACH, 1997) Moreover, online discussions provide support for a student academically and socially by eliminating social and academic inequalities that often present barriers to in-class discussion. These benefits reinforce the constructivism philosophy of learning which concludes that a cooperative learning environment based on shared experiences towards solving problems enables students to actively contribute to their own knowledge development, rather than rely on the passive uptake of information through instructor led one-way lecture. (Kop, 2011) In theory, the participatory nature of ALN should enable the learner to emphasize his or her own gathering and mental processing of information. However, just making an ALN available will not guarantee its use by the student for active learning and collaborative opportunities. Often it is reported that students will engage in a passive role as an observer in computer-mediated communication (CMC) as well. (Rovai, 2007) Therefore, in order for CMC to be an effective learning experience, an instructor must successfully facilitate online discussions and make CMC a part of the pedagogical framework of the course. If CMC is made a priority, data suggests that overall ratings of courses by students with ALNs are equal or superior to those for traditional courses, while grade distributions seem to be at least similar to that of traditional courses. (Hiltz, JALN, 1997)

Some would argue that distance education compromises the quality of education, contending that the interpersonal nature of the traditional classroom is invaluable towards achieving true learning. (Nissenbaum, 1998) However, multiple sources suggest that teaching within a virtual classroom can be effective provided the methods and technologies are appropriate to the instructional tasks. (Rovai, 2003)

Of the research available detailing the effectiveness of augmenting the traditional classroom with outside electronic discussion, most conclude that given the choice, students prefer the interpersonal nature of the traditional classroom; however, they also perceived online discussions as value added to the course infrastructure. (Tiene, 2000) Online course discussion provides self-paced learning in the convenient environment of their own personal space. Electronic discussions also provide the student with a repository of class notes for future
Moreover, as discussed earlier, research shows that online classrooms provide the learner with a strong sense of community. (Hiltz, Communication of the ACH, 1997) It would seem, based on these common observations, that offering outside discussion would facilitate improved student performance and collaboration.

Overall, more research is needed to determine how electronic discussion affects learning. Specifically, how does online discussion outside the classroom affect collaboration amongst students, student outcomes, and teacher’s time investments into the course? Therefore, this study aims to examine the reinforcement of traditional face-to-face dialog within the classroom with continued on-line discussion outside of the classroom. Our hypothesis is that the use of an online discussion forum, where students can come together in a virtual and asynchronous environment to collaborate, ask questions, and discuss course topics, will facilitate student understanding of the course material, decrease student reliance on out-of-class instructor assistance, motivate students to complete homework requirements with greater frequency, and increase peer collaboration.

**Research Methodology**

In order to evaluate the validity of our hypothesis we chose the Piazza™ online platform (www.Piazza.com) as our asynchronous learning network for computer-mediated communication. According to the Piazza™ home page, their engineers constructed the website in order to build student collaboration through an on-line community that fosters student-to-student learning as well as instructor feedback. Other factors that went into the platform decision were that use of the website was free and that access was not limited to a private network. The latter reason was the primary factor against using BlackBoard™, which was also available.

The participants involved in the study consisted of two groups of General Chemistry (CH101) students at the United States Military Academy. Group one consisted of 142 CH101 students during academic year (AY) 13-1 (Fall, 2013). Group two consisted of 93 CH101 students during AY 14-2 (Fall, 2014). Group two students (AY 14-1) were asked to register and participate in online out-of-class discussion on Piazza™. In an effort to extrinsically motivate participation, 1% of total course points were offered for compliance. Students were introduced to the website functionality on lesson five of forty total lessons. The material and course content
between the two groups did not change significantly and the instructors were the same two
individuals for both semesters of the course.

We used several different assessments to compare the two groups of cadets, whose major
difference lies with the augmentation of traditional face-to-face student-teacher interaction with
an online question, answer, and discussion forum. The first assessment utilized the United
States Military Academy end-of-course feedback system. The system is an anonymous, online
survey provided to all cadets who take CH101. Course specific responses from the authors’
classes were compared between the two groups of participants (AY 13-1 and AY 14-1). Of 235
total students in the CH101 classes, 158 students participated in the survey. 95 students
participated from group one (AY 13-1) and 63 students participated from group 2 (AY 14-1).
Another assessment technique involved the use of an author-written survey specific to the use of
the Piazza™ program. The survey was given only to group 2 students exposed to the Piazza™
website. Participant feedback was anonymous, and class time was allotted to ensure maximum
participation. The seven question survey contained four possible responses on a scale of one
through five, one being of strong disagreement and five being of strong agreement. One of the
seven questions required a yes or no response. Of 93 total students in group 2, 85 students
participated in the survey.

Usage statistics for the ALN were obtained from the Piazza™ website. The platform
provided a class statistics page that included student and teacher contributions, views, questions,
answers, follow-ups and days online, as well as reports of usage trends over time. Of 93 group 2
students enrolled in both authors’ sections, 75 registered for and participated in the Piazza™
program; a greater than 80% compliance.

Student performance was measured between groups 1 and 2 by comparing student
averages on major graded events as well as homework averages and overall completion rates.
Major graded events included three Written Partial Reviews (WPRs) throughout the course of a
semester and one Term-End Exam (TEE). Homework for the CH101 course was administered in
an online format utilizing McGraw Hill Connect™. The homework consisted of 28 assignments
due over the course of a semester. Student registration was mandatory; however, each
assignment was not graded. Instead, homework compliance was rewarded with instructor points;
up to 4% of total course points available. Instructor points were awarded based upon whether the
student completed the assignment, not on assignment score. Average homework scores for all
assignments and compliance were obtained from McGraw Hill Connect™ and compared between the two subject groups. The data is based on how many students submitted the assignments and not on how many submissions were made.

**Results and Discussion**

Analysis of website usage statistics:
The Piazza™ online classroom interface contained robust usage statistics tracking. As instructors, the two authors were able to monitor student contributions and usage statistics daily. Of the 93 of students enrolled in the course, 75 registered to use Piazza™. Of the 75 students who registered on Piazza™, 28% of them made at least one contribution. In total, counting all posts, responses, and comments, there were 64 student contributions and 66 instructor contributions. The students asked a total of 27 questions on Piazza™; of which they received 17 student responses (65%) and 21 instructor responses (81%). Usage statistics for Piazza™ are summarized in Table 1 below.

Table 1. Piazza™ usage statistics for CH101, AY 14-1.

<table>
<thead>
<tr>
<th></th>
<th>Days online</th>
<th>views</th>
<th>contributions</th>
<th>questions</th>
<th>answers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student Totals</strong> ^A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>331</td>
<td>958</td>
<td>64</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>4.41</td>
<td>12.77</td>
<td>0.85</td>
<td>0.36</td>
<td>0.23</td>
</tr>
<tr>
<td>Hi</td>
<td>21</td>
<td>58</td>
<td>10</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Instructor Totals</strong> ^B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>56</td>
<td>102</td>
<td>66</td>
<td>N/A</td>
<td>28</td>
</tr>
</tbody>
</table>

^A – Sample size included 75 students.
^B – Sample size included 2 instructors.
^C – Contributions include posts, responses, follow-ups and comments.
Students spent 331 total days online with an average per student of 4.41 days. On the whole, 958 views of content occurred with an average of 12.77 views per student. Students contributed a total of 64 times throughout the semester, with an average of 0.85 contributions per student. 27 questions were asked in the open forum with 0.36 questions asked per student on average. The single student maximums for each category were 21 days online, 58 views, 10 contributions, 6 questions posted, and 2 answer replies. The student minimum for each category was zero. The authors noted that usage and contributions peaked before laboratory homework due dates and examinations (both Written Partial Reviews and quizzes). These trends can be observed in Figure 1 below.

![Usage Trends](image)

Figure 1. Piazza™ usage trends, AY 14-1. Unique users per day plotted versus time.

Of note, class content discussion also included questions and comments pertaining to proper documentation practices.

Overall usage of the ALN was somewhat low and as depicted by Figure 1, tapered off toward the end of the semester. Despite attempting to motivate student participation extrinsically with points, the average participant viewed the site 12.77 times and made 0.85 contributions. These results corresponded to previous studies that found that without successful teacher facilitation, the majority of students often participated only passively in the online classroom discussion. Of note, over half of all questions were answered first by students. This statistic indicates that certain participants within the group took on the role of an active learner and began collaborating with their classmates. Interestingly, 2 of the 17 total responses to questions were
by students who utilized outside resources. This indicates that on-line discussion fostered both a connection between students as well as outside resources.

During the course of the experiment, the instructors’ role in the ALN was limited to posting classroom notes and answering questions that either went unanswered or were incorrectly answered by students. This led to an approximately equal number of instructor contributions as students, 66 to 64 respectively.

**Analysis of student surveys:**

In order to assess student opinion of utilizing Piazza™ as a classroom tool, a survey was given to the group 2 students (AY 14-1) at the end of the course. The survey feedback was anonymous, consisted of seven questions, and included data for 85 total participants. Figures 2 through 8 below display the results of the survey.

![Survey Results](image)

Figure 2. Cadet responses to the survey question “I feel that the Piazza™ program has contributed to my understanding of the CH101 lesson objectives.” N = 85.
Figure 3. Cadet responses to the survey question “I feel that the availability of lesson materials on Piazza™ decreased my reliance on AI.” N = 85.

Figure 4. Cadet responses to the survey question “Piazza™ helped me to complete my out-of-class assignments.” N = 85.
Figure 5. Cadet responses to the survey question “Piazza™ allowed increased collaboration with my peers in the course.” N = 85.

Figure 6. Cadet responses to the survey question “Were you a part of an informal study group as a result of collaboration through Piazza™?” N = 85.
Figure 7. Cadet responses to the survey question “I feel that Piazza™ is a useful tool for students in this course.” N = 85.

Figure 8. Cadet responses to the survey question “The questions that I asked in the Piazza™ program were answered in a timely manner, and to my satisfaction.” N = 85.

Interestingly, greater than 63 percent of students agreed that Piazza™ was a useful tool during the conduct of the course, and greater than 38 percent of the students believed that computer-mediated communication facilitated increased collaboration with their peers. However, students relayed disagreement (>32%) that the asynchronous learning environment
helped them to complete out-of-class assignments. Responses were more neutral over whether CMC decreased their reliance on additional instruction outside of the classroom and whether it contributed to their understanding of the learning objectives. A majority of students reported (>94%) that they did not participate in an informal study group as a result of collaboration through Piazza™.

These findings indicate that students believed CMC added value to the course and increased collaboration amongst their peers. These results are consistent with earlier studies; however, participation in a virtual classroom did not necessarily correlate with increased face-to-face collaboration outside of the course; as indicated by the results displayed in Figure 6. (Hiltz, JALN, 1997, Lowry, 1994)

End-of-course surveys were used during AY 13-1 and 14-1 in order to gauge student learning and instructor effectiveness. Four of the more than 30 questions were used in this study to determine student perception on the effectiveness of the Piazza™ program for peer collaboration, out-of-class studying efficiency, and motivation for self-learning. The survey responses to these four questions were limited to five possible choices, from “strongly agree” to “strongly disagree.” Figures 9 through 12 display the percentage of responses for each question, with the responses for AY 13-1 and AY 14-1 shown side-by-side.

![Figure 9. Cadet responses to end-of-course survey question A5, AY 13-1 (N = 95) & AY 14-1 (N = 63).](image-url)
Figure 10. Cadet responses to end-of-course survey question E6, AY 13-1 (N = 95) & AY 14-1 (N = 63).

Figure 11. Cadet responses to end-of-course survey question A6, AY 13-1 (N = 95) & AY 14-1 (N = 63).
The analysis of the end-of-course survey data shows minor differences in the responses to the targeted questions by students from AY 13-1 and AY 14-1. The major difference in the response to the end-of-course survey is evident in question E6, “on average, the time I spent preparing for daily lessons was…” It appears that a majority of students surveyed indicated that they spent 30-60 minutes studying for each lesson. During AY 13-1, the survey data shows a more even split between 30-60 minutes of studying time and 1-2 hours of studying time. Access to the Piazza™ program by the students in AY 14-1 may have contributed to the lower overall time spent studying for individual lessons. The program, and the content within it, may have allowed greater efficiency in studying for the students who had access to the program, vice more traditional study resources, such as the textbook or class notes.

Analysis of Cadet Performance and Additional Instruction (AI) attendance:

The cadet attendance at Additional Instruction (AI) just prior to each of three Written Partial Reviews (WPR) and the one Term-End Exam (TEE) were recorded for each CH101 section taught during AY 13-1 and AY 14-1. The AI sessions were facilitated by the chemistry instructors, during the two days preceding the WPRs and/or TEEs, for three hours each day.
During the analysis of cadet attendance, it was assumed that each cadet that attended AI stayed for the entire three hours of the AI session. Table 2 summarizes the results of cadet-hours spent in AI prior to each major graded event.

Table 2. Additional Instruction (AI) attendance, AY 13-1 & AY 14-1.

<table>
<thead>
<tr>
<th>Cadets</th>
<th>AY 13-1</th>
<th></th>
<th>AY 14-1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadets</td>
<td>WPR I</td>
<td>WPR II</td>
<td>WPR III</td>
<td>TEE</td>
<td>WPR I</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>24</td>
<td>31</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Cadet-Hours</td>
<td>63</td>
<td>72</td>
<td>93</td>
<td>33</td>
<td>42</td>
</tr>
<tr>
<td>Total Cadet population</td>
<td>142</td>
<td>142</td>
<td>142</td>
<td>142</td>
<td>93</td>
</tr>
<tr>
<td>Percentage of AI attendance</td>
<td>15%</td>
<td>17%</td>
<td>22%</td>
<td>8%</td>
<td>15%</td>
</tr>
</tbody>
</table>

During AY 13-1, the total number of sections taught by the authors was 8 sections, totaling 142 cadets. The AI session for WPR I was conducted on 17 and 18 September 2012. During this session, a total of 21 cadets attended AI, equaling 63 cadet-hours. The AI session for WPR II was conducted on 24 and 25 October 2012. During this session, a total of 24 cadets attended AI, equaling 72 cadet-hours. The AI session for WPR III was conducted on 26 and 27 November 2012. During this session, a total of 31 cadets attended AI, equaling 93 cadet-hours. The AI session for the TEE was conducted on 13 and 14 December 2012. During this session, a total of 11 cadets attended AI, equaling 33 cadet-hours.

During AY 14-1, the total number of sections taught by the authors was 5 sections, totaling 93 cadets. The AI session for WPR I was conducted on 16 and 17 September 2013. During this session, a total of 14 cadets attended AI, equaling 42 cadet-hours. The AI session for WPR II was conducted on 18 and 22 October 2013. During this session, a total of 9 cadets attended AI, equaling 27 cadet-hours. The AI session for WPR III was conducted on 19 and 20 November 2013. During this session, a total of 7 cadets attended AI, equaling 21 cadet-hours. The AI session for the TEE was conducted on 16 December 2013, in two three-hour sessions. A total of 9 cadets attended AI, equaling 27 cadet-hours.

In the analysis of time spent in AI, it is clear that the vast majority of all cadets do not attend AI prior to a major graded event. During AY 14-1, when the authors utilized the Piazza™ program within their sections, the percentage of AI attendance decreased or did not change for
all graded events except the Term-End Exam. The greatest change in AI attendance between the academic years was during the middle of the semester, centered around WPRs II and III. Since the Piazza™ program was implemented on 29 August 2014 (Lesson 5), the lack of change noted for AI attendance prior to WPR I may be attributed to unfamiliarity of the program with the students, or the lack of student experience with the studying requirements for a WPR. The significant change noted for WPR II (7% decrease) and WPR III (14% decrease) may be an effect of increased student familiarity with the Piazza™ program, increased collaboration amongst students prior to the graded events, and increased utility of the program for out-of-class studying.

The performance on major graded events of the cadet sections taught by the authors was recorded and is shown in Table 3. The overall course average for the 142 cadets taught during AY 13-1 was 84.1%, while the average for the 93 cadets taught during AY 14-1 was 82.1%.

Table 3. Cadet performance in CH101, AY 13-1 & AY 14-1.

<table>
<thead>
<tr>
<th></th>
<th>WPR I</th>
<th>WPR II</th>
<th>WPR III</th>
<th>TEE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Score</strong></td>
<td>80.3%</td>
<td>73.2%</td>
<td>71.3%</td>
<td>82.5%</td>
</tr>
<tr>
<td><strong>Total Cadet population</strong></td>
<td>142</td>
<td>142</td>
<td>142</td>
<td>142</td>
</tr>
<tr>
<td><strong>Overall Course Average</strong></td>
<td></td>
<td>84.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WPR I</td>
<td>WPR II</td>
<td>WPR III</td>
<td>TEE</td>
</tr>
<tr>
<td><strong>AY 14-1</strong></td>
<td>75.6%</td>
<td>75.3%</td>
<td>76.4%</td>
<td>79.3%</td>
</tr>
<tr>
<td><strong>Total Cadet population</strong></td>
<td>93</td>
<td>93</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td><strong>Overall Course Average</strong></td>
<td></td>
<td>82.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In analyzing the cadet performance on major graded events for CH101 in AY 13-1 and AY 14-1, the trend in noticeable differences occurring between WPR II and III for each academic year continues. Cadets in AY 14-1 scored 2.1% and 5.1% higher on WPRs II and III respectively than the cadets in AY 13-1. Although these cadets scored higher, attendance at AI prior to those WPRs was decreased. This increase in performance, with less AI time prior to the graded event may be due to the utilization of the Piazza™ program by the cadets as a studying tool.

Homework completion rates and average scores for all sections in both AY13-1 and AY14-1 are displayed in figure 13. As depicted in the figure, completion percentage in the control group (AY13) was 84.6 percent of the assignments, while for the Piazza group’s (AY14) percentage completion dropped to 75.4 percent indicating a decreased homework completion rate. Interestingly, while homework completion percentage decreased, the average score upon
completion increased slightly from the control group to the group utilizing the outside online discussion forum (58.1%-AY13-1, 59.3%-AY14-1). These results would suggest that while Piazza™ did not encourage increased student completion rates, students performed slightly better on the homework assignments they did complete.

Figure 13. Student homework averages and completion rates, AY 13-1 (N = 142) & AY 14-1 (N = 93).

**Conclusion**

Overall, the data collected by this study supported the hypothesis that the use of an online discussion forum would decrease student reliance on instructor assistance and increase peer collaboration. Approximately one third of students who chose to participate in the asynchronous learning network took on an active role within the online discussions. This would suggest that to some degree, the augmentation of the traditional classroom with computer mediated communication reinforces active learning. This conclusion is also supported by the fact that a significant percentage of students responded positively when surveyed about out of class online discussions; agreeing that augmenting traditional instruction with computer mediated communication was useful and increased overall collaboration with their peers. Interestingly, a comparison of surveys between students who participated in an asynchronous learning network
versus those who did not revealed that students who had access to the network spent, on average, less time preparing for lessons than students who did not have access to the ALN.

With respect to student grade percentage, results were varied. Overall, performance compared to the control group remained comparable, however, on two of the four major graded events students scored an average of 3.5% higher than the control group with less time spent in additional instruction prior to each exam. These results suggest that utilization of the Piazza™ program as a study tool is beneficial to the student.
References


