Group Collaboration and Learning Through Online Assessments: Comparison of Collaborative and Participatory Online Exams

Jia Shen[1], Starr Roxanne Hiltz[2], Michael Bieber[2]

[1] New York Institute of Technology (The author will join Rider University in Sept. 2007)
jiashen05@gmail.com
[2] New Jersey Institute of Technology {hiltz, bieber}@njit.edu

Abstract. Online environments are regarded as well constructed to support collaborative and social learning. This research investigates small group collaboration and learning in the context of online exams. Incorporating constructivism and collaborative learning theories, the online Collaborative Exam features students' active participation in various phases of the exam process through small group activities. The online Participatory Exam features similar processes except that students participate in the exam individually. A large scale field experiment was conducted to compare the two exam structures in terms of learning strategies and exam outcomes. Results show that students in the collaborative exam adopted significantly higher levels of social engagement than those in the participatory exam, learned from other students, and formed a sense of learning community. Areas for future research are briefly discussed.

Keywords: Group collaboration, collaborative exam, participatory exam, online assessment

1 Introduction

Much attention has been paid in recent years in the study of online environments to supporting virtual teams and collaborative learning. Online learning environments are regarded as well constructed to support social learning theories, which argue that learning is fundamentally social in nature [1, 2]. Researchers of online education suggest that the unique nature of asynchronous course discussions such as threaded discussions and anytime, anywhere participation can benefit social learning, including creating a culture of mindfulness and reflection [3] and a democratic atmosphere [4]. More recent research suggests the emergence of a virtual learning network in the most successful online courses [5].

This research aims at a deep investigation of small group collaboration and learning in the context of online exams. Collaborative learning, an offspring of the constructivist model, is a learner-centered and team-oriented approach that assumes

that learning emerges as learners interact with each other. Studies have shown the superiority of collaborative learning in both face-to-face settings and online education using Group Support Systems (GSS) [6, 7].

Despite the collaborative learning paradigm that dominates online education, only a few studies have been conducted to incorporate student active participation and collaboration into the assessment process online. For example, with the use of GSS, students' participation and collaboration have been integrated into specific phases of collaborative assessment, such as collaborative development of the grading scheme [8], question composition [9], collaborative question answering [10-12], and peer and self-grading [13-15].

This paper begins in §2 by introducing the collaborative exam and the participatory online exam. §3 presents the research hypotheses, followed by research design in §4 and findings in §5. §6 closes the paper with conclusions and future research.

2 The Collaborative and Participatory Exams

Incorporating constructivism and collaborative learning theories, the online **Collaborative Exam** features students' active participation in various phases of the exam process through small group activities. Small groups of students design exam questions, individuals answer questions designed by their peers, and small groups grade answers to the questions they authored. Another online exam process, the online **Participatory Exam**, features similar processes except that students participate in the exam individually in all steps. Note that in both exam modes, individual students answer the exam questions. Software with features such as threaded discussions and anonymity supports these processes. Fig. 1 compares and contrasts the two exam processes as they were conducted in this study.

Both the participatory exam and the collaborative exam are conducted online. While students in the participatory exam perform these steps individually, students in the collaborative exam first participate individually (i.e., individually design questions and grades), and then the group (three to five students) as a whole discusses, improves, and reaches consensus on the questions and grades. Typically, essay type questions are designed and answered by students. In both exam modes, individual students answer exam questions to ensure the exam's ability to assess individual student's knowledge.

3 Research Hypotheses

The research hypotheses are formulated to compare the collaborative exam with the participatory exam from two aspects: learning strategies students adopt while studying for the exam, and perceived exam outcomes including perceived learning, satisfaction, and perceived fairness in grading.

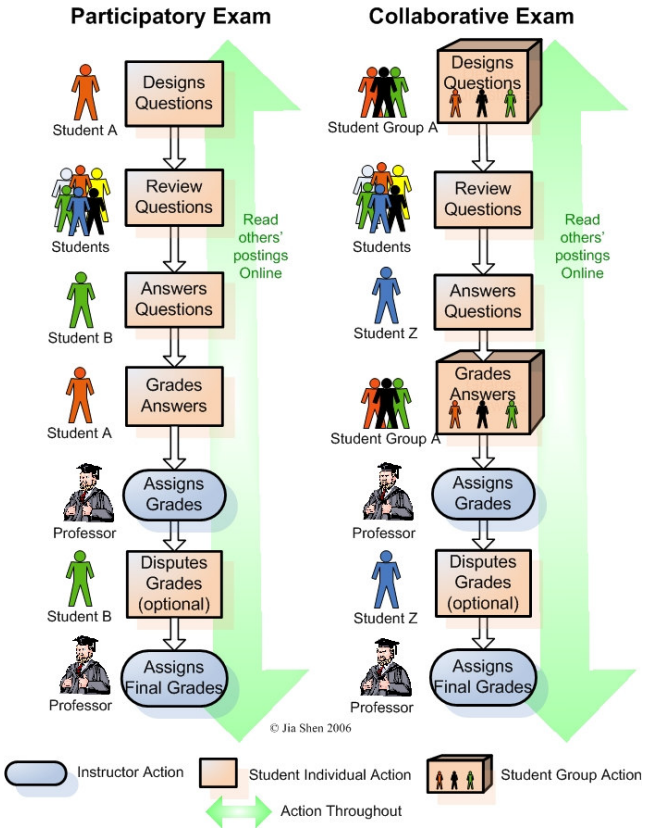

Fig. 1. Comparison of the participatory and the collaborative exam.

3.1 Learning Strategies

Studies have shown that students dynamically form learning strategies according to different assessment methods, and one of the strategies is deep vs. surface learning [16, 17]. Adapting the concept into this study, **Deep Exam Study** is defined as the extent of the student's search for knowledge and understanding during the exam studying process. Low adoption of deep exam study (surface exam study) is associated with passing exams by memorizing facts, while high adoption of deep exam study is associated with seeking knowledge and understanding. Deep exam study is reflected in a number of strategies the student uses in exam studying, such as taking professional perspectives to understand course materials, and spending extra time to obtain more information on interesting topics [16, 17].

With the differences in the group configurations in the two exam modes, it is expected that students would also adopt different approaches while interacting with others during the exams. In this study, **Social engagement** is defined as the extent of a student's active involvement in learning from other students through the exam study process, and the sense of forming a learning community. High adoption of social engagement in exam studying is reflected in a number of strategies the student uses when studying, such as getting to know other students better through the exam process, in acknowledging learning from others, and in forming a learning community.

Based on the collaborative learning theories, it is hypothesized that the small group discussions in the collaborative exam will encourage students to actively seek a deeper level of understanding in studying for the exams, and promote learning from other students, thus higher levels of deep exam study (H1) and social engagement in the exam study process (H2). Deep exam study and social engagement were measured in the post-exam questionnaire through questions about the specific approaches students adopted in exam studying.

H1: Students taking the collaborative examination will have higher social engagement in the exam studying process than students taking the participatory exam.

H2: Students taking the collaborative examination will have higher adoption of deep learning in the exam studying process than students taking the participatory exam

3.2 Perceived Exam Outcomes

Collaborative learning theories suggest that knowledge is created as it is shared, and learning emerges through interaction of an individual with other individuals [18]. The more knowledge is shared, the more it is learned. In particular, it has been demonstrated that small group activities are essential for effective collaborative learning [4, 19]. Therefore, it is hypothesized that students' perceptions of the exam will be higher in the collaborative exam compared with the participatory exam in terms of perceived learning (H3), satisfaction (H4), and perceived fairness in grading (H5). Perceived learning measures based on Bloom's taxonomy [20] range from lower levels such as understanding materials to higher levels such as solving problems, comparing and discriminating ideas, and making predictions. The perceived outcomes were measured in the post-exam questionnaire.

H3: Students taking the collaborative examination will have higher perceptions of learning than students taking the participatory exam.

H4: Students taking the collaborative examination will have higher satisfaction with the exam than students taking the participatory exam.

H5: Students taking the collaborative examination will have higher perceptions of fairness in grading than students taking the participatory exam.

4 Research Method

4.1 Design

The research design for this study is a 1*3 quasi-experiment non-equivalent groups design with pre and post measures. The three conditions were the participatory exam, the collaborative exam, and the traditional proctored in-class exam used as a baseline group. The results of the traditional exam are not reported in this paper.

4.2 Participants & Tasks

A total of 22 course sections at the undergraduate and graduate levels of an American university participated in the experiment in the spring, summer, and fall semesters of 2004. A balancing technique was used to assign sections with similar characteristics to different exam modes in order to counterbalance possible pre-existing differences among students. A pre-exam questionnaire was used to measure if there were pre-existing differences among the conditions. Table 1 shows the number of subjects in the two online exam conditions and the response ratio. Extra credits towards the exam grade were provided.

Table 1. Number of Participants in the Experiment

	Exam Mode		Total
	Participatory	Collaborative	
No. of students	152	199	586
No. of students answering the surveys	137	175	485
Return Rate	90.1%	87.9%	82.8%

Participants completed several main experiment steps, including a pre-exam questionnaire (for demographic questions and learning predispositions), the actual exam, and a post-exam questionnaire. Interviews were conducted with some students and faculty after the exams to collect qualitative data.

4.3 Systems

Both exams were conducted entirely online using either Webboard or WebCT, depending on the instructor's choice of courseware. The pre and post exam surveys were conducted online too. The exams were conducted using the discussion forum

component on these two systems, which are similar in functionalities. At all phases, the various questions and answers and grading critiques are visible to all members of the class, with assigned pen names used to hide the identity of the question and answer authors.

5 Analysis and Results

The raw data were analyzed using SPSS™. It is necessary to point out that analysis using the pre-exam survey data shows no significant difference in the two exam modes before the exam, including demographics and learning predispositions.

Using principle component factor analysis with PROMAX rotation, six factors were extracted from the post-exam questionnaire. The items measuring the deep exam study construct split into two factors. The positive items converged into one factor (termed deep exam study), and the negative items converged into another factor (termed surface exam study). The items measuring other factors converged as expected. The reliability analysis of the factors suggests the factors are highly reliable, with Chronbach's alpha all at the .7 level. Table 3 shows the factors, the number of items, and reliability scores. Detailed items for each factor are not provided in this paper for brevity.

Table 3. Factor Analysis Results with Chronbach's α

Factor	No. of Items	Chronbach's α
Social Engagement	4	.80
Deep Exam Study	6	.80
Surface Exam Study	2	.70
Perceived Learning	12	.93
Satisfaction	4	.81
Fairness in Grading	2	.73

Given deep learning splits into two factors (deep learning and surface learning) through the factor analysis, hypothesis two is revised into two sub-hypotheses:

H2.1: Students taking the collaborative examination will have higher adoption of deep learning in the exam studying process than students taking the participatory exam.

H2.2: Students taking the collaborative examination will have lower adoption of surface learning in the exam studying process than students taking the participatory exam.

The mean scores were calculated for all the factors, and the data were tested for normal distribution. A Kolmogorov-Smirnov (K-S) test was used and the significance level p=0.01 was adopted. Among the six factors, three were normally

distributed (deep exam study, social engagement, and satisfaction). Through data transformation, perceived learning was successfully normalized.

In hypothesis tests, T-tests for two independent samples were conducted on post-exam constructs that are normally distributed, and Mann-Whitney tests, the nonparametric equivalent of the T-test, were conducted on constructs that are not normally distributed. Table 4 shows the result of the T-test, and Table 5 shows the result of the Mann-Whitney test.

Table 4. Collaborative vs. Participatory Exam (T-test)

Learning Strategies and Outcomes	Exam Mode	N	Mean	SD	T	P
Social Engagement	Participatory	110	3.27	1.45	6.15**	.000
	Collaborative	136	4.41	1.43		
Deep Exam Study	Participatory	110	4.78	1.00	-0.29	.775
	Collaborative	137	4.74	1.18		
Perceived Learning [T]	Participatory	109	23.91	10.04	0.67	.504
	Collaborative	133	24.78	10.19		
Satisfaction	Participatory	109	4.46	1.57	0.55	.582
	Collaborative	133	4.57	1.64		

[T]: Transformed scale **: Significant at p<.01 level.

Table 5. Collaborative vs. Participatory Exam (Mann-Whitney Test)

Learning Strategies and Outcomes	Exam Mode	N	Mean Rank	Mann-Whitney U	P
Surface Exam Study	Participatory	110	159.55	7057.50	.389
	Collaborative	137	169.78		
Fairness in Grading	Participatory	109	193.02	7016.00	.666
	Collaborative	133	186.59		

**: Significant at p<.01 level.

The results show that students in the collaborative exam reported significantly higher levels of social engagement than those in the participatory exam, thus H1 is supported. There is no significant difference between the two exam modes in terms of the use of deep or surface exam study strategies, and thus H2.1 and H2.2 are not supported. In terms of perceived exam outcomes, students in the collaborative exam had slightly higher perceived learning and satisfaction, however the differences are not significant; thus H3 and H4 are not supported. Interestingly, students' perceived fairness in grading is lower in the collaborative exam than the participatory exam, the reverse of what is hypothesized, yet the difference is not significant and H5 is not supported.

The results of hypothesis tests are summarized in Table 6.

Table 6. Summary of Hypothesis Test Results

Hypothesis	Test	Result
H1: Social Engagement	T-test	Supported, p=.000**
H2.1: Deep Learning	T-test	Not Supported
H2.2: Surface Learning	Mann-Whitney U	Not Supported
H3: Perceived Learning	T-test	Not Supported
H4: Satisfaction	T-test	Not Supported
H5: Fairness in Grading	Mann-Whitney U	Not Supported

**: Significant at p<.01 level.

6 Conclusions & Future Research

Using a large-scale experiment, this research shows that compared with working individually online, small group online collaboration can enhance students' level of social engagement and the sense of an online learning community. Students are more likely to learn from other students to enhance their understanding and knowledge.

One area for future exploration is to more carefully examine what makes group work a good collaborative learning experience. It has been observed in this study that some groups in the collaborative exam truly worked together. Members of the group were highly involved in the group process, and they worked together to enhance the quality of the group questions and grading. In contrast, the level of involvement in some groups was very low and members of the group simply participated in the exam individually. Possible areas for further investigation in group process include: group composition [21], group communication [22], and leadership styles [23]. For example, the group conferences on Webboard or WebCT can be examined and coded to further examine involvement levels of group members, communication patterns, and leadership styles in different groups.

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