A Course on Multimedia QoS Networking: Transition to Hybrid Offering and Comparative Evaluation

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Abstract— A companion paper describes the development and evaluation of the on-campus format of a novel Multimedia QoS Networking course that introduces students to the basic principles and current developments in this emerging field through a combination of lecture, topic exploration, and paper critiquing and discussion. This paper presents (i) the transformation of the course from the on-campus-only format to a hybrid on-campus/distance learning format, and (ii) the comparative evaluation of the two formats and different forms of the paper critique discussions in the hybrid format. While the lecture (40% of class time) and topic exploration (30% of class time) components could be transformed with standard approaches to the hybrid on-campus/distance education with streaming class video format, the transformation of the highly interactive paper critique discussions (30% of class time), which are crucial for developing a deep understanding of the course content, proved challenging. Three different forms of the paper critique discussion were tested and evaluated: 1) in-class discussion (with distance students visiting the campus or viewing the video of the recorded discussion), 2) asynchronous web-based discussion board, and 3) synchronous web-based live chat. The two course formats as well as the different forms of the paper critique discussion in the hybrid course format were evaluated through extensive student surveys and interviews. The results indicate that student attitudes were approximately equally positive toward both course formats. There was a tendency for the asynchronous discussions to be perceived more positively in terms of learning effectiveness and effectiveness of interaction with the peers than the live chat discussion, while the live chat was preferred in terms of interaction with the instructor. These results and the reported student feedback to the open-ended survey questions and the interviews provide valuable guidance for designing interactive seminar-style courses on emerging topics in a hybrid format.

Index Terms— distance learning, hybrid course, multimedia networking, paper critiques, paper discussions.

I. Introduction

Providing Quality of Service (QoS) in the Internet for multimedia networking applications, such as audio and video streaming, has been a growing field for over a decade. To provide instruction in this emerging area, which is of increasing importance for electrical, computer, and industrial engineers [1], a course on Multimedia QoS Networking has been developed at Arizona State University (ASU). A companion paper [2] presents (i) the course structure for the on-campus-only offering, and (ii) its evaluation. This paper presents (iii) the transformation of the course to a hybrid on-campus/distance learning offering, and (iv) the evaluation of the transformation.

A key challenge in developing a course on a rapidly evolving area, such as multimedia QoS networking, was to provide the students with balanced instruction in both the fundamental principles, and in the current development trends. To achieve this goal, the course structure developed in [2] has three components: 1) Lecture (40% of class contact time), in which the instructor presents the basic principles of the class material, 2) Topic Exploration (30 % of contact time), which expands on the basic principles covered in the lecture component and explores current trends and developments through student presentations and follow-up discussions, and 3) Paper Critique, in which the students critically evaluate readings from the recent literature in terms of novel contributions, the benefits and drawbacks, and the grounding in the literature. The student paper critiques are examined in instructor-led discussions (30 % of contact time) in class. The evaluation in [2] found that the developed structure was effective and very well received by the students. The students especially enjoyed and derived significant benefits from the in-class paper discussions.

The first offering of the developed course in the fall 2003 semester was in the traditional on-campus format. The Fulton School of Engineering at Arizona State University has initiated a growing distance education program that allows students to take courses and complete their entire degree program at a distance. To support this program the courses are offered in a hybrid format that caters simultaneously to the on-campus students and the distance learning students. In this hybrid format, the classes are taught in on-campus studio classrooms to the on-campus students. The classes are captured on video and the class video is made available to the distance learners through web-based video streaming. To allow distance learning students to participate the multimedia QoS networking class, it was transformed to a hybrid course format for the fall 2004 offering. This paper discusses the challenges encountered in transforming the course. The course had a significant portion of the class time (30%) devoted to interactive discussions among the students and the instructor, which are crucial for developing a deep understanding of the course content. The transformation of the highly interactive paper critique discussions proved especially challenging and is examined in detail in this paper.

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II. CHALLENGES AND APPROACHES FOR COURSE TRANSITION TO HYBRID FORMAT

A. Lecture Component

The lecture component, which constituted approximately 40% of the total instructional time, could be transformed to the hybrid format with standard approaches. In particular, the instructor delivered the lecture to the on-campus students in a studio classroom and via the web-based video streaming to the distance learners. With the current web-based video streaming at ASU, the video is made accessible a short time (few hours) after the on-campus class is completed. Distance learners have thus not the opportunity to interact synchronously with the on-campus class. Instead, distance learners ask questions and give feedback asynchronously through e-mail or discussion board exchanges.

B. Topic Exploration

Each student in the class conducted one topic exploration, which consisted of (a) a topic exploration paper, (b) a student presentation, (c) instructor-led discussion and feedback on student presentation, and (d) topic exploration review and assessment. The presentation, discussion, and review/assessment constituted approximately 30% of the total instructional time.

Two modes were developed for the transformation of the topic exploration to the hybrid course format: the in-class mode and the distance mode. In the in-class mode, the student gives the presentation in the studio classroom and is immediately followed by the instructor-led discussion that grounds and connects the presented materials with the basic principles covered in the lecture component. Immediately after the discussion, the on-campus students work on the review set (quiz) on the presented topic exploration. The review set is distributed in hardcopy to the students in the classroom and electronically through the class web page to the distance learning students. The distance learning students complete the review set within two to three days and submit them via e-mail. The presenting student and the instructor assess the review sets and return them to the students.

In the distance mode, the student presentation and instructor-led discussion are conducted via the synchronous and asynchronous communication facilities on the class web page. Specifically, asynchronous threaded discussion group posting accompanied by synchronous live chat are used for the student presentation. The instructor-led follow-up discussion is conducted via the asynchronous blackboard discussion group and the review set (assessment) administered through the Blackboard platform.

C. Paper Critiques and Discussion

Each week the students were assigned a paper for critique. A paper critique consisted of (i) a one paragraph summary of the paper, (ii) a one paragraph discussion of contribution of the paper (what does the paper add to the previously known state-of-the-art?), (iii) a one paragraph discussion of the strengths of the paper, (iv) a one paragraph discussion of the weaknesses of

the paper, and (v) a list of at least three additional references that the paper could/should have cited plus a justification for each reference why it could/should have been cited. In the on-campus course offering, the critiqued paper was discussed in class on the due date of the critique. The discussion took up about 30% of the weekly class contact time (i.e., about 45 minutes per critiqued paper).

The discussion on a given paper was aligned with the structure of the paper critique. For each of the five parts of the paper critique the instructor selected one student to initiate the discussion. The selected student made an opening statement outlining his/her main views on that particular aspect of the critiqued paper. The instructor and the other students then commented on the opening statement by bringing up additional considerations, elaborating on the main points, asking follow-up questions, or challenging comments from the other students. The instructor directed the discussion on the contribution aspect of the critiqued paper to clearly bring out (i) the relationship of the critiqued paper to the existing literature, and (ii) the distinguishing features of the critiqued paper against the backdrop of the literature. These distinguishing features were then further discussed and examined in the discussion of the strengths of the paper, focusing on the intellectual and practical significance, technical thoroughness, and presentation of the paper. The discussion of the weaknesses of the paper was directed by the instructor to not only bring out the weaknesses in significance, technical thoroughness, and presentation, but also to examine the limitations of the work presented in the critiqued paper. In particular, the instructor encouraged the students to identify areas and questions that remained unexplored in the critiqued paper (as well as the additional papers that could/should have been cited) and could lead to worthwhile topics for new research.

After completion of the discussion, the instructor collected the paper critiques that the students had written. The instructor carefully assessed the written critiques, provided detailed feedback (mark-ups) on the critiques, graded them, and returned them to the students in the next class meeting. The additional paper references from all the critiques were compiled—and if key references had been overlooked, added by the instructor—into a literature list that was posted on the class website.

III. APPROACHES FOR CONDUCTING PAPER DISCUSSIONS IN HYBRID COURSE FORMAT

A. Face-to-Face Discussion

With the face-to-face discussion, the paper discussion follows essentially the approach of the on-campus offering, as reviewed in Section II-C. That is, the paper discussion takes place in the on-campus studio classroom. The distance learners may travel to campus to participate in the discussion. If a distance learner cannot attend the on-campus discussion s/he is limited to watching the video recording of the discussion via the web-streaming video. Since the web-streamed video is not a live video transmission with the current hybrid class systems at ASU, the distance learner cannot participate from off-campus

in the discussions. S/he may follow up on the discussion with e-mail or discussion board postings.

B. Asynchronous Discussion Board

With the asynchronous discussion board approach the paper is discussed by the entire class online via postings on the asynchronous discussion board facility on the class web site (which was hosted on the Blackboard system). With the asynchronous discussions, all students irrespective of whether they are on-campus or distance learning students have equal access and can participate in the discussions. For the asynchronous discussions it is preferable to have relatively small discussion groups of, say, five to eight students, to keep the volume of postings within the discussion group manageable [3]–[6]. For our course offering with twelve enrolled students, we split the class into two groups of six students each for the asynchronous discussions.

As ground work for the discussions, an assigned student compiled an *aggregate* paper critique from the individual critiques written by the students in the group. The aggregate critique contained all the points raised in the individual critiques in a coherent form, as well as all the additional references from the individual critiques. The aggregate critique was made available on the discussion board prior to the start of the discussion. For each discussion a student moderator was assigned, who in collaboration with the instructor developed the discussion question for a given critiqued paper. The moderator also initiated the discussion by posting the discussion question on the board and regularly summarized the status of the discussion and gave leads for further discussion.

The discussion on a given critiqued paper lasted for one week. Each student was required to make two significant and relevant postings in response to a discussion question during the one week discussion phase. A posting could either provide an original answer/viewpoint to the question, or comment on an earlier posting by a fellow student. The instructor monitored the ongoing discussions and answered any questions from the students. The instructor corrected any incorrect or misleading statements in the discussion board postings. Also, the instructor grounded the discussions in the basic principles from the lecture component.

Two types of asynchronous discussions were conducted, namely so-called *topical* discussions, and *taking-sides* discussions. In the topical discussions, the discussion question on a paper was formulated so as to stimulate discussions on the contribution of the critiqued paper and the benefits, drawbacks, limitations of, and alternatives to the approach proposed or examined in the critiqued paper.

In the taking sides discussions, a given discussion group was split into two "camps". A given camp argued in favor of a certain approach/scheme while the other camp argued for an alternative approach/scheme, whereby the discussed approaches/schemes related to the problem setting, approach, or scheme studied in the critiqued paper. For example the discussion question for the two camps in the critiqued paper [7]

were for Camp 1: Pro TCP/Con UDP "What is the case for using TCP versus UDP in the context of streaming media?" and for Camp 2: Pro UDP/Con TCP "What is the case for using UDP versus TCP in the context of streaming media?"

C. Live Chat

With the live chat approach the paper was discussed during a synchronous chat session, which was conducted through the chat facility provided by the Blackboard hosted class web site. The chat was scheduled ahead of time (the scheduling was done through asynchronous discussion board exchanges) at a time that suited all students, i.e., both on-campus and distance learning students. The online chat was instructor moderated and proceeded in a similar fashion as the in-classroom paper discussion, outlined in Section II-C, with the main difference that all communication was conducted via typing and reading messages in the online chat facility.

IV. EVALUATION

A. Overview

The developed course was offered as EEE598/CSE591 Multimedia QoS Networking at Arizona State University in the fall 2003 and fall 2004 semesters. The fall 2003 offering was an on-campus only offering in the traditional classroom format. The fall 2004 offering was in the hybrid on-campus/distance learning format. There were a total of eight students enrolled in the fall 2003 offering and twelve students (eleven on-campus students and one distance learner) in the fall 2004 offering. The course was assessed through an extensive student survey (henceforth referred to as course survey) developed by the authors for assessing this course, the regular student course evaluation survey conducted by the Fulton School of Engineering for all classes (henceforth referred to as FSE survey), student interviews, and the evaluation of student work.

The course survey developed by the authors consisted of eight parts that asked for the students' evaluation of and attitudes toward (1) the course activities, (2) the course structure, (3) the course delivery, (4) the learning resources, (5) the content, (6) the course instructor, (7) the student peers in the course, and (8) the course workload in the multimedia QoS networking course. Additional parts of the course survey, which are described in Section IV-C, asked the students to evaluate the different approaches to the paper discussions.

B. Comparative Evaluation of Overall Course

The students' evaluation of and attitudes toward the eight aspects noted above of the multimedia QoS networking course were assessed using the course survey, the FSE survey, and the student interviews. The student evaluations and preferences exhibited the same tendencies in both the on-campus only and the hybrid on-campus/distance learning offering. The students preferred lecture, topic exploration presentations, and paper critique discussions as the main course activities and components in the course structure. The students also largely preferred a delivery mode that emphasizes traditional face-to-face meetings with complementary online readings and assignments.

There were slightly different tendencies in the student assessment of the course workload. In particular, in the on-campus offering, all students agreed that the course workload was reasonable (coded as 1 in the survey evaluation, while too low was coded as 0 and too high was coded as 2), i.e., the mean score on the work load item was $M = 1.00$ with standard deviation SD = 0.00. For the hybrid on-campus/distance learning offering, on the other hand, the mean score for the workload survey item was $M = 1.27$ with standard deviation $SD = 0.65$. This indicates that the students in the hybrid on-campus/distance learning offering had the tendency to perceive the workload as higher. Interestingly, the self-reported average numbers of hours per week worked on the class were $M = 9$ hours for the on-campus offering and $M = 6.13$ for the hybrid offering. This appears to indicate a tendency for the students to perceive the workload as higher even though they perceived to spend less time on the course. One explanation for these tendencies could be that the students in the hybrid offering perceived the on-line class activities as more demanding due to their novelty.

C. Comparative Eval. of Different Forms of Paper Discussion

The different forms of the paper discussion were assessed as part of the course survey developed by the authors. The specific survey items are listed in a generic form in Table I. In the actual course survey these items were formulated in terms of the individual forms of paper discussion and presented in three separate parts of the course survey. In particular, there was a part on the face-to-face discussions, a part on the asynchronous discussion board, and a part on the live chat. Each part contained the survey items in Table I, which asked for the students' evaluation of and attitudes toward (i) the effectiveness of the discussions, (ii) the course instructor, and (iii) the student peers in the discussion group/class in the context of a particular paper discussion approach. The survey part for the asynchronous discussion contained three additional survey items to assess the student learning from moderating the asynchronous discussions, which are not included in the table and discussed in Section IV-C.3. To keep the overall length of the survey within reasonable limits, the survey part on the asynchronous discussion did not distinguish between the topical and taking sides asynchronous discussions; rather the students were asked to give an overall evaluation of the asynchronous discussions. (The student interviews reported in Section IV-D provide insights into the student perceptions regarding the two types of asynchronous discussions.) Each survey item consisted of a statement about an aspect of the paper discussions in the multimedia QoS networking course accompanied by a 5-point Likert-type rating scale on which the students indicated their level of agreement with each statement from strongly agree (scored as 5) to strongly disagree (scored as 1). In addition, for each paper discussion approach the students were asked for open-ended comments on ways to improve the approach. Table I reports the descriptive statistics mean M and standard deviation SD from the received $N = 11$ completed surveys.

1) Effectiveness: The survey results for the items relating to the effectiveness of the paper discussions indicate that the students perceived the face-to-face discussions as most effective, followed by the asynchronous discussions. The chat discussions were perceived as the least effective of the three examined forms of paper discussion. Note however that the average of the mean score for the effectiveness of the chat is 3.66, which indicates a rating between "neither agree nor disagree" which was scored as 3 and "agree" which was scored as 4. It is also interesting to note that the students were fairly consistent in their high rating of the effectiveness of the face-to-face discussions as indicated by the small standard deviations SD, whereas the opinions of the individual students differed more on the effectiveness of the asynchronous discussions and yet more on the chat discussions, as indicated by the larger standard deviations.

2) Instructor: The student perceptions of the instructor were the most positive for the face-to-face discussions followed by the chat discussions and the asynchronous discussions. The student ratings of the instructor were fairly consistent as demonstrated by the small standard deviations SD. One explanation of this result is that the students may have preferred the immediacy of the instructor comments in the face-to-face and chat discussions, which provided them with instantaneous feedback on their thoughts and questions. On the other hand, in the asynchronous discussions, which were running for 7 days each, the delay from posting a comment or question on the asynchronous discussion board to the posting of the corresponding instructor response or clarification (usually within 24–48 hours) may have given rise to the perception that the instructor was less supportive, enthusiastic, and helpful.

3) Peers: The student perceptions of their peers were about equivalently high in the face-to-face and asynchronous discussions, while it was rated lower, but still somewhat positive in the chat discussions. This result may be due to the students perceiving their peers as helpful for their learning and easy to interact with in the face-to-face discussions due to the ease of the aural communication and the visual clues, which helped to ensure that only one person was speaking at a time. In the asynchronous discussions the individual students posted quite well thought-out contributions, which were typically consisting of one or several paragraphs. The students apparently enjoyed and derived benefit from these fairly substantial contributions and view points. On the other hand, in the live chat the exchanged messages were relatively short, typically consisting of one sentence, as is typical for live chat in the context of distance education [5]. Also, live chats are typically less coordinated and quite often several thought threads are evolving simultaneously, which may be difficult to follow. As a result, the students may have perceived their peers as less helpful in their learning due to the their short messages, which individually may have had little content. Also, a given student may have perceived the postings by his/her peers on different thought threads as interfering with his/her thought thread.

The survey part on the asynchronous discussion board con-

TABLE I

Means M and standard deviations SD from course survey evaluation of the different formats of the paper discussion, each format evaluated by $N = 11$ students.

Survey Statement	In-Classroom		Asynchronous		Chat	
Effectiveness	M	SD	M	SD	M	SD
I learned a lot from the instructional format.	4.18	0.60	4.00	1.00	3.55	1.21
The discussions in the instructional format were worthwhile.	4.27	0.47	4.18	0.75	3.82	1.17
The overall quality of the instructional format was good.	4.27	0.65	3.73	1.01	3.73	1.35
I would recommend this instructional format to others.	4.36	0.67	3.91	1.14	3.55	1.29
I enjoyed the discussions with this instructional format.	4.36	0.67	3.91	1.04	3.64	1.43
Instructor						
The instructor was supportive in this instructional format.	4.73	0.47	4.09	0.70	4.55	0.52
The instructor was enthusiastic about this instructional format.	4.73	0.47	4.00	0.63	4.55	0.52
I enjoyed the opportunities to interact/communicate with the instructor in this instructional format.	4.60	0.52	3.73	0.65	4.27	0.79
It was easy to interact/communicate with the instructor in this instructional format.	4.50	0.71	4.00	0.77	4.27	0.65
The instructor was helpful in my learning during this instructional format.	4.82	0.40	3.73	0.65	4.36	0.67
Peers						
I enjoyed the interaction with peers in this instructional format.	4.30	0.67	4.18	0.75	3.91	1.38
I learned a lot from interactions with peers in this instructional format.	3.82	0.98	4.00	1.10	3.55	1.29
I enjoyed the opportunities to interact/communicate with peers in this instructional format.	4.10	0.57	4.27	0.65	3.73	1.27
It was easy to interact/communicate with peers in this instructional format.	4.20	0.92	4.18	0.87	3.64	1.43
My peers were helpful in my learning in this instructional format.	3.60	1.26	3.70	1.16	3.55	1.37

tained three additional items asking the students to assess the student moderation aspect of the asynchronous discussions and the preparation of the aggregate critique. Specifically, the survey item "The student moderator facilitated my learning from the asynchronous discussions" received a mean score of $M = 3.73$ ($SD = 1.27$). The item "Being a moderator of asynchronous discussions helped me to learn" with $M = 4.10$ ($SD = 1.10$) indicates that students perceived their role of a moderator to be effective for their learning process. The item "Compiling the aggregate critiques helped me to understand the topic better" with score $M = 4.45$ ($SD = 0.82$) suggests that this activity was perceived as promoting deeper comprehension of the subject matter by the students.

4) Responses to Open-Ended Questions: Table II reports the answers constructed by the $N = 11$ students for the open-ended questions. The students were overall very happy with the face-to-face paper discussions, as is evident from the numerical survey results reported above, and was underscored by several students who noted that they very much enjoyed the face-to-face discussions in their open-ended comments. Two students noted that they would prefer a more structured face-to-face discussion that ensures that every student has an opportunity to comment on every aspect of the paper. This was indeed a challenge due to the limited time of about 45 minutes allotted to the discussion of a given critiqued paper and the different aspects of the paper to discuss (summary, contribution, strengths, weaknesses, and additional references). Also, the discussions in the class were at times rather lively which may have resulted in some not so outspoken students to miss their chance to express their views and receiving feedback on them. One possibility to ease the time constraints could be to skip the summary of the paper, as suggested by one student. The comment on the microphone button refers to the studio classroom, which required students to press the button on the microphone at their seat whenever they spoke to record their voice on the class video.

TABLE II

Constructed responses from $N = 11$ students to the open-ended questions (multiple responses allowed)

Question and constructed responses	# of Res.
Please suggest potential improvements for the in-classroom discussions	
Discussion was very good, impressive	3
More moderation (more structured discussion setup, give every student a chance to speak)	2
Skip paper summary, focus on other critique aspects	1
Pushing microphone buttons is inconvenient	1
Please suggest potential improvements for the asynchronous discussions	
Increase frequency of postings and participation	3
Increase timeliness of moderation and instructor feedback	2
Aggregated paper critique needs better description	1
Liked this format	1
Software improvements	1
Please suggest potential improvements for the live chat discussions	
Focus on specific questions during chat	2
Assign a moderating student per session	1
More moderation (organize the discussion)	1
Software improvements	1
Access problems	1
Too little allotted time	1
Audio/Video conferencing	1

The suggestions for improvements of the asynchronous discussions related mostly to the timing of the discussion phase. With the one week discussion phase during which each student was required to make at least two substantial postings, the asynchronous discussion process was typically of a low to moderate intensity and apparently perceived as slow by the students. One option to increase the perceived frequency of the asynchronous exchanges while keeping the workload on the students and the instructor reasonable, could be to shorten the discussion phase to a few days. With the entire discussion and feedback process taking place in a shorter time period, the discussion exchanges and feedback could be perceived as more prompt and timely. One trade-off with a shorter discussion phase is that it may create scheduling conflicts for the distance learners, who are often on business travel.

The suggestions for improving the live chat related to improving the organization and moderation of the chat to limit the number of thought threads that are discussed simultaneously. A student moderator could focus on this task, allowing the instructor to focus on providing technical feedback and grounding in the principles.

D. Student Interviews

One-on-one interviews were conducted with two randomly selected students from the 2003 on-campus only course offering, two randomly selected students from the on-campus students in the 2004 hybrid offering, and the distance learner enrolled in the 2004 hybrid offering. The purpose of the interviews was to obtain additional insights into the student perceptions about the course. The interviews responses of the on-campus students mainly elaborated on the numerical survey results and provided additional interesting insights on the two types of asynchronous discussion. In particular, the students noted that they preferred the taking sides discussions as they provided a better sense as to from which angle to approach a question or problem. It was also felt that the taking sides approach is more reflective of the real-life work environment where company employees often are sent to committee meetings to argue for the approach, scheme, or standard favored by the company. It was also noted that closing statement posting could be a useful addition to the asynchronous taking sides discussion. The closing statement would provide a summary argument in favor of the benefits of the approach favored by the camp and attempt to defeat the points that the opposing camp raised in favor of their approach. Such a closing statement could be useful practice for summarizing the main points of the discussion from each camp's perspective before a committee vote, or for reporting back to company management.

The interview with the distance learner provided valuable insights into his perspective of the hybrid course. The distance learner, who had given his topic exploration presentation on campus, had attended one face-to-face paper discussion on campus, and had watched the other face-to-face paper discussions on the class video, noted that he did not necessarily feel as an outsider in the face-to-face class discussions that he watched on video. He noted that while it was useful for his learning to follow the discussions, it was difficult to only consume these discussions and not being able to promptly make a counterargument. He noted that this was a conscious trade-off for him, a sacrifice for the convenience of completing the class work at his own time while we was working a full-time job.

V. CONCLUSIONS

This paper presented the transition of a course on multimedia QoS networking that strives to achieve a balance between the underlying principles and current research trends from an on-campus-only format to a hybrid on-campus/distance learning format. The course has a significant portion of the class contact time (30%) devoted to the discussion of research papers.

Transforming these highly interactive discussions, which are common in advanced seminar-style courses, to the distance learning format posed a significant challenge. Three approaches for the discussions, namely face-to-face discussions in the classroom, asynchronous discussions on a discussions board, and live chat discussions were implemented and evaluated. There was a tendency for the discussion board approach to be perceived as more effective for learning and peer interactions compared to the live chat approach. With the live chat approach on the other hand, the interaction with the instructor was perceived as more effective. The face-to-face discussions were perceived as very effective in all aspects, but required the distance learners to either come to campus to participate or to be limited to watching the class video recording of the discussion (with the web-streaming technology employed in ASU's distance learning program).

The presented hybrid class structure is flexible in that it can accommodate varying TV studio classroom availability and enrollment. Only the lecture component requires TV studio classroom time. The topic exploration can be either conducted in in-class mode (if TV studio time available) or in the distance mode exclusively online (without requiring TV studio time). The paper critique component can be conducted in the studio classroom or solely online.

Our evaluation exposed the trade-offs involved with the different approaches to seminar-style class interactions in a hybrid course and provides valuable guidance for designing courses on emerging topics in a hybrid format. One of the main lessons learned is that there is an apparent tradeoff between the immediacy and spontaneity of student-student and student-instructor interactions in live chat exchanges and the more substantiative and contemplated exchanges on a discussion board. Further exploration of this tradeoff is an interesting topic of further course development and assessment.

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