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Effective Shifting of Software Capstone Demonstrations to an Online Experience

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Abstract:

The rapid transition to remote instruction during the coronavirus disease of 2019 (COVID-19) pandemic created many challenges for students, instructors, and, in the case of a capstone software development course, clients of project teams. We describe an approach for creating and delivering a successful, online culminating event that involved all stakeholders that also addresses learning outcomes such as solving open-ended problems and communicating effectively. We describe the processes and technologies we used and offer feedback that we collected from participants. We conclude with lessons learned in order to improve the experience in future offerings.

Keywords: Capstone Course, Remote Delivery of Instruction, Software Development, Communication Skills.

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1 Description of the Problem, Challenge, and Opportunity

Many baccalaureate programs require a capstone experience (e.g., engineering and computer science accreditation require it). The capstone experience that we describe here comprises a two-course sequence that students take in their final year. The projects have external and faculty clients for team-based software development and span the academic year. Many capstone experiences in various disciplines share the challenge we faced: how to transition the final presentation and demonstration event in the era of remote instruction while 1) achieving learning outcomes, and 2) meeting student, client, and faculty expectations. The course learning outcomes include working as a team to solve an open-ended problem, demonstrating written and oral communication skills with technical and non-technical audiences, and displaying professionalism. These outcomes align with the information systems 2010 curriculum guidelines (Topi et al., 2010) for skills and knowledge areas including designing and implementing solutions and applications, collaborating effectively in teams, and giving effective presentations.

All of our stakeholders expect a culminating event with a high level of interaction and a discussion and demonstration of project functionality. The transition also brought about an additional goal: to mitigate negative impacts on students such as loss of recognition for their efforts, of the lack of closure for the project and academic term, and of the opportunity to practice their communication skills.

The specific challenges we faced included how to remotely prepare for, deliver, participate in, and evaluate a capstone culminating event. The event typically took the form of an in-person poster and demonstration expo. The opportunity we describe concerns leveraging technologies to create an expo as a multi-track, online event that satisfies all learning outcomes and all participants' expectations.

Several papers about information systems/technology capstone courses mention that students give a presentation (e.g., Tuttle, 2000; Farrell, Ravalli, Farrell, Kindler, & Hall, 2012; Mew, 2014; Zheng, Zhang, & Li, 2015; Davis & Zilora, 2016; Herbert 2018), but they do not mention an expo or event. Adya, Nath, Sridhar, and Malik (2008) and Davis, Germonprez, Petter, Drum, and Kolstad (2009) describe global, virtual collaborations on different software projects. While these two efforts do not include a remote presentation of final project results, some of the lessons they learned pertain to our effort. In particular, they identified the importance of managing student expectations and managing technological risks and recognizing instructors' "substantial planning and coordination that extends well beyond typical preparation for traditional courses" (Adya et al., 2008). Topi (2012) advocates for including real-world projects throughout the IS curriculum, not just in capstone courses; however, because real-world projects "teach students about the contexts in which they will be applying their IS capabilities," (Topi, 2012, p. 21) that students gain experience in conducting and presenting projects remotely increases in importance in the pandemic era.

In Section 2, we describe planning for the transition to an online expo. In Section 3, we describe students' and faculty members' experience and our efforts to evaluate student efforts. Finally, in Section 4, we offer lessons learned and key takeaway ideas.

2 Innovative Practice of Remote Learning

In this section, we discuss the activities leading up to the online expo and the expectations for the event itself.

2.1 Preparation for the Expo

Discussions regarding the traditional expo began early in the second semester in order to encourage students to keep the end in mind as they progressed through developing and testing their software. Midway through the term, our university transitioned to remote instruction. Since the capstone course uses project-based learning, the instructor engaged the university's eLearning staff to discuss particular ways to engage with the project teams. The conversation segued into the need for an expo, and brainstorming for an online alternative began.

We faced two pressing issues in delivering a successful virtual expo: timing and attendance. Regarding timing, the traditional expo was an open house in which students attended just over two hours. Faculty, alumni, and guests could freely move through the expo and stop at any table to discuss a project. In early 2020, the expo involved 43 project teams. For an online conference of the same duration, each team would have about three minutes to present. Alternatively, to give each team 15 minutes to present, the

virtual expo would be over 10 hours long. Regarding attendance, an online scenario would lack visual cues, such as a poster, to draw attention to projects. Teams could remain online and available for the duration of the expo but have no one stop in to talk about the project. Finally, we needed something substantive to garner additional attendance beyond faculty and students.

To address these concerns, the instructor, in consultation with eLearning and other faculty, decided to run the virtual expo like a conference with scheduled sessions. First, to promote the projects and encourage attendance, the instructor asked each team to prepare a 10-minute video rather than a poster. Second, to promote the event, the instructor prepared a dedicated website. Finally, to ensure the event lasted for a similar duration as the original event, the instructor scheduled five tracks that each contained eight or nine projects. For readability, we show only three of the five total tracks in Figure 1. The instructor scheduled each team for a 15-minute question-and-answer (Q&A) session in which attendees could submit questions via the chat feature.

For the project video, the teams included content similar to content in a poster (e.g., experiences, technical skills, and lessons learned). Typical content included the problem statement, project scope, high-level requirements, product design, and a demonstration of the final product. With the new medium, the instructor advised them to plan and script the presentation. If the students did not have their own video recording software, the instructor recommended that they use Open Broadcast Software (obsproject.com).

START TIME	TRACK 1 Join Session »	TRACK 2 Join Session »	TRACK 3 Join Session »
Click a project name for detail			
5:00 PM	M3 Miami Mapper	Big Touch Phase 3	SP Analytics II
5:15 PM	Parking Pal	Model Clone Portal (MoCoP)	eSports Analytics
5:30 PM	Distributed Taxi	Grant Management System —R&I	Pairmaster
5:45 PM	Wheelshare	MME CardSwipe	Hobi
6:00 PM	Miami LibFinder	Visitor Management System	Twilight Bark A
6:15 PM	Miami LibTracker	AV Processing	The Custodians of Oxford
6:30 PM	3D Object Annotation	Scale Interface	Twilight Bark B
6:45 PM	Organic Matter Detection	Molecular Visualization	Calorie Counter A
7:00 PM	Temporospatial Visualization	The Station	

Figure 1. Online Expo Schedule (3 of 5 Tracks Shown)

The instructor prepared the expo website using WordPress. The website communicated project information, the expo schedule, and attendance procedures. The website presented each project as an individual blog post (see example in Figure 2). Each blog included the project name, the client name, the problem statement, the project purpose, the team member names, and the team video. We assigned each project a category for client type (external, student sponsored, faculty, or university), project type (development or R&D), time slot (assigned Q&A start time) and track (1-5). The categories provided a means for users to search and filter projects.

Before the expo, we published the website with all track links. The homepage presented an introduction from the department chair and the website's purpose. We expected participants to use the website to find relevant projects, view relevant videos, and pick the Q&A sessions to attend. In particular, we expected faculty to attend several Q&A sessions. To assure an even distribution, faculty reviewed the project blogs and then signed up on a shared Google Sheet.

We selected Webex Events as the conferencing venue because it supports large-scale interactive experiences (https://www.webex.com/webinar.html). Additionally, Webex Events allows for early scheduling, invitation lists, recording, and user role assignments. We used roles in order to eliminate any potential disruption during the event. To manage traffic and pace, we assigned a moderator the owner role for each track. Moderators had full authority over the event, attendee participation, and audio/video privileges.

Prior to the evening of the Q&A sessions, moderators conducted two practice runs. These practices allowed the moderators to familiarize themselves with the technology and to review the procedures and expectations. We expected moderators to introduce each project and start it on time, assign the presenter, manage participants, bring overlooked questions to students' attention, and conclude each session on time.

An event participant joined as either a panelist or an attendee. Panelists could ask and answer questions and share their screens. A student, client, faculty mentor, or other guest had to be pre-assigned as a panelist in order to receive an email invitation containing the correct link. Any other participant could join as an attendee by clicking the link provided on the website's schedule page. As an attendee, a participant had only listening/text chat privileges. If an intended panelist accidentally joined as an attendee, the moderator could change the role to panelist. The moderators had the list of team members and a designated presenter for each session prior to the event.

2.2 Participation in the Expo

On the evening of the Q&A sessions, the moderators had several duties before the expo began. Each activated their events track 30 minutes early, posted a splash page, joined a moderator support session, and started recording 10 minutes before the first session. The recording then ran continuously for the entire track. Participant saw the splash page as default in situations with no active screen sharing. The splash page included the track number and the schedule for that track. To further support the moderators, a separate Google Hangout ran for the event's duration so moderators could communicate quickly or ask the backup moderator to take over in an emergency.

Students had three main responsibilities for each Q&A session. First, they needed to attend the sessions with both video and audio. We required they used video to make the event more personable. Second, the students had to manage their time. They first introduced the team members and then briefly introduced their project prior to taking questions. Finally, we expected the teams to have several discussion points prepared in advance in case they had extra time with no questions.

Faculty judged the projects using a rubric implemented in Google Forms. The form collected feedback and recommendations for an outstanding project award. By using Google Forms, we could also easily compile the results afterwards.

Objective Congressional Districts

Track 5, 6:15 PM

CLIENT: Alan Farrenberg

PROBLEM STATEMENT:

The gerrymandering of congressional districts has caused confusion and distrust within the general public about how district lines are drawn and for what reasons. There is a need for a system to generate optimal congressional districts for the State of Ohio and allow users to view the districts on a map.

PROJECT PURPOSE:

The purpose of this project is to draw congressional districts using algorithms so that political bias is removed from the drawing process. This will ensure that citizens are fairly represented by their congressional districts according to the U.S. Constitution.

TEAM MEMBERS:
Tim Romer, Steven Kast, Gauthier Knox Kelly, and Brian Fotheringham

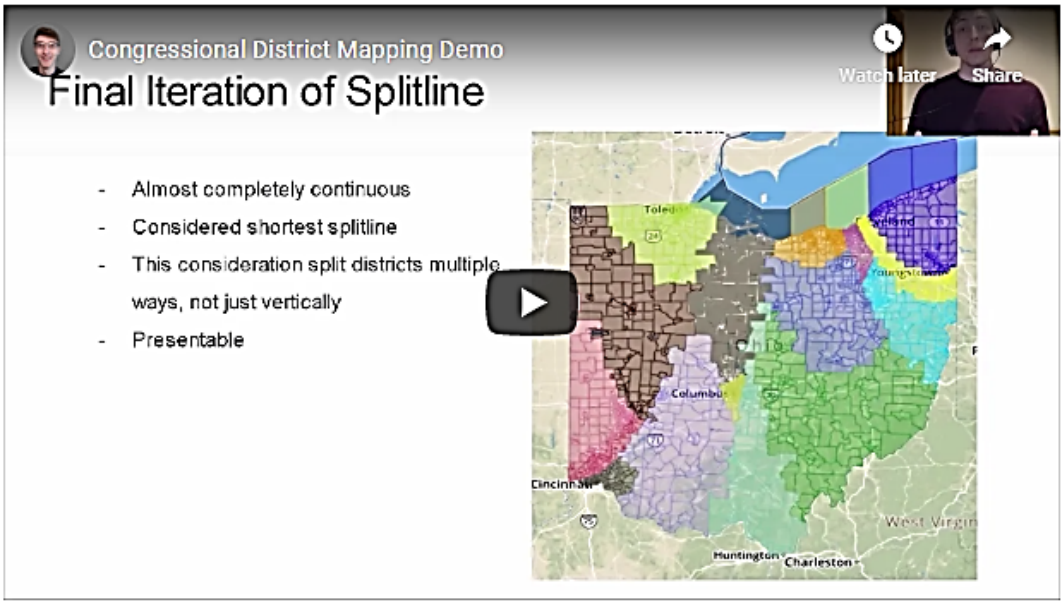

Figure 2. Example Project Blog

3 Discussion of Experiences

In this section, we describe three kinds of feedback: a student survey, a faculty survey, and the project evaluation rubric. Both surveys were online, anonymous, and approved by our university's institutional review board. The judging rubric indicates that a student achieved learning outcomes, while the student and faculty participant feedback indicates satisfaction and recommendations for future improvements.

3.1 Student Experiences

Immediately following the event would have been the ideal time to collect feedback about the online expo; however, we remained focused on meeting end-of-semester and end-of-academic-year obligations and did not leverage the opportunity. Anecdotal, unsolicited feedback from students via a general reflection assignment indicated that they viewed the expo experience in mostly a positive manner. We followed up with the students via an email link to an online survey in the following semester since our university allows students to retain their email accounts in perpetuity and some alumni may continue to read their email. We sent the survey link to 157 students, and 22 responded (7% response rate). Despite the low response rate, the respondents provided actionable feedback about the event.

We asked students to rate their agreement with statements about the video assignment and the expo experience using a five-point Likert scale (5 = strongly agree; 1 = strongly disagree). We provide the weighted averages for the 22 respondents in descending order by weight in Table 1. In both the video and expo feedback, we found the highest agreement for the expectations that the instructor communicated, while the lowest score in both cases concerned communication skills.

Table 1. Student Survey Results

Weighted average	Statement
Video feedback	
4.09	The course instructor clearly communicated expectations for the video assignment.
3.95	The video allowed my team to showcase our project's highlights.
3.50	My previous experiences in classes prepared me for giving a video presentation.
3.36	Preparing the video helped me to develop my remote presentation skills.
Expo feedback	
3.77	The course instructor clearly communicated expectations for the online expo.
3.59	My previous experiences in classes prepared me for participating in an online question and answer activity.
3.45	Participating in the expo helped me to practice communicating with an audience about project accomplishments.

We also asked the students two open-ended questions about the positive aspects of the expo (n = 18) and ways to improve it in the future (n = 10). The most frequently reported positive aspect concerned convenience (the length of the expo sessions (5) and that the event did not require travel (3)). The next most frequent comments concerned the event's good response to the challenges that the pandemic presented (3) with one student commenting that "it felt like a real (non-superficial) expo." Three respondents also commented on the good organization of the event, while two commented on how it prepared them for the remote work environment they now find themselves in. In the areas for improvement, four students thought the Q&A time did not last long enough, three suggested that expectations for the Q&A activities be clarified, two suggested that talking time be more balanced among team members, and two wanted more attendees.

3.2 Faculty Experiences

We surveyed faculty in the following semester to identify positive aspects of their experience and ways to improve the event in the future. The faculty rated their agreement with statements about the teams, videos, and expo using a five-point Likert scale (5 = strongly agree; 1 = strongly disagree). Of the 21 faculty members eligible to take the survey (we did not take the survey), 11 responded (52%). We summarize the results in Table 2. We found the strongest agreement for the video presentations, the format of the Q&A sessions at the online expo, and professional behavior exhibited at the expo. We found the lowest scores for communication skills both in the videos and the expo.

In an open-ended question about the videos' and expos' positive aspects, nine faculty members responded. They most frequently mentioned the ability to view the videos in advance (5) followed by the organization of the videos and online site (3 and 3, respectively), while two faculty suggested that the expo served as a good learning experience for students to adapt to adversity. One person mentioned that the audio for the Q&A was much better online than the acoustics in person. Areas for improvement (n = 8)

included that students repeated video content in the Q&A (3), that Q&A time should be increased (2), and the event had too many parallel sessions (2).

Table 2. Faculty Survey Results

Weighted average	Statement
4.09	Overall, the video presentations were informative and well-organized.
3.91	The teams exhibited professional behavior in the videos.
3.73	The teams exhibited good communication skills in the videos.
4.00	The format of the expo was adequate for question and answer sessions.
4.00	The teams exhibited professional behavior in the online expo.
3.70	The teams exhibited good communication skills in the online expo.

3.3 Evaluator Experiences

In 2020, department faculty primarily evaluated the online expo. In contrast, the in-person expo operated in conjunction with an industrial advisory board meeting in 2019 and had almost as many external evaluators as faculty. The evaluators in both years used a rubric with the categories and scores that we show in Table 3. They scored the categories as follows: excellent = 4, good = 3, acceptable = 2, and marginal = 1. The online expo achieved a score of 3.11, which indicates that the students achieved well in communication, project scope, and project accomplishments. Furthermore, the expo achieved comparable scores in both years.

Table 3. Judging Results (Four-point Scale)

Category	2019 in-person expo score	2020 online expo score
Visual appeal / quality of the poster or video	3.11	3.22
Verbal explanation / description of project achievements	3.35	3.16
Challenge, difficulty level, and / or scope of the project	3.04	3.08
Quality of project accomplishments	3.12	2.98
Overall average	3.16	3.11
Number of projects	36	43
Number of faculty evaluators	15	23
Number of external evaluators	14	1
Average number of evaluators per project	3	2-3

4 Lessons Learned

Overall, the event went well, and faculty and students viewed the site and the videos positively. Our department chair suggested that students prepare a video for future expos regardless of whether we conduct it in person or online. Future teams now have a library of videos to review for perspective and examples. The site itself had 947 views on the day of the Q&A session and 2,050 total views since its publication date. Of the 18 projects with external clients, 17 had client attendance at the expo for a total of 21 people. All of the clients for the 25 internal projects attended along with 14 non-client faculty; 42 of 43 teams had a non-client faculty attend their Q&A session.

While the faculty evaluators expressed satisfaction with students' effort, the instructor found videos' quality somewhat disappointing. At other times during the course, the teams had opportunities to present material in person. While the instructor found previous presentations good to exceptional, the online videos lacked the organization, presentation, and scripting compared to earlier work. Accordingly, the instructor identified the need to update efforts to teach communication skills and have students practice them to reflect the changes and challenges of virtual communication (such as videos and online conferencing). Other opportunities for creating videos could be introduced earlier in the capstone courses to allow additional practice.

To implement an event of this nature in the future, instructors could improve several aspects. The instructor built the website on her own, and it took much time to complete. We recommend that instructors implement an automated process for teams to load and manage their material with instructor oversight. WordPress has some plugins that could provide this functionality.

Webex Events worked as we expected, but we experienced two problems in managing the panelist and attendee roles. First, the instructor found it cumbersome to set up and administer the invitation lists for each track. Webex Events has a bulk-load feature for invitee information, but we could not locate sufficient documentation about this feature, we found navigating the website non-intuitive, and it lacked list-verification features. As a result, we found it difficult to verify panelists on the list. Second, having the two roles seemed to confuse both faculty and students despite the extensive instructions they received. Many students joined their tracks as attendees and, via chat, requested that the moderator change their role to panelist. While we experienced no major delays, the execution did not go as smoothly as we expected. Additional low-stakes practice with the technology could help to alleviate these issues.

We received some recommendations for the Q&A sessions. Students suggested more time for Q&A, more balance among speakers, and more attendees. Faculty requested less repeated video content and more ability to see projects of interest scheduled at the same time. One could address all these issues with minor adjustments such as by adding more time per Q&A session, reducing the number of tracks, inviting more attendees, and enhancing the requirements for student preparation and participation. Since one would have to increase the event's duration with such changes, one could split it into multiple evenings like many virtual conferences. In the future, we plan to offer an online expo (perhaps in addition to an in-person event) due to the many advantages that it offers; we also intend to invite industry representatives, alumni (especially recent graduates), and students in lower-level courses. A future research direction could be to follow-up with recent alumni about the impact that remote collaboration and communication have on their current career activities. We summarize the key takeaway ideas in Table 4.

Table 4. Key Takeaway Ideas

- Students need to be able to engage in remote collaboration and presentations to develop their workforce skills.
- The way in which one organizes and manages online content and events dictates success, but one can improve such processes via automating some routine administrative tasks
- Additional practice and constructive feedback throughout the course may enhance presenters' communication skills presentations' quality
- Finding the right balance between session length, number of tracks, and duration of the event contributes to both convenience and attendance

We met the course learning outcomes during the transition to remote instruction. The student teams worked together to solve an open-ended problem and to professionally communicate their solutions in both videos and online conferencing.

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About the Authors

Lynn Stahr has over 20 years of experience in public sector IT project management. She joined the Department of Computer Science and Software Engineering at Miami University in 2019 as the instructor for the senior design courses. She is also a graduate student working on her master's degree focusing on effective delivery of a capstone experience using agile methodologies.

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