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The Influence of Attendance, Communication, and Distractions on the Student Learning Experience using Blended Synchronous Learning

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The Influence of Attendance, Communication, and Distractions on the Student Learning Experience using Blended Synchronous Learning

Abstract
A second-year engineering course at the authors' institution was offered via a blended synchronous learning (BSL) method of delivery whereby students could choose to attend lectures live (face-to-face) or remotely (via a synchronous, live stream over the internet) during a summer semester. Survey and grade data were collected across two years of this offering. Attendance, interaction, communication with the instructor, and general distractions were main themes affecting the student learning experience both positively and negatively. Specifically, students found the remote access, the ability to ask questions, the teaching style, and having more time during the summer semester as positive aspects to their learning experience. Negative influences on their learning experience related primarily to their busy work schedules, technological issues associated with BSL, and typical summer distractions. Critically, our results indicate that attendance is a key indicator of student grades (after correcting for GPA), regardless of whether students attended lectures remotely or face-to-face: students attending more than 75% of the lectures performed on average 12% better than students who did not (p=0.0093). The consensus in the student comments was that the remote attendance option allowed students to attend in situations where the alternative was no attendance at all, implying that the potential gain in grades due to higher attendance may outweigh any potential impact the mode of attendance may have. Overall, a synchronous, remote attendance option may provide a lifeline to students who would not otherwise be able to attend a course, and (assuming a mode of interaction, such as the synchronous chat, is available) students do not perceive remote attendance as having a negative influence on their learning.

Un cours de deuxième année en génie dans l'établissement de l'auteur a été offert par le biais de l'apprentissage mixte synchrone, où les étudiants pouvaient choisir d'assister aux cours magistraux en personne ou à distance (par le biais de diffusions synchrones sur internet) au cours d'un semestre d'été. Des données ont été recueillies (sondages et données sur les notes obtenues) au cours de deux années pendant lesquelles ce cours avait été offert selon cette méthode. L'assiduité, l'interaction et la communication avec l'instructeur, ainsi que les distractions générales, étaient les thèmes principaux qui ont affecté l'apprentissage des étudiants, tant positivement que négativement. Plus précisément, les étudiants ont trouvé que l'accès au cours à distance, la possibilité de poser des questions, le style d'enseignement et le fait d'avoir davantage de temps au cours du semestre d'été avaient été des aspects positifs de leur expérience d'apprentissage. Les aspects négatifs de cette expérience d'apprentissage étaient principalement liés à leur emploi du temps chargé, aux problèmes d'ordre technique liés à cette méthode d'enseignement, ainsi qu'aux distractions typiques de la saison d'été. De façon critique, nos résultats indiquent que l'assiduité est un indicateur clé des notes obtenues par les étudiants (après correction pour la moyenne pondérée cumulative), quelle qu'ait été la manière d'assister au cours de l'étudiant (à distance ou en personne) : les étudiants qui avaient assisté à 75 % des classes avaient en général obtenu de meilleures notes (12 %) que les étudiants qui n'avaient pas été assidus (p=0,0093). Le consensus observé dans les commentaires des étudiants était que la participation au cours à distance avait permis aux étudiants d'assister aux classes dans des situations où l'alternative aurait été de ne pas y assister du tout, ce qui implique que le potentiel d'obtenir de meilleures notes grâce à une meilleure assiduité pourrait peser davantage que n'importe quel impact causé par la manière de participer au cours. Globalement, l'option de participation synchrone à distance pourrait offrir une bouée de sauvetage aux étudiants qui, sans cela, ne seraient pas en mesure de suivre un cours, et (en supposant qu'il existe un mode d'interaction, tel que le clavardage synchrone) que les étudiants ne perçoivent pas que l'assiduité à distance a une influence négative sur leur apprentissage.

Keywords
blended synchronous learning, attendance, online chat, student learning, asking questions; apprentissage mixte synchrone, assiduité, clavardage en ligne, apprentissage des étudiants, poser des questions

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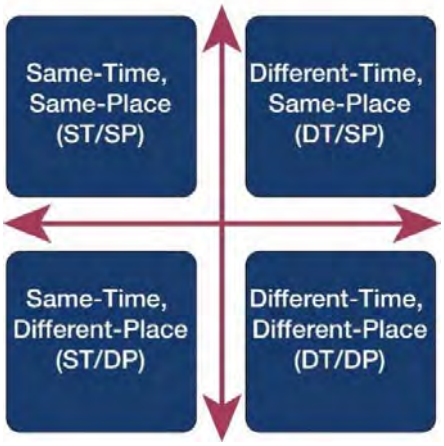
The traditional classroom model, often referred to as "face-to-face" or "bricks and mortar," requires that learners physically come together, typically grouped in a cohort by age or level, to meet at scheduled times and locations for a fixed duration. Conversely, distance education (DE) is a means to deliver content and instruction to learners separated by time and/or location via correspondence text packages, or, with technology developments, broadcast television, radio or teleconferencing (Kovanović et al., 2015). As information communication technology has evolved, and with advancements in learning management systems, online delivery of DE has become a more popular option for most post-secondary institutions and their learners (Conklina et al., 2017)

In the last three decades, the Internet has born several new modes of delivery in higher education and various forms of technology-enabled learning, allowing students and instructors to interact at the same time (ST) and in the same place (SP) as in a traditional lecture and/or at different times (DT) and in different places (DP) as is the case for distance education. These elements of time and place have been organized into Coldeway's Quadrants, as depicted in Figure 1 (Simonson, 1995; Simonson et al., 2009). New delivery methods incorporating technology have allowed for additional flexibility in delivering course content such as blended synchronous learning (BSL) where students can attend lectures at the same time (ST) but from different places (DP).

Figure 1

Coldeway's Quadrants Illustrating Combinations of Time and Place for Learning



Note. Adapted from Simonson et al. (2009).

As defined by Bower et al., (2015), blended synchronous learning (BSL) takes into account time, location, and technology by leveraging technology to allow remote, but synchronous access to the course. BSL is "learning and teaching where remote students participate in face-to-face classes by means of rich-media synchronous technologies such as video conferencing, web conferencing, or virtual worlds" (Bower et al., p. 1) Also referred to as synchromodal learning (Bell et al., 2014), multi-access learning (Irvine et al., 2013), or synchronous hybrid learning (Cain & Henriksen, 2013), these course designs allow students agency in access and personalized learning experiences within the same course (Irvine et al., 2013). Furthermore, designing courses in this way allows all learners to maintain the ability to interact in real time with the instructor, content, and their peers, even if attending remotely.

Recently, there has been considerable interest in the efficacy of the BSL approach and the establishment of best teaching practices (Bower et al., 2015; Cain, 2015; Hastie et al., 2010). As this is an emerging research area, there are some studies that have explored the student learning experience using BSL (Raes et al., 2019). While generally positive, there is still a need to identify the effects BSL has on student learning, how students perform academically, and the long-term implications of adopting a BSL approach (Conklina et al., 2017; Raes et al., 2019; Wang et al., 2017; Zydney et al., 2019).

Delivering a BSL Course

The BSL delivery method was used to teach a second-year course within the engineering curriculum at the authors' institution. Typically, this course was offered in the winter semester to a class of approximately 400 students. If students failed this course, they had to wait a full year to enroll in the course again. Given the course focus on developing both technical and problem-solving skills, there tended to be a high failure rate (approximately 15%). The department observed that approximately 70-100 students annually were losing a year of school due to these high fail rates, so, to allow these students to remain on track in their programs, a summer offering of the course was created.

Most students moved away for the summer (many for co-op jobs). To allow students to attend and interact with the lectures from off campus, the instructor (one of the authors) chose to deliver the course using a BSL approach. As this was the department's first summer offering of an undergraduate course, students were surveyed to assess the impact of the offering on their learning experience and to better understand their overall summer experience. The results of that survey prompted this study and the associated study questions.

Research Questions

The department's main concern was with respect to the overall student learning experience in the summer offering of the course. In this study, we were interested in two components of that experience: (a) the students' perception of their learning experience and (b) whether the delivery method had an impact on student grades. While we are aware that student grades do not always correlate to the quality or durability of learning (Soderstrom & Bjork, 2015; Stanca, 2006), we include grades in this study because students themselves tend to place significant focus on the assessment and the associated grades (Ramsden, 1992). Therefore, the overall grade in the course is a component in the overall student experience even if it is not indicative of their learning. These interests led to this paper's research questions:

- What influence, if any, does the BSL delivery mode have on the student learning experience?
- Does attendance and the mode of attendance (remote or face-to face) affect students' overall course grades?
- When taking this course delivered in this BSL mode, what do students perceive to be the positive and negative aspects of their learning experience?

Method

The Course (Traditional Offering)

The course is core to all second-year engineering students in the authors' institution. The primary focus of the course is to teach fundamentals of circuit analysis. A secondary focus of the course is to develop problem solving competencies. The course has three hours/week of lectures and two hours/week of problem-solving tutorials and hands-on lab time. Tutorials and labs are delivered by teaching assistants, and lectures are delivered by a faculty member.

The regular offering of the course was a traditional offering with no online components aside from the standard Learning Management System (LMS) content: lecture notes, assignments and solutions, and online forums. Lectures were delivered in one large section (approximately 300-400 students in a classic lecture hall). The instructor delivered the lecture by scribing handwritten notes on a Microsoft Surface tablet which were projected onto large screens at the front of the class. In addition to the live handwritten notes, all students had access to a set of incomplete textbook-style course notes that contained strategic blank spaces for students to fill in during lectures. Active learning techniques were used in every lecture, including opportunities for students to solve problems with peers and then report their methods and solutions back to the class.

Tutorials were ungraded and provided students with structured mini-lessons on the previous two weeks' material followed by structured, peer-assisted problem-solving sessions. Labs were performed and assessed in groups of two and consisted of hands-on learning opportunities where students built and measured circuits and compared their results to theoretical predictions based on the material that they learned in lecture.

The assessment breakdown of the course was (nominally)

- Lab (group): 15%
- Midterm (individual): 30%
- Final (individual): 55%

Students were required to pass the combination of the midterm and final to pass the course.

The Intervention – BSL Approach

The BSL approach incorporated many aspects of the traditional lecture, with a similar delivery style using the same course notes, active learning techniques, and grading scheme. To address the needs of all students in the first summer offering (S1), including those attending from off-campus, the instructor used Adobe Connect version 9 (Adobe Systems, San Francisco, California) to live-stream the lectures. The live-stream included the instructor's voice and the instructor's hand-written notes, which were scribed using Microsoft Journal (Microsoft, Redmond, Washington) on a Surface Pro 2 (Microsoft, Redmond, Washington). The classroom was not equipped with video cameras, so video was not included in the feed. In retrospect, this may have reduced student complaints about technical issues and cognitive load which are common in other BSL studies where video is incorporated into the BSL lecture delivery (Conklina et al., 2017; Raes et al., 2019) Students were free to choose between attending face-to-face or remotely as their situation allowed.

Tutorials and office hours were also conducted using this BSL methodology. The midterm and final exam were written in-person and required students to travel to campus. Students who had successfully completed labs in a prior term were given lab exemptions; remaining students were required to travel to campus twice (on weekday evenings or on Saturdays) to complete the lab components.

A major concern during course planning was the ability for remote access students to engage with the lectures, so the "Chat Pod" feature in Adobe Connect was enabled, allowing remote users to participate synchronously in the lectures by typing text in an online chat box. Students (remote and local) could type questions or comments, and the instructor would then acknowledge and verbally respond. The chat and handwritten notes were simultaneously projected onto the screen at the front of the classroom so that participants physically present in the room could see the chat content without being logged in.

During the active problem-solving opportunities, the instructor would monitor the chat for any questions or potential solutions and reply to the students verbally. The instructor would also encourage interaction between local students and remote students by verbally repeating in-person student comments so that remote students could hear and then reply via the chat. When appropriate, the instructor would probe the class (both local and remote students) and wait for responses from multiple students before proceeding.

Lectures and the chat were not recorded and retained; however, the instructor did report the following observations. In the S1 offering, approximately 20-30 students would log into the chat for every lecture and approximately 5-10 of those students would participate by typing at least one comment. There was engagement during group problem solving opportunities (3-5 students actively participating in questions and answers and 2-3 additional students making one or two comments). Similarly, background (on-topic) chatter was present in the chat during lecture, with approximately 2-3 mini conversations per 1.5-hour lecture.

An additional offering of the course was held the following summer (S2). Both offerings were delivered by the same instructor, in the same format, and with the same set of lecture notes. The fail rate in both offerings was similar to that of the regular Winter offering.

Participants

The participant pool included all registered students for the S1 (n=74) and S2 (n=47) offerings. In total, 43 students in S1 and 16 students in S2 (for a total of 59 participants) provided consent to participate and were included in this study. Participants were removed from the study for one of two reasons: (a) participants did not fully complete the survey and/or (b) participants did not write one of the two exams. The overall course averages were 61.5% (S1) and 57.9% (S2), while the overall course average of participants was 63.6% (S1) and 63.7% (S2).

Participants were recruited via an in-class announcement and an email inviting them to participate in the study in the last two weeks of class prior to the final exam. Informed consent was administered via the first question in the on-line survey. This study was approved by the University of Guelph Research Ethics Board (approval #14JN034). Participants received an identification code and were anonymous for the processing of both qualitative and quantitative data. The course instructor examined de-identified data only after course completion.

Instruments – Survey

The survey was initially created by the researchers as a quality assurance tool; as such, many of the questions were asked as part of the instructor's continual improvement efforts and are not relevant to this study. Relevant questions are included in the appendix. The online survey used a combination of Likert-style questions, open-ended response boxes, and specific numeric questions. The S1 survey was re-administered the following year (S2). In all cases, responses from participants who provided informed consent were tied to their final course grade.

A potential limitation of this study is the reliance on self-reported student data. However, according to Owston et al. (2011) and Kuh (2001), as long as survey questions are clear and refer to recent activities, the respondents think the questions are important, and answering the questions does not violate the privacy of the respondent, then the results are likely valid. In this case, the survey questions generally met the above criteria as they were reviewed for clarity by senior teaching and learning support staff and they directly related to the student experience in that semester with a new course delivery method.

Statistical Analyses

To address the first research question, multiple linear regression (MLR) parallel slopes models were performed ($p \leq 0.05$) on the dependent variable Grade (%). Two-sided t-tests were also performed ($p \leq 0.05$). All independent variables were self-reported and included grade point average (GPA), percentage attendance, and attendance in the two modalities (face-to-face or remote). Data for the independent variables were obtained from the completed questionnaires. All statistical analyses were performed using R, version 3.5.1.

Qualitative Analysis

To review student perceptions, qualitative data were collected from the open-ended survey questions relating to the student experience with the BSL delivery method. These responses were reviewed by the first author to identify a list of significant statements that were later binned into common themes. Similarly, the last author also reviewed the responses and binning of the themes. Generally, there was good agreement regarding the identification of themes between the authors and any discrepancies were discussed to reach a consensus. Some survey question responses highlighted multiple themes and were identified as such, resulting in more statements than the count of the overall responses to that particular question. In many of the open-ended answers, students explicitly wrote "nothing" or equivalent (e.g., "I can't think of anything", "NA", or "it's perfect"). These responses were collected in the "nothing" bin to indicate that they were explicitly different from a blank response. In all cases, only responses containing actual text were counted.

Results

Quantitative Results

It is well known that GPA and attendance both correlate positively to final course grades (Chen & Lin, 2008; Crede et al., 2010; Gatherer & Manning, 1998; Marburger, 2006; Purcell, 2007; Romer, 1993). A goal of this research was to determine if this held true in a BSL setting and

whether the mode of attendance (i.e., face-to-face or remote) had any correlation. To this end, our quantitative analysis looked at three variables: GPA, attendance, and the mode of attendance (i.e., face-to-face or remote).

Correlation of GPA and Overall Attendance to Course Grades

Students self-reported their GPA through a text box and their overall attendance via a four-point scale (<25%; 25-50%; 50-75%; >75%). The first three bins (<25%; 25-50%; 50-75%) were collected into one category (Attendance=0, *n*=17) and the >75% bin into another (Attendance=1, *n*=40). This grouping aligns with other studies in the literature where attendance can have a significant effect when students attend most of their lectures (Bethune, 2010; Stanca, 2006; Purcell, 2007); furthermore, this grouping was necessary due to low counts in the bottom bins (<25% *n*=5; 25-50% *n*=1; 50-75% *n*=12). With this setup, we applied a multiple linear regression (MLR) parallel slopes model, yielding the following:

$$\text{Grade} = 0.97 + 0.80 * \text{GPA} + 12.72 * \text{Attendance},$$

with R^2=0.285 (Table 1 and Figure 2). The interaction term between Attendance and GPA yielded negligible improvement in the model and was not significant so it was not included.

Table 1

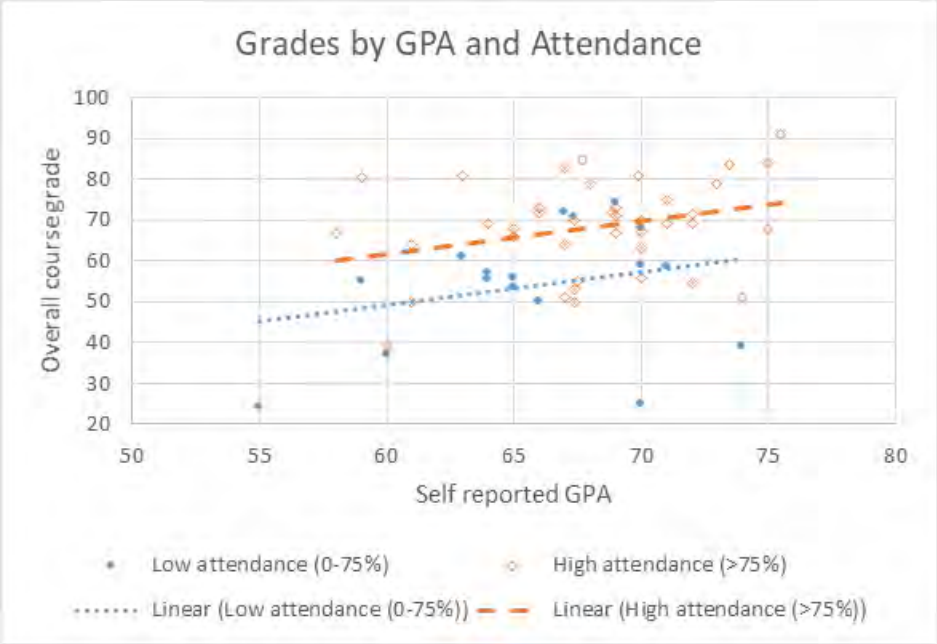
Coefficient Table of Grade vs Self-reported GPA and Attendance, Parallel Model

	Estimate	Std. error	*p*
Intercept	0.97	24.32	0.9685
GPA	0.80	0.367	0.0328
Attendance	12.72	3.65	0.0010

These statistically significant results indicate that attendance and GPA are good predictors of grades. In particular, attending more than 75% of lectures yields grades that are (on average) 12.7% higher for participants with the same self-reported GPA, with a 95% confidence interval of 5.42%-20.05%.

Figure 2

Overall Course Grades Against Self-reported GPA and Attendance, Parallel Model

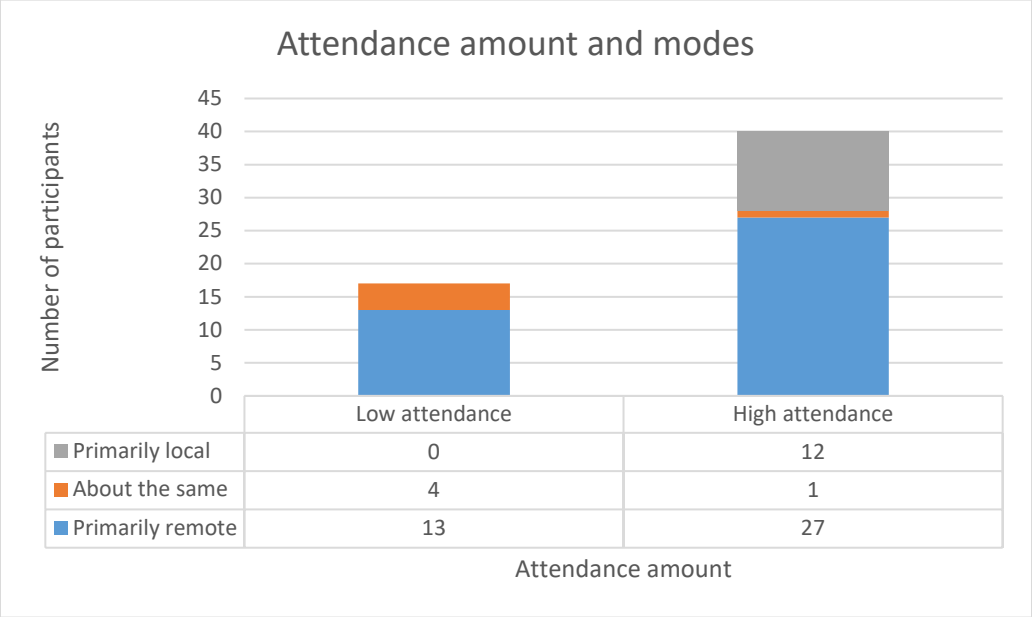


Impact of Attendance Mode

To assess whether attendance mode (i.e., remote or face-to-face) impacted student grades, students were asked to self-report their remote attendance and face-to-face attendance on the four-point scale (<25%; 25-50%; 50-75%; >75%) and were then placed into one of three categories: (a) Remote: higher remote attendance than face-to-face attendance; (b) Local: lower remote attendance than face-to-face attendance; and (c) Same: same remote and face-to-face attendance. All Local participants reported attending more than 75% of lectures (Figure 3).

Figure 3

Attendance Amount, Separated by Mode of Attendance



Due to the small sample sizes in the Same group (n=5), we excluded the Same group and proceeded with a parallel slopes MLR on the primarily local and primarily remote participants (n=52), yielding

$$\text{Grade} = -2.41 + 0.84 * \text{GPA} + 11.33 * \text{Attendance} + 7.84 * \text{Mode},$$

with R^2=0.32 (Table 2 and Figure 4). Again, interaction terms provided negligible improvement and hence are not included. Note that Mode was not significant.

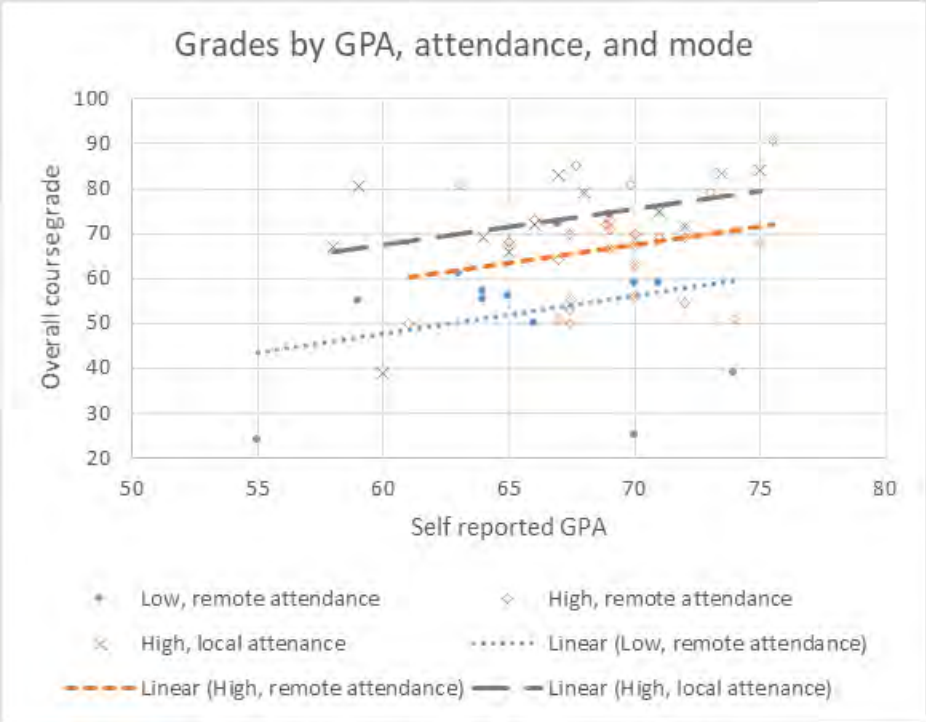
Table 2

Coefficient Table of Grade vs Self-reported GPA, Attendance, and Remote vs Local Attendance Mode, Parallel Model

	Estimate	Std. error	*p*
Intercept	-2.41	26.081	0.9267
GPA	0.84	0.392	0.0379
Attendance	11.33	4.291	0.0111
Mode	7.84	4.338	0.0771

Figure 4

Grades vs GPA, Attendance, and Mode of Attendance - Parallel Model, Excluding Same Attendance Mode



To determine whether remote attendance has an impact on grades *independent* of attendance amount, we analyzed the subgroup consisting of only those participants who reported high attendance (n=39), yielding the MLR

$$\text{Grade} = -0.8138 + 0.978 * \text{GPA} + 8.191 * \text{Mode},$$

with R^2=0.1691 (see Table 3).

Table 3

Coefficient Table of Grade vs Self-reported GPA, and Remote vs Local Attendance Mode, for High Attending Participants, Parallel Model

	Estimate	Std. error	*p*
Intercept	-0.814	30.04	0.9785
GPA	0.978	0.434	0.0304
Mode	8.191	3.975	0.0466

These statistically significant results indicate that the mode of attendance (remote or face-to-face) does affect grades. In particular, attending remotely yields grades that are (on average) 8% lower for participants with the same self-reported GPA, with a 95% confidence interval of 0.241%-16.141%.

Interestingly, these significant results emerge for this sub-group only when **both** GPA and Mode are included in the model. For example, a two-sided t-test of this subgroup comparing the Remote (Mean=66.7, SD=11.3, n=27) vs Local (Mean=72.5, SD=12.4, n=12) categories yields

p=0.186. A power analysis (power=0.8) revealed that, if a significant difference between the means of these two groups does exist (independent of GPA), then 110 more participants (149 total, 46 Local, and 103 Remote) would need to be added to the study to observe that difference while maintaining approximately the same ratio of participants in the groups.

Qualitative Results

In the survey, students were asked, "Do you feel that the [department] should start offering more summer courses?" and "Should these offerings follow the simultaneous local/remote delivery style that was adopted for this offering of [course code]?" All responses to both questions were unanimously "Yes." Given the quantitative results showing that remote attendees tend to have lower grades than local attendees, what could the motivations be for students to have such a strong desire for BSL courses of this type?

Based on the survey responses, the student learning experience can be divided into two overarching themes of (a) interaction and communication and (b) general distraction, both of which positively and negatively affect the student learning experience. Generally, students attend lectures so that they can interact with the instructor in order to learn the course material (Gysbers et al., 2011). When this interaction is enhanced through the ability to ask questions and engage with the instructor and classmates, students have a positive learning experience. When this interaction with the instructor is inhibited as a result of technological issues, large class sizes, and personal insecurities, students have a negative learning experience. Also contributing to a negative learning experience is the level of distraction resulting from work commitments, fellow classmates, and other technologies.

Positive Learning Experiences

Since there are fewer courses offered in the summer by the institution, students experienced a reduced course load with smaller class sizes. This reduced course load in combination with the ability to attend lectures with the BSL format provided for a positive student learning experience.

Responses to 'What **positively** impacted your learning experience?" (*n*=48) tended toward issues outside of the student's individual control, such as the BSL approach, the teaching methods/style, and the fact that this was a summer offering (Table 4). The highest number of participant comments centered on *BSL* related pedagogy, such as remote access, the online chat, etc., while the second highest number of comments focused on *non-BSL Pedagogy*, such as the small class size and compliments for the teaching team. Some participants specifically commented on the *lower course load*, while a few comments discussed *study habits*.

Table 4
*What **Positively** Impacted your Learning Experience this Term?*

Bin	Sub-theme	Representative Comment(s)	Count (*n*=48)
Blended Synchronous Learning (BSL)	Distance/ accessibility	"Remote lecture were (sic) the biggest thing. Being able to tune into the lecture from a quiet, distraction-free environment was amazing. I was much more engaged in the lectures because of this factor alone"	10
		"Accessing class, tutorials and office hours remotely"	
		"Being able to access the lectures from work…"	
		"… being able to attend all the lectures from my home"	
	Live, online chat	"I like the fact that I got to voice out my opinion freely on the virtual platform and speak up if I don't like anything regarding the course without a fear of facing the prof in person and telling them the exact same thing. […]."	5
Non-BSL Pedagogy		"smaller class size made it less distracting for me to learn, allowed me to stay more focused on the discussion occurring during lecture time"	10
		"Good teachers and ta (sic) assistance"	
Asking questions		"was able to ask more questions during lecture and received a quick response"	7
Lower course load		"The fact that I was only taking 1 course and had time to study every night/weekends really helped."	9
Study habits		"Friends in the same course who wanted to do assignments and studying as groups."	7
		"Attending every lecture, doing practice problems, asking for help when needed."	

The accessibility provided by the BSL format along with the online-chat (in-class and remotely) allowed students to ask questions and otherwise interact with the instructor (see Table

5). Some participants commented that the chat feature gave them anonymity which provided comfort to ask a question they might not have otherwise asked. The lower course load, smaller class size, and motivation to do well reduced some of the outside distractions that could potentially limit their learning experience.

Table 5

Is There Anything that you Experienced During this Summer Offering that Would be Valuable to Include in a 'Traditional' Course Offering?

Bin	Representative Comment(s)	Count (*n*=37)
Online chat	"The online chat was extremely helpful! For shy students, like my self, who would never ask a question in a lecture hall I was able to ask my questions through the chat." "The online discussion was actually very valuable! A great way to communicate with the professor and other students. It was a cool way to see other people participate - especially when you were unsure of an answer and saw that many others were unsure as well, it was reassuring in a sense to know that it wasn't just you."	18
Remote access	"I would love if every class could have this option. Although it is beneficial to attend class in person for various reasons (can ask questions, no distractions), remote access made it possible to attend all lectures and not miss any content from the prof. It is sometimes hard to attend all classes (sick, buses, other commitments) and when you miss classes it can be hard to catch up by just copying notes from a friend or getting them online. Online office hours also have many benefits."	9
"Nothing"		6
Recording lectures	"Recordings of lectures would be awesome […] because a lot of important information comes straight from the prof speaking and not necessarily just the notes. Also, with the course-load <program> has it's not always easy to make it to every class."	4

Negative Learning Experiences

The BSL approach was implemented to allow students to attend lectures remotely because they were off-campus and/or working. Consequently, participants found that job duties and other typical summer distractions impacted their learning experience negatively. In the case of co-op or full-time jobs, participants were working 35 to 40-hour jobs (based on survey responses) and this course added approximately 10 hours more per week onto that load, leaving little time for social activities. That said, 44 participants reported having a summer job, 38 of which reported working over 35 hours per week (including 12 that were co-op students), but less than half of those

respondents (*n*=14) indicated co-op or a job as a negative impact on their learning. This response rate suggests that most respondents with full time jobs felt that other negative impacts were stronger or that working did not have a negative impact.

Participant responses to "What **negatively** impacted your learning experience this term?" (*n*=38) focused on work, distance, and time of year (Table 6). Many participants had full time summer jobs or co-op placements (*n*=38) and the largest bin identified *co-op/jobs* as negatively impacting learning, while almost as many comments referenced the fact that the course was offered in the *summer* – no other Engineering courses were offered in the summer semester. The summer category also includes statements around lacking a term 'off' to mentally rest. A large portion of comments also referenced *BSL* specific aspects of the experience, such as technology issues, feeling distanced from classmates, or distractions. Seven responses explicitly indicated that nothing negatively impacted learning.

Table 6
*What **Negatively** Impacted your Learning this Term?*

Bin	Representative comment(s)	Count (*n*=38)
Co-op/job	"The stress of handling a co-op work term and <course> at the same time. It was hard to go straight from a work mind focus to <course>." "maybe work?"	14
Summer	"I guess the only thing would be the fact that it was summer, and I had never been in school during the summer months. It was strange to always have school hanging in the back of my mind when I was making cottage & vacation plans. But it was also nice to have the time to be able to study during exam time."	12
Blended Synchronous Learning (BSL)	"poor internet at times resulted in lectures cutting out" "The distractions that occur when you are not in a classroom environment." "Distance from classmates inhibited groupwork."	10
"Nothing"		7

Further negative aspects to the learning experience can be identified through aspects of suggested improvements to the BSL delivery method (Table 7). Many of the comments related to *improving the ability to interact* via the chat and reliability of the technology to ensure timely and reliable interaction with the teaching team. To mitigate any technological issues, participants suggested that lectures be *recorded* so that they could reference and/or review the lectures later to address any misconceptions or missed content. A number of participants explicitly said *"nothing"* was needed to improve the lecture experience indicating a general satisfaction of the BSL approach. Some participants (*n*=7) identified that extending the BSL approach to a larger class setting (>350

students) may be problematic depending on the distribution of local vs. remote attendees and the volume of chat traffic and questions asked by students.

Table 7
What Would You do to Improve the Lecture Experience for Students Attending Remotely?

Bin	Representative Comment(s)	Count (*n*=57)
Recordings	"I would make the lectures available after they are held that way a student who couldn't make it to a lecture would be able to stay on top of things" "Record Lectures. Poor internet leads to cutting out of sound, picture, etc. […]."	16
"Nothing"		14
Improve ability to interact	"Make it easier for students to get the profs attention. They have to type really quickly to ask a question and the prof could have already moved on before they got to ask there (sic) question. Also maybe make it possible for students to draw and post it in a chat it is really hard to type math equations using a key board" "possibly audio interaction"	10
BSL technology	"It would be easier if the microphone picked up the students in the class as well so we could tell the questions the professor was answer (sic), and when <instructor> was just casually answering a trivial question." "If there was a way for there to be a chat for just the students, so small questions could be clarified by other students without distracting <instructor> […]. If a question asked in the student only chat could be highlighted by other students also confused, and enough students highlighted it, then if that question got reposted into the original chat […] then <instructor> could address questions that might seem insignificant but are actually confusing a lot of people."	9

Attendance Modality Preferences

Some participants attended class remotely some days and in person for others. For these students, we asked them which option they preferred and why (Table 8). All attendance methods had commentary around the ability to *ask/answer questions*; interestingly, different participants found the different modalities superior with respect to this aspect. Many participants who preferred Remote or Combination mention the *convenience* afforded by the BSL format; some of these comments focused on the students' jobs, while others were more general. Some responses in the

In-person and Combination sub-themes provided only vague comments regarding *preference/study habits*. A small number of responses discussed *distractions/concentration*.

Table 8
If You Attended Class Remotely for Some Days and In Person for Others, Which Did you Prefer? Why?

Bin	Representative Comment(s)	Count (*n*=23)
Ask/answer questions	(Preferred Remote) "Remote access makes it really easy to communicate and have questions answered by the prof and peers almost instantly." (Preferred In-person) "If I had a question I could simply raise my hand and [instructor]'d answer it. Trying to get your question answered when a bunch of other students are also asking questions on the chat is a lot harder. Yours tends to get lost."	10
Convenience	"Since I was working it helped me save my time by being home and attend the lecture and ask any questions freely using the virtual system." "having remote made it easier for me to be able to attend class if there was a day when I couldn't attend in person; combination motivated me to learn"	8
Preference/study habits	"Because that is how I feel I can get the most out of the class."	7
Distractions/concentration	"I found it easier to stay concentrated in class. I had a hard time staying concentrated when I attended online." "They both were really well done, I almost preferred doing it remotely because there were less distraction (sic) with friends and classmates"	5

Responses arranged by attendance mode preference are provided in Table 9. Interestingly, two of the four bins have responses from all three categories.

Table 9
If You Attended Class Remotely for Some Days and In Person for Others, Which Did You Prefer? Why? Responses Arranged by Attendance Modality Preference

Bin	Remote	In-person	Combination	Total Count (*n*=23)
Ask/answer questions	4	3	3	10
Convenience	6	0	2	8
Preference/study habits	0	4	3	7
Distractions/concentration	2	1	2	5

Discussion

Our research questions asked whether BSL influences a student's perception of the quality of their learning experience and whether BSL affects student grades. Broadly speaking, our results indicate the following:

- Correcting for GPA, attendance is the single strongest predictor of grades.
- While the method of attendance did have an impact on grades, students perceive that the opportunity to attend remotely is superior to the inability to attend at all.
- Students seem to care more about good teaching and lecture interaction than about how they attend lectures.
- Distractions such as technological issues relating to BSL delivery and work responsibilities negatively influenced the students' learning experience, while the smaller class size and lighter course load positively influenced their learning experience.

Overall, we can conclude that the BSL technology is a valuable tool to improve the ability for students to attend classes without overly interfering with the quality of their learning. It is crucial, however, that a rich method of interaction and communication be provided while minimizing distractions. The benefits of the BSL approach can be summarized by the following participant response:

> No distractions; <instructor's> voice was in my ear so I missed fewer points; I felt immersed in the online experience, and I enjoy spending much time of my day on my computer anyway. The ability to interact with other students without causing a distraction to class was a pro. My confidence in asking questions went up due to the anonymity, and so did other students', so I learnt alot (sic) from the questions. My everyday life was minimally impacted by having to attend class. There was no excuse for missing class so my attendance was higher than my average class attendance, and even the classes I was unable to attend live due to extenuating circumstances I still watched so I have 100% attendance technically.

Influence of BSL on Student Grades

Based on the quantitative analysis, it is clear that attendance is a significant predictor of student grades; indeed, in our study, even with the relatively small sample sizes, attending more

than 75% of the lectures led to an average increase in grades of 12%. This result is consistent with other studies examining student performance and attendance (Chen & Lin, 2008; Crede et al., 2010; Stanca, 2006) and with a prior study indicating that attendance has a significant impact on grades when students miss more than a specific threshold of classes, typically between 30 – 50% (Bethune, 2010; Stanca, 2006; Purcell, 2007). Our study provides further evidence that one of the easiest things students can do to improve their grade is simply to attend class.

Given the strong relationship between low attendance and remote attendance, we hypothesise that external distractions may be contributing to remote students' ability to attend, which in turn impacts those participants' grades (e.g., remote attendees may have jobs that prevented class attendance at the scheduled time). The relatively lower grades of the remote attending participants in this study is different from other studies indicating that remote attending students achieve similar grades to local attending students (Lightner & Lightner-Laws, 2016; Szeto, 2014). An earlier analysis of our survey (Vale & Clemmer, 2019), included an analysis of the impact of jobs and/or co-op on grades. While that analysis yielded no significant results, it did point to jobs and work hours as a potential reason why remote students may have attended less or received lower grades. Indeed, many students attended remotely because they had jobs, and it is possible that those jobs impacted their ability to focus on the course (Greene & Maggs, 2015; Svanum & Bigatti, 2006). Technical issues, such as internet connectivity, as mentioned by participants, may have also contributed to lower performance of remotely attending students and have been mentioned as negatively contributing to the learning experience in other studies (Conklina et al., 2017; Raes et al., 2019).

Student responses to what improved their learning indicate that being able to attend lectures remotely was favourable to not being able to attend at all. In fact, many students preferred attending remotely as it allowed them to connect from off-campus or a distraction-free work area. Given the strong influence of attendance on student grades, having the ability to attend lectures at all (even if it is remotely) may outweigh the potential negative impacts of that attendance being remote. In fact, several studies have shown that students often choose to attend lectures or not based on the value of attendance versus the opportunity cost of not attending. Moore et al. (2008) suggests that non-attendance can be a short-term coping strategy during illness or heavy workloads. Similarly, Purcell (2007) found that lecture attendance is greatly impacted by student work and travel to school. In this regard, if a lecture is offered with the BSL format, students may be better able to attend through remote access as they can connect to the classroom wherever they may be.

The fact that attendance is such an important factor in predicting overall grades may stem from the ability for students to communicate and interact with the instructional team. The importance of interaction and communication with the instructors is by far the most pervasive finding in the qualitative results in the sense that it shows up in responses to nearly every question we asked (except for "what negatively impacted your learning"). Several studies have investigated student motivation for attending or missing lectures (Friedman et al., 2001; Gosper et al., 2010; Gysbers et al., 2011; Moore et al., 2008); in general, students attended lectures because they were more engaged, learned more, and were more entertained or felt an obligation to attend (Gysbers et al., 2011). Interacting with the instructor is often listed as another reason to attend lectures but it is much lower on the reasons given for student attendance (Friedman et al., 2001; Gysbers et al, 2011).

In this study, when asking students what positively influenced their learning, it is evident that the opportunity to interact with the instructor and ask questions is a significant motivation for attendance. In total, there were 52 comments relating to the ability to effectively ask questions and

have those questions answered. Some of these comments directly speak to the ability to ask and answer questions, while others mention the online chat and concerns around class sizes being a limiting factor to easy communication with the instructor. Based on the prevalence of these comments, we argue that successful BSL implementations must enable direct interaction during lecture time between the instructor, remote attendees, and peers. In our study, this was achieved through the synchronous online chat tool. We believe that if the chat had not been present, remote students would have been at a disadvantage compared to their local peers. This is consistent with other studies where students expressed frustration with being unable to interact with the instructor due to technological reasons or the instructor focussing on one particular group (Raes et al., 2019).

One of the most favourable aspects of the BSL format was the anonymity it offered students when asking questions. As indicated in the comments and supported in the literature (Ryan et al., 1998), students will avoid asking questions because they feel too shy or embarrassed to ask, fearing that their need for help indicates a lack of ability. By incorporating the online chat, students attending lectures either remotely or face-to-face could ask their questions more freely. From our survey results, students want to ask questions so that they can clear up any misconceptions relating to the topic material. This may be one of the aspects that contributed to the higher performance for students that attended lecture more frequently. This desire to ask questions is important to consider in the traditional classroom as well: instructors should be mindful that students have questions and they should provide greater opportunities for students to ask those questions. In fact, the incorporation of the online chat into a traditional larger classroom to facilitate discussion is a subject of on-going research.

Study Limitations

Our study has a number of limitations. As is typical with this type of study, the sample sizes are small, therefore the power of our statistical analysis is weak. More survey data from additional summer offerings would be required to strengthen our results. Additionally, the survey was originally developed as a quality assurance tool and was therefore not validated.

Importantly, this offering was primarily directed at Engineering students who had failed either this or the pre-requisite course. We suspect that students treated this secondary opportunity as a lifeline to timely completion of their degrees. For some, the opportunity meant that they were able to stay in their co-op program. We have no way to know how this affected their attitude toward the course or the technology and their studying motivations or habits.

Conclusions and Future Work

There are two main themes relating to both the positive and negative learning experiences of participants that arose from this study: (a) interaction and communication and (b) distractions. Improved interaction and communication with the instructor and classmates positively influence the student learning experience while distractions from work, course load, and technology negatively influence the learning experience.

Attendance is a key indicator in student success, regardless of whether students attended lectures remotely or face-to-face. Students attending more than 75% of the lectures performed on average 12% better than students that did not. The main motivator for attending lectures was the ability to ask the instructor questions in order to clear up any misconceptions. The use of an online

chat facilitated the asking of questions and allowed students attending remotely to engage in the class.

In terms of the learning experience, students found remote access, the ability to ask questions, the teaching style, and having more time during the summer semester to be positive impacts on their learning. Negative influences on their learning experience related primarily to distractions stemming from their busy work schedules and typical summer activities. Overall, students found the remote method of attending lectures with the use of the online chat a valuable method of attending lectures and suggested that it should be offered in more courses going forward. Student comments imply that the potential gain in grades with better attendance outweighs any potential impact remote attendance may have.

Given the importance of asking questions and interacting with the instructor on student performance, the addition of the chat feature in traditional large classes and the effect of recording lectures on student performance is of interest. Questions of scalability and the level of interaction between students and the instructor can be investigated within a traditional lecture and specifically in large classes. It is expected that too many students participating in the chat may limit its effectiveness as the instructor loses the ability to monitor the chat. The authors have explored this and shared preliminary results in presentations at educational conferences (Kukkonen et al., 2017); the main takeaway is that course context is crucial (i.e., chats in social sciences classes have a different "flavour" than those in engineering classes) and such chats may actually be harmful in some circumstances. Other researchers are also investigating the implementation of backchannel chats in large classes (Aagard & Olesova, 2010). Further work in this area is warranted.

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Appendix

Relevant survey questions

What percentage of classes did you attend? 0-25%, 25-50%, 50-75%, 75-100%

a. How many did you attend in person? 0-25%, 25-50%, 50-75%, 75-100%
b. How many did you attend remotely? 0-25%, 25-50%, 50-75%, 75-100%

Did you have a job this summer? (Y/N)

a. Was this a co-op placement? (Y/N)
b. How many hours/week did you work?

If you attended class remotely for some days and in person for others, which did you prefer? (Remote, in person, combination.) Why?

What would you do to improve the lecture experience for students attending remotely?

Is there anything that you experienced during this summer offering that would be valuable to include in a 'traditional' course offering?

Is there anything that you liked about this summer offering that you think would not work well in a 'traditional' course offering?

What positively impacted your learning this term?

What negatively impacted your learning this term?

What is your overall undergraduate average?