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The Influence of Remote Instruction on Student Situational Motivation

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Abstract

The recent pandemic has necessitated a mix of in-person and remote instructional formats at most universities. This paper presents a case study on the influence of the remote synchronous instruction on students' situational motivation.

Data for the new study was collected in the spring semester of 2021 from one section of a junior-level engineering course taught by the author using synchronous instruction at a the University of St. Thomas in St. Paul, MN. Sixteen times throughout the semester the students completed "Situational Motivation Scale (SIMS)" surveys at the end of the class period. SIMS is a validated, self-report scale that measures situational Amotivation, External Regulation, Identified Regulation, and Intrinsic Motivation. Students were also asked at the end of each survey to describe the one aspect of the classroom activities that most influenced their attitudes and to indicate whether they attended the class remotely or in-person. All students enrolled in the class participated in the surveys and received instruction on situational motivation and learning theories. Survey results were only included in the study for those students who consented.

Twenty-five students chose to participate in the study, providing over 300 survey responses. Survey results indicate that remote instruction tended to reduce the students' intrinsic motivation and increase their amotivation. Themes from student comments were used to identify influences which include: difficulties getting classmates to engage in discussions in remote formats, difficulties staying alert and attentive in remote formats, frustrations with learning new software for remote instruction, and the fun of engaging with physical devices in the in-person format. While in general remote instruction lowered students' self-determination, one remoted session from the study was particularly motivating. Attributes from various remote sessions are compared to identify successful strategies to motivate students during online synchronous classes.

I. Background

Engineering education has been slow to enter the realm of online instruction [1] especially in comparison to other educational disciplines [2]. The pandemic of 2020 pushed all disciplines to adopt remote instruction, at least temporarily. The sudden shift has not been easy. Shuey et al [3] found through student interviews that ad hoc remote instruction has been challenging for students in terms of motivation, time management and social interaction. Students reported feeling that the teaching responsibilities had been shifted onto them. However, quality online instruction is possible. Shuey et al [3] and Bourne et al [4] both point to a number of studies that found online instruction can actually be more effective than in-person in terms of student outcomes, especially when a blend of in-person and online instruction is used.

In today's world, almost all college-level instruction has some online element to it. Instructors use learning management systems to: communicate schedules, assignments, and classroom

policies; share videos and articles; facilitate discussions, etc. “Online” is commonly used to describe a course or program in which 80% or more of the content is delivered online [2]. Therefore, the terms *in-person* and *remote* will be used in this work to describe the instructional format of a given class period. In-person indicates that student and instructor are in the same physical classroom, and remote indicates that the student is not in the same physical space, but rather, has joined remotely via a video conferencing application. The focus of this study is on synchronous instruction, so whether in-person or remote, the reader may assume that all activities described in this paper were facilitated synchronously.

One reason to pursue synchronous remote instruction is that not having mandatory class periods can be hard for students to navigate [3]. In both remote and in-person, a variety of instructional methods can be employed during synchronous instruction to increase student motivation and enhance learning, many of which focus on “active learning”. This author embraces Bonwell and Eison’s [5] definition of active learning as “anything that involves students doing things and thinking about the things they are doing.” As Prince [6] concludes from his wide literature review, even brief activities introduced into lectures can increase learning. Short discussion breaks [7], pauses for reflection [8] and any small activity that encourages students to analyze, explore, apply or question [9] increase students’ deep processing strategies and self-efficacy.

Active learning is more than a way to keep student’s attention, it helps them to “construct meaningful representations of knowledge” [9] , confront misconceptions [10], and tap into their existing knowledge. Active learning techniques can be adapted for online instruction with proper preparation. Prince et al [11] provides a comprehensive summary of techniques for engaging students online and adapting familiar in-person activities to an online environment. Prince et al emphasize the importance of designing activities that support learning objectives. Kyrkjebø [12] notes the tendency for students to become “watchers” during remote instruction–making active learning even more important in remote instruction.

Not every learning objective is best tackled with a full class period of active learning. Using a variety of instructional methods will help the students to succeed in different learning modes [13] and increase their learning flexibility [14] [15] which will benefit them in the classroom and in their careers. Without denying all the benefits of active learning, students also need to become capable listeners, note takers, and questioners if they want to successfully participate in project proposals, planning sessions, and public meetings as engineers.

Whether using passive or active instructional methods, motivation matters. Deci and Ryan [16], Cavanagh [17], and Eccles and Wigfield [18] provide summaries of current motivation studies and conclude that the more self-determined and intrinsically motivated the student is, the more conceptual learning, cognition, and retention is achieved. In Self-Determination Theory (SDT) [16], Deci and Ryan define intrinsic and identified regulation as self-determined motivations. Intrinsic motivation is exhibited when we do something for its own sake and for our own pleasure. Identified regulation describes motivation toward behavior that is chosen as a means to an end. In contrast, controlled motivations, in which behavior is a response to external factors, are considered less self-determined. For example, extrinsic regulation occurs when the behavior is motivated by external rewards or punishments, and amotivation refers to behavior that has no

perceived value. A more detailed description of Self-Determination Theory can be found in Ryan and Deci [19].

An earlier study by Holte et al [20] examines the effect of classroom activities on these four types of motivation and finds passive instruction can result in high levels of identified regulation and intrinsic motivation when the student sees value in the content. This corresponds with Ryan and Deci's assertion that while some behaviors are not initially intrinsically motivated, they can become more so if their value becomes internalized [21]. Reading is a passive activity that can be dull. However, reading about a topic you love or know well can be very intrinsically motivating. Movement toward intrinsic motivation and more self-determined behavior is a process [22]. Building students' familiarity and curiosity about a topic factors into that process, but is not the only factor. Student situational motivations can shift within a single week related to a single project [23]. Numerous variables can either frustrate or satisfy an students' basic need for autonomy and competence which greatly influences to their intrinsic motivation [24].

The question in this current study is how much does the instructional format (remote vs. in-person) affect student motivation? Is there a difference in how active, passive, and mixed instructional methods are received in the different formats? And what are the contributing factors influencing motivation in the remote format?

III. Procedure

One section of Machine Design at a private four-year institution was the subject of this case study. Twenty-nine students were enrolled in the section. In addition to three 65-minute lectures, the students attended a 3.5-hour lab section each week. The lab sections are taught by several different lab instructors, and motivation toward lab activities was not studied in the work.

On the first day of class, students were introduced to the concept of situational motivation and participated in a think-pair-share activity exploring four types of motivation: amotivation, external regulation, identified regulation, and intrinsic motivation. Brief discussions were facilitated twice more during the semester about motivation, learning theory [25] [26], and the different roles of the teacher and the student in the classroom. Sixteen times throughout the semester, lecture class periods were ended five minutes early to complete a survey on classroom computers via Qualtrics [27]. The survey was based on Quay et al's [28] Situational Motivations Scale (SIMS) which uses 16-question survey to capture the students self-reported motivations in the four types of motivation mentioned above, Amotivation, External Regulation, Identified Regulation, and Intrinsic Motivation. Each question is answered on a seven-point Likert scale. SIMS survey questions were modified slightly in this study to indicate past tense. A listing of the exact wording is provided in a publication by Holte et al [20]. In addition to the SIMS survey questions, the students were asked to indicate if they attended the class remotely (online) or in-person and to state one aspect of the activity (i.e. class period) that most influenced their attitude toward the activity.

All students were required to log into the survey via Qualtrics and enter the keyword for the day. This step was used to push attendance points to Canvas [29]. However, to prevent hurried or even meaningless responses, the 16 SIMS questions were optional. For students who did

complete the SIMS survey, their personal situational motivation profile was generated by Qualtrics and presented to them as a graph to aid understanding of their own motivations.

Date	*Format*	*Keyword*	*Topic*	*Activity Description*
2/3/21	In-Person	A1DOF	Degree of Freedom	Students follow instructions to assemble links via pins and slots and eventually derive Gruebler's equation to determine DOF.
2/5/212	In-Person	B1DOF	Degree of Freedom	Students work in pairs to classify joins by DOF. Instructor periodically polls class on responses and shares examples
2/8/21	In-Person	B2DOF	Degree of Freedom	Students alternatively work alone, work in pairs, or observe instructor to evaluate DOF of a variety of mechanisms
2/10/21	In-Person	L1FBR	Four-bar Linkage Def	Lecture/demos on terminology re: four-bar linkages (Time spent on in-class quiz, discussing homework format made lec. short).
2/15/12	In-Person	A2SRT	Four-bar Linkage Design	Students work in pairs and quads to identify the defects in two physical models. Students present findings to the class.
2/17/21	In-Person	B3LNK	Four-bar Linkage Design	Follow up on linkage defect activity (Active). How to predict defects in a four-bar. Extensions of transmission to winches (Lec).
2/19/21	In-Person	L2LNK	Four-bar Linkage Design	Instructor presents graphical design methods for two precision positions with solution rectification. Started three positions.
2/24/21	Remote	B5EXT	Ordinary Gear Trains	Guest Instructor introduced gear nomenclature and involute profiles, identifying circles. Used a lot of polling.*survey optional
3/1/21	Remote	L3OGR	Ordinary Gear Trains	Guest instructor presents methods to design compound ordinary gear trains. Students use Jamboard to solve problems
3/8/21	In-Person	L4PGR	Planetary Gear Trains	Instructor presents equations and examples for determining gear ratios for planetary gears.
3/15/21	Remote	A7EXT	Empathic Design	Instructor presented Mural as a tool for brainstorming. Students explored ways to improve the manual wheelchair in groups of 9.
3/19/21	In-Person	A3WHL	Empathic Design	Students take on role of observer, guide, and wheelchair user. They complete series of tasks on campus in groups of 3, then enter notes into Mural. *survey at start of next class
3/26/21	Remote	A4WHL	Empathic Design	Students read peer writing empathic design, enter comments into canvas rubric, and discuss in groups of 3.
4/7/21	Remote	L6STF	Static Failure Theory	Instructor briefly review class-prep video on ductile and presents notes/examples Static Failure Theories for Brittle Materials
4/9/21	Remote	A6FTG	Fatigue Failure	Used Zoom rooms for speed research, and planning for persuasive presentation in the following class period
4/26/21	In-person	L7FTG	Fatigue Failure	Instructor presented an example on determining the life of a rotating shaft.

Table 1: Chronological Summary of Activities and their Keywords

Table 1 shows a summary of the classroom activities that occurred on the dates that students were surveyed. Class periods are referenced by their keyword in this paper. The first letter of the keyword indicates whether the instructional methods used in the class period were primarily active (A), passive (L) or mixed (B). For active class periods, students are primarily engaged with some sort of activity throughout the class. Activities might include working with models, solving problems alone or together, conversing with a partner or team, planning a presentation, or engaging in a physical activity. The letter L comes from the word lecture and indicates that the instructor is primarily disseminating information in a structured lecture format while students take notes. The letter B comes from the word blended and is used to indicate that passive and active methods of instruction were mixed intermittently throughout the class period with neither dominating.

Note that all instruction is mixed to a certain degree. Active methods are always combined with at least some passive components. At a minimum, students passively receive instruction on how to participate in the activities. Completely passive lectures do not exist in this course either. Students are asked to respond to intermittent check-ins via paper clickers (or polls) and may be asked to turn to a partner to discuss concepts (or comment in the chat).

Table 1 also indicates whether the instructional format was in-person or remote. All of the class periods studied were synchronous, although there were other asynchronous elements to the course. Eight class periods were conducted remotely via Zoom [30] throughout the semester for reasons related to Covid, but the majority of classes were held in-person. On occasion, individual students under quarantine attended in-person classes remotely via a Zoom connection to the classroom.

Survey results were monitored by a faculty member not directly involved with the teaching of the course such that students could respond freely without concerns that their responses would influence their grade. A summary listing of the comments without personal identifiers was periodically shared back to the instructor throughout the semester to aid with continuous course improvement. The course instructor did not have access to the full data set until after course grades were posted.

Each survey also included a consent statement. Twenty five of the 29 students enrolled gave consent each time they completed the survey. Responses from the non-consenting students were removed from the data set presented in this work.

When analyzing the data set, the author identified the tone of comments, the theme, and influencing factors. For example, student comment, “I thought that the demonstrations were super helpful in being able to actually see how the different situations occur,” was categorized as follows: tone, positive; theme, helped/helpful/useful; factor1, demonstration; and factor 2, variety. A statement’s tone was considered mixed if included a combination of positive and negative. For example, the comment "Kind of a slow class but rightfully so because peer reviews needed to be done" was categorized as mixed. If a student made a factual statement such as “Working through a problem” with no indication of whether they felt positively or negatively

about the fact, the comment was considered neutral. If the student left the comment blank when completing the survey, it was not included in the count of comments.

When comparing the overall motivational impact of activities, a single index is also helpful. The self-determination index (SDI) used in this study weights the four motivations measured by SIMS surveys as follows: $-2\ AM - 1\ EX + 1\ ID + 2\ IN$ where *AM* = amotivation, *EX* = External regulation, *ID* = identified regulation, and *IN* = intrinsic motivation [31]. The result is an SDI that ranges from -18 to +18 with a higher score indicating a higher level of self-determination. The SDI was computed for each SIMS survey response. Average SDI for a given class period was computed by averaging all the individual SDIs.

IV Findings

a. Confirms results of previous study on in-person instruction

Previous work by Holte et al [20] comparing active, passive, and mixed methods for in-person instruction found that while active methods of instruction generally increase students' intrinsic motivation, passive instruction can be extremely motivating if students perceive a high value in the content. The previous study also found that a student's personal orientation [16] can have a stronger influence on situational motivation than the teaching methods employed. Those findings were reconfirmed in this new study. Passive lecture L2LNK was again found to be extremely motivating to the students, three students reported very high self-determination in every class regardless of the format or methods of instruction, and one student reported very low self-determination in every class regardless of the format or methods of instruction.

b. SIMS survey data shows influence of format on motivation

Figure 1 charts the average SDI for each class period along with the two self-determined motivations (identified regulation and intrinsic motivation). When looking at the complete data set, students' self-reported situational motivation is the most self-determined for in-person formats where active instructional methods were employed.

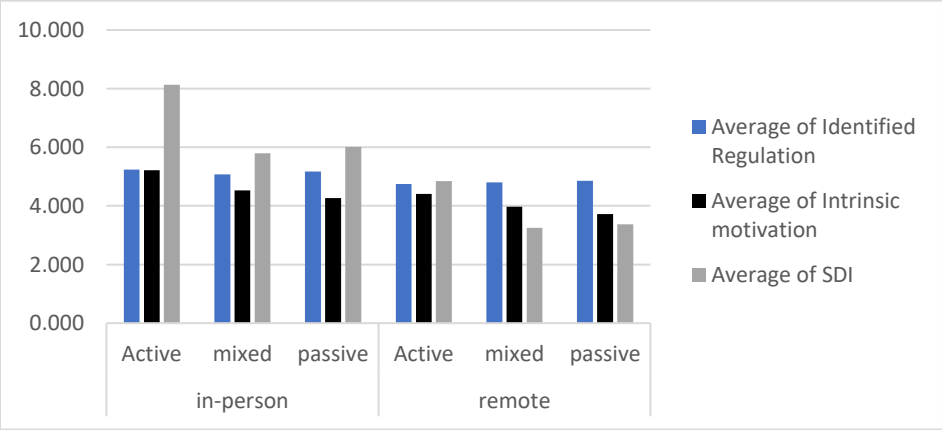


Figure 1: Self-Determined Motivations and the SDI by Method and Format

The intrinsic motivations in Figure 1 also show that the more active the class period the higher their intrinsic motivation, indicating that active instructional methods are more enjoyable for students. We can infer from Figure 1 that active learning is still more intrinsically motivating than passive, but less so when done when remotely. The identified regulation doesn't follow the same trend, but since identified regulation is related to how the student perceives value in the activity, more factors influence that measure as was seen in Holte et al [20]. However, it is interesting to note that the average SDI is higher for passive in-person instruction than for active remote instruction.

Figure 2 charts the controlled forms of motivation (amotivation and external regulation) reported by the students. One goal of quality instruction is to minimize amotivation since high amotivation indicates the students don't know why they're doing the activity or don't feel the activity is worth doing. Amotivation was consistently the lowest reported form of motivation across all class periods. However, students reported more amotivation on average in remote formats (2.5 remote and 2.1 in-person). Average external regulation were higher for remote than in-person formats, 3.9 and 3.8 respectively, but not significantly.

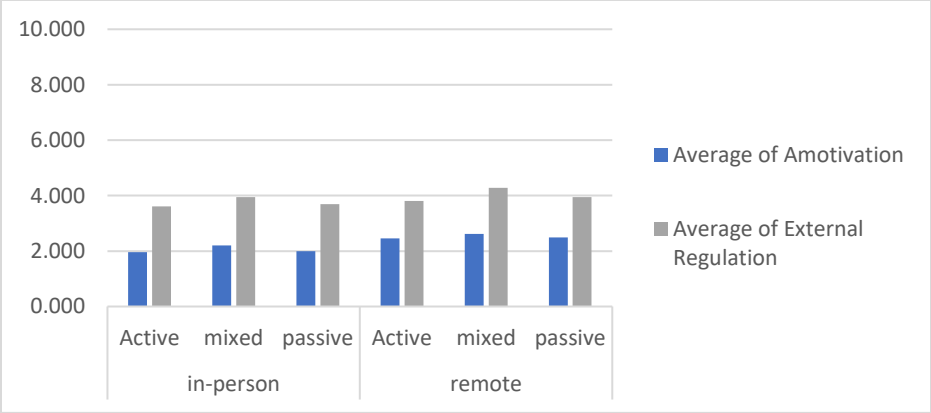
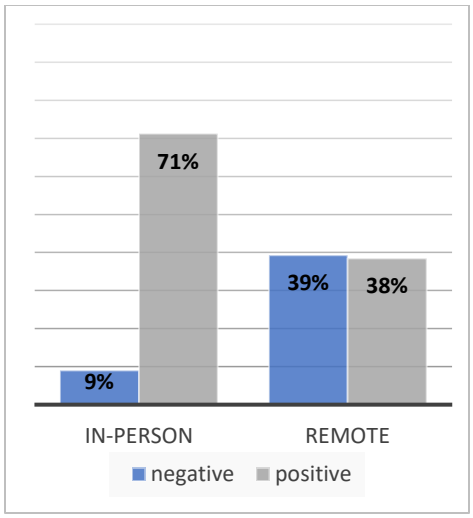


Figure 2: Controlled Motivations by Method and Format

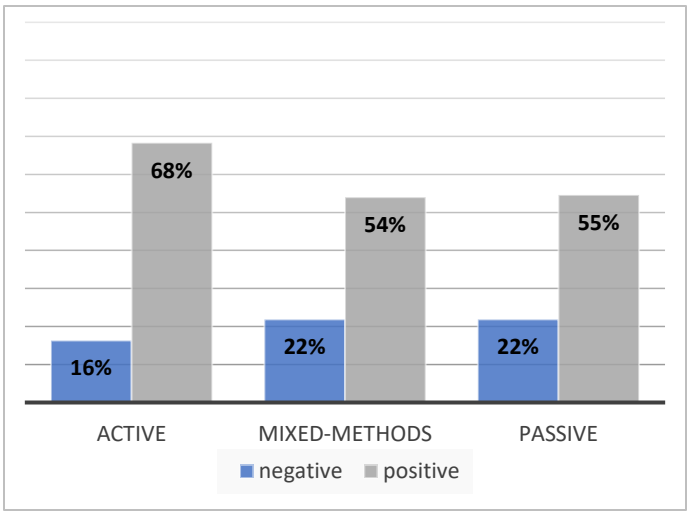
Since this is a case study involving only 25 students in 16 class periods, any trends observed should met with a level of skepticism. Larger studies would be needed to confirm the findings. However, the trends combined with student comments will help us evaluate what influenced the motivations of this small group.

c. Tone of Student Comments

Student comments show an even stronger preference for in-person instruction. Since the number of responses and comments varied for each class period, percentages out of the total number of comments in each category were used to compare student attitudes as shown in Figure 3. Neutral and mixed comments were included in the total count of comments but are not displayed in the charts. The data shows again the preference for in-person instruction and for active instructional methods. The following sub-sections take a deeper look at the tone of comments and themes found within the comments for in-person and remote instruction.



a. Format

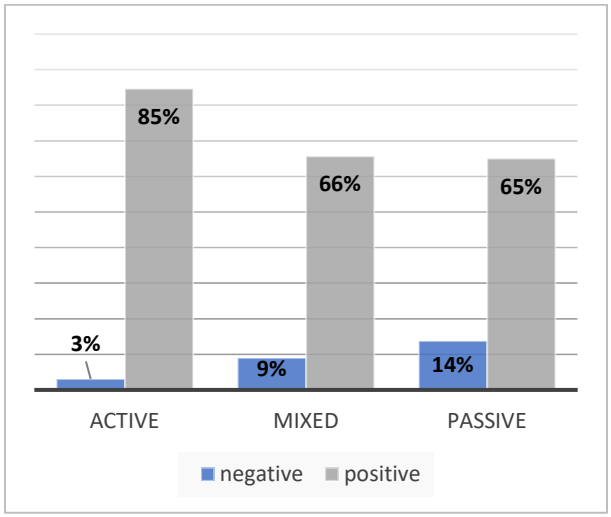


b. Instructional Method

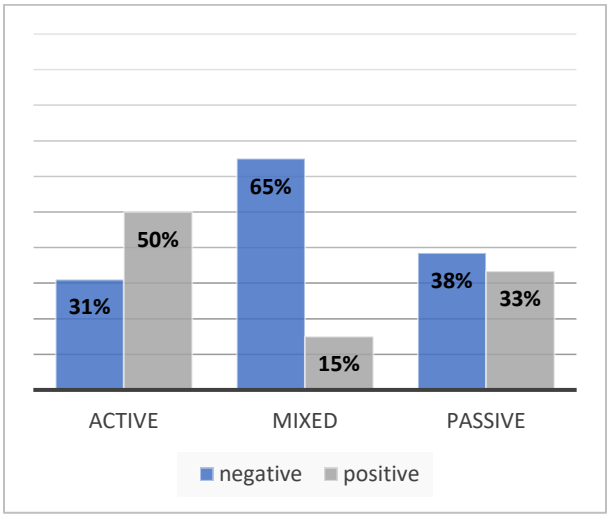
Figure 3: Percentage of Positive and Negative Comments

i. In-Person Instruction – Active methods produced more positive comments.

Figure 3 shows students had a more positive tone in response to in-person instruction. The percentage of comments that were negative is very low. Figure 4 further breaks down the comments of Figure 3a by instructional method.



a. In-Person



b. Remote

Figure 4: Percentage of Positive and Negative Comments Further Parsed

In response to *active in-person* instruction, only two students had primarily negative comments. The vast majority of the comments were positive and of those 53% fell into themes of enjoy/fun or like/love. The most common factors influencing their enjoyment were that the activities were

hands-on and visual. For example, one student wrote, “Enjoyed using my hands and being able to see the [degree of freedom]. Liked trying to come up with the equations on our own.” Another said, “Once again I really liked having visuals and something I could work hands-on with, it really enhances my learning.” Only a small number of comments directly mention learning. However, studies have shown that intrinsic motivation is tied to increased learning [16], [17], [18] and the positive comments reaffirm the self-determined situational motivation factors exhibited in Figure 1.

When provided a mix of passive and active instructional methods within the in-person format, 66% of the comments were positive and 9% negative—almost flipped from remote mixed instruction in Figure 4b. There is a real advantage to implementing mixed instruction methods in-person because transitions between active and passive instruction are quick and seamless. When in-person, the instructor can observe all the discussion groups at once and read the room for when to jump in to help or when the students are ready to move on. Polling can be done instantaneously with paper clickers [32] and students are free to focus more on the content. Thirty-four percent of the positive comments related to *mixed in-person* instruction fell into the themes of useful/helpful or learned/important such as “Visualizing the concepts and discussing them with a partner were helpful and engaging.”

Regarding *passive in-person* instruction, 65% of the comments were positive and 14% were negative. Positive comments for in-person passive instruction included themes such as enjoy/fun or liked/loved (23%), good/nice (17%) and helpful/useful (17%). Students seem to value the content being delivered saying “Getting into the math side of the class is very interesting and keeps me focused,” and “I like learning new things that I am certain I will need to know…” and “This activity was good. It is laying the groundwork for 4-bar linkage designs for us.” Even though students were mostly listening, taking notes, they felt mostly positive about the experience. Out of the negative comments, the pace (either too fast or too slow) and feeling tired or having difficulty paying attention was mentioned, but in small numbers.

ii. Remote Instruction – Mixed methods produced the most negative comments

When breaking down remote instruction, it may be surprising that the highest percentage of negative comments occurred when the remote instructor used a mix of passive and active teaching methods (see Figure 4b). The comments give us clues as to why.

Starting on the far right with *passive remote* instruction, 38% of the comments were negative, compared to 14% for passive in-person. The strongest factor emerging from the negative comments was related to difficulty in paying attention (40%). One student wrote, “Difficult to stay engaged for most remote classes, especially ones that are mostly lecture,” another said, “I just don’t like online stuff... that’s the only factor negatively effecting anything, but I understand the logic behind it.” Not all comments were negative, some students seem unphased by remote instruction. Examples of positive comments include, “A lot of talking but overall easy to follow,” and “I enjoyed learning about gears.”

Using a combination of active and passive instructional methods during remote instruction is one way to prevent students from becoming disengaged and distracted. However, as Figure 4b

shows, adding active learning elements isn't guaranteed to increase satisfaction. In the *mixed remote* learning session B5EXT, a significant amount of polling and breakout room discussions were used to keep the students engaged. While this helped to reduce difficulty paying attention (23% of negative comments), other complaints surfaced regarding the pace (15%) and breakout activities being too much or a waste of time (31%). Measures the instructor took to promote social engagement, sometimes annoyed students. One student commented, "[I] felt that [being] forced [to have our] video [cameras on] was not necessary. Breakout rooms were a waste of time. More lecturing should have occurred." The remote format makes it challenging to transition quickly between activity and lecture, and the instructor is not able to monitor all the breakout rooms simultaneously which affects the pace of the class. The comments are revealing, but the data set is very small. Only one mixed remote class-period (B5EXT) was studied, and that class period was taught by a visiting instructor with less teaching experience.

Active remote class periods in which the students actively engaged with each other for most of the class period (A4WHL, A6FTG, and A7EXT) produced a smaller percentage of negative comments and of those only 6% were related to ability to pay attention. Negative comments varied widely and were more difficult to group into themes. Among the positive comments, the strongest themes were enjoy/fun or like/love (55%) and good/nice (10%) and interesting/intriguing/engaging (17%). Factors influencing attitudes toward active remote instruction will be explored more thoroughly in the next section.

d. Factors Influencing Motivation in Remote Active Instruction

While results discussed in previous sections point to the added challenges of motivating students in remote synchronous instruction, motivating students in online is possible. Figure 5 shows the students' average SDI for each surveyed class period in Table 1. Active instructional methods used in A6FTG succeeded in engaging remote students almost as much active in-person class periods. This section will consider the attributes of the three active remote class periods and student comments to see if there are clues to what made A6FTG more successful than the others.

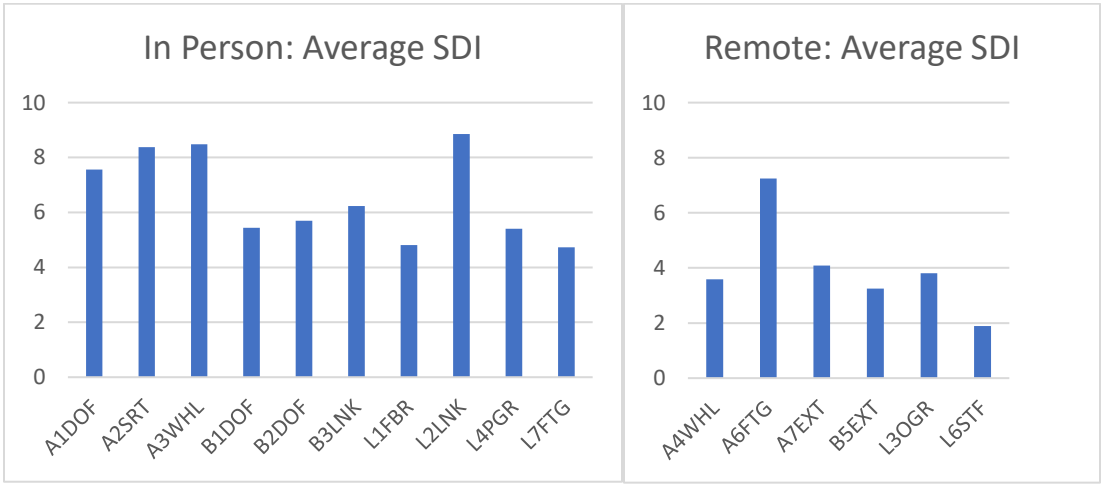


Figure 5: Students' Average Self-Determination Index (SDI) by Class Period
(Excludes data from individuals who attended in-person classes via Zoom)

All three of the remote active class periods were intentionally moved to Zoom to allow for longer conversations among groups of students that would have been more challenging in the classroom due to Covid protocols that required students to maintain a six-foot distance. Average motivation profiles for the three class periods are shown in Figure 6. The graph shows that in response to A6FTG students felt on average less amotivation, less external pressure, more identified regulation, and more intrinsic motivation. Thus, A6FTG was better at supporting students' self-determination in every category measured by the SIMS surveys. Following a brief description of each remote active class period and comparative summary in Table 2, key influences on motivation will be discussed.

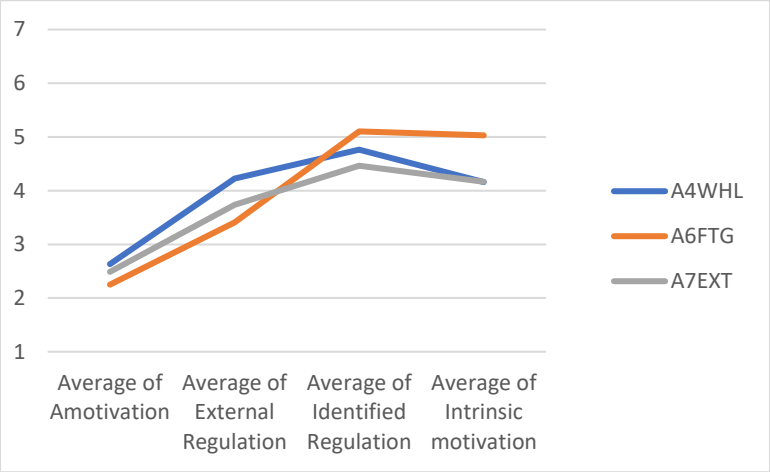


Figure 6: Class Motivation Profiles for Active Remote Class Periods

A7EXT was a brainstorming session on design improvements to manual wheelchairs. This was the first class in a week-long unit on empathic design. Students were asked to brainstorm wheelchair improvements. In a separate class, the students would use wheelchairs and then reconvene to reconsider their design ideas with new insights and perspectives. Mural [33], an online digital collaboration platform, was used so that students could return to their design discussions several days later for self-guided follow up activities. Since the students were new to Mural, the class period was carefully timed with intermittent 3-minute segments of instruction on how to use features of Mural and 5- to 15-minute segments for students to do individual brainstorming, small group brainstorming, and small group ranking of ideas.

A4WHL was the final class period devoted to empathic design. Prior to class, students completed a rough draft of a magazine article on the theme of their choice related to empathic design. The objective of A4WHL was for students to peer review each other's writing. Students were divided into groups of three. In the first 30 minutes, students independently read their group members' articles and completed a Canvas rubric. This was followed by a 25-minute small group discussion.

The goal of A6FTG was for the students to learn about fatigue failure and prepare for communication with a non-engineering audience in a fun and fast-paced environment. First, the instructor gave a mini lecture on rotating shafts and fully reversed bending. Then the instructor presented a storyboard about a giant chicken atop a popular restaurant. In the fictitious story, management decides to attract patrons by rotating the giant chicken on its spit. Student teams were tasked with creating an oral presentation to persuade the management to consider fatigue failure and redesign the now rotating spit. Before planning their presentations, the teams spent 15 minutes in breakout rooms to do "speed research." Another 15 minutes was allotted for the teams to plan their brief presentations. The timeline was very tight, and students were asked not to work on their presentations outside of class. Informal oral presentations were made in the next class period.

A comparative summary of these three class periods is provided in Table 2. The student comments collected in their surveys reveal influences on their motivations. In the first activity, A7EXT, the leading factors were technology and partner interactions.

Technology was associated with mostly negative comments. Comments such as, "I didn't like how we had to deal with the mural thing I would have liked just talking to my group better," and "I do not like using this software during class. I have no idea how to operate it effectively to have a discussion while being productive at the same time," demonstrate student frustration with learning the new digital tool. Even some more positive comments revealed the challenge Mural presented challenge, "Mural was interesting to use. I need[ed] to get used to it though before I saw how good it was." One lesson from this experience is that introducing a new online tool with many features and a steep learning curve may not be worth it unless it will be used repeatedly within the class. Another option would have been to have the students complete a brief tutorial on Mural prior to the class.

Comments regarding partner interactions were evenly split between positive and negative. "When it came to the breakout rooms for discussion, it was only really me and two other people discussing. I think having them in person motivates people to talk more." While the student attributed the lack of participation to being online, the groups were large (9 students) which may have allowed some students to hide in any format. Another student commented, "I wish we had a little bit more time to discuss because we were still figuring out how to work the mural software." Working in smaller groups may have increased participation and motivation.

Regarding A4WHL, the leading influences mentioned in the comments were peer feedback and online format. Comments on peer feedback were mostly positive, such as "Really good to get other people's view on your writing," and "I really appreciated having insight on my writing. I was also able to recognize changes when exchanging feedback with one another." The second commenter recognized that he also learned from discussions of his classmates' work which is the instructional goal. Comments regarding the online format were mostly negative, although one student wrote, "I liked the format of the activity. It got to the point and helped improve my paper." Some of the challenge in A4WHL may be related to getting students excited about editing their writing in general, as revealed in this comment, "I generally don't care for peer reviews. However, I did get some stuff from this, so that's good." Others felt the entire class

should have been done asynchronously and were disappointed at having to attend a synchronous class the day before spring break.

	A7EXT	*A4WHL*	*A6FTG*
Attributes	Intermittent instruction throughout the class period	Minimal instruction twice during the class period	15 minutes of instruction at the start of class period then minimal instruction
	Short to Moderate time periods in Zoom (5-15 minutes each)	Extended time periods in Zoom rooms (25-30 minutes each)	Moderate time periods in Zoom rooms (15 minutes each)
	Active work: mix of independent and groups of 9	Active work: half alone, half in groups of 3-4	Active work: all in small groups of 3-4
	Using many new tools on a new digital platform (Mural)	Using one new tool (peer evals) on a familiar digital platform (Canvas)	Using familiar tools. (Presentation tools, books, and internet searches.)
	No assigned goal to accomplish other than exploring and ranking ideas	Distinct end goal: to produce final draft of writing assignment	Clear and urgent goal: Plan a presentation for next class.
	Quick Pace	Moderate pace--depended upon the student	Breakneck pace
Topics	Design methods	Design methods	Fatigue Failure
	Digital collaboration tool	Written communication to a non-technical audience	Verbal communication to a non-technical audience
Leading Influences in Comments	Technology - mostly negative	Peer Feedback - mostly positive	Conversation with a partner - mostly positive
	Partner interactions - 50% negative	Online format - mostly negative	No clear leading second factor - wide range of factors in positive comments: research, application, metal fatigue

Table 2: Comparison of Active Remote Class Periods

Finally, A6FTG, had mainly positive comments in the surveys. Twenty-four percent were related to conversation with partners (24%). The students mentioned a wide range of other influences in

their positive comments. Students said, “It helped me learn the basic idea of metal fatigue,” “I love being able to apply and think about what we have learned,” and “Was fun and pretty interesting.” The quick pace was seen as both a positive and a negative. For example, one wrote, “I enjoyed the activity. It was a little rushed for my taste, but overall, it was fun,” and another said, “I felt really rushed and that I couldn't get as much out of the activity as I wanted.”

The wide range of influences reported regarding A6FTG makes it challenging to identify the attributes that made this remote active session more motivating to the students. Possibly the absence of one highly annoying feature (such as navigating new software or working on a writing assignment) is enough to allow the students to immerse themselves in more aspects of the work. The small groups size and upcoming presentations did provide an incentive for every student to engage.

V. Conclusions

The sample size from this case study is quite small, so while graphs reveal that generally remote instruction decreases students’ situational motivation, student comments provide insight into how we can improve remote instruction. Class period A6FTG demonstrates that students can experience self-determination within the remote synchronous instructional format.

The following recommendations come from the study.

- Moving between methods of instruction in a remote setting can be challenging. Careful planning and preparation are required to minimize transition time in mixed-method remote instruction so that students do not become disinterested or feel their time is being wasted.
- Online collaboration tools can be used to enhance remote instruction. However, introducing too many unfamiliar features at once may contribute to amotivation. Possible mitigations would be to introduce new features of a tool gradually over multiple sessions or to have the students practice with new tools via online tutorials in advance of the synchronous class-period.
- Content matters. Some topics may be inherently more or less motivating to students. Coaching students on the value of the content may be as important as the instructional methods used during class.
- Keep discussion groups small in remote instruction. Large discussion groups make it easy for students to hide or withdraw, especially in a remote setting when cameras can be turned off and intervention from the instructor is difficult.
- Make students accountable. The most successful remote synchronous instruction in this study required students to produce something tangible. Discussion groups were small, time was tight, and each student was needed to meet the goals within the time frame. All students knew they would have to stand before their classmates and present an argument in the next class period.

The recommendations are offered here are based on student comments. However, student comments were limited to one aspect of the instruction that they felt most influenced them and do not provide comprehensive feedback on all the attributes of a given class period. Future studies might have students rate multiple attributes of a class (pace, amount of instruction, size of teams, topics, etc.) along with their self-reported motivations to determine which attributes correlate to increased self-determination. However, just as a wide range of ingredients and proportions create great tasting dishes, the same attributes and proportions may not be needed for each class period to be engaging.

While in-person instruction is preferred, there are many benefits to engaging students synchronously when we are forced to move instruction online.

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