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Lessons from Listening to Students during the COVID-19 Pandemic: Using Self-Determination Theory to Contextualize Course Evaluations and Best Practices for Online Teaching

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Abstract:

This paper examines the intersection of best practices for effective online teaching from pre-pandemic scholarship with student feedback on teaching effectiveness during the pandemic. The shift to compulsory online learning may have affected the students' motivations for and needs from online learning, so student feedback about online learning during the pandemic should be examined. Self-Determination Theory (SDT) is applied as a theoretical framework for examining student feedback because it addresses motivation. This paper considers the following research questions: 1) How does feedback of students who were forced into online learning during the COVID-19 pandemic align with established best practices for online teaching?; and 2) How did student feedback on course evaluations change during COVID-19 emergency remote teaching (ERT)? Three published surveys provide broad context for student feedback during the pandemic, and course evaluation data are compared for pre-pandemic and pandemic semesters. Collectively, these data foreground student perceptions of their pandemic online learning experiences. Ultimately, the paper finds the use of best practices for online learning may have promoted student motivation during the pandemic by supporting basic needs identified by SDT—autonomy, competence and relatedness; however, even with implementation of best practices for online teaching, qualitative student feedback shifted negatively during COVID-19 ERT.

1. Introduction

The pandemic-induced mass migration of on-ground university classes to online learning in the Spring of 2020 often is identified as a move to "emergency remote teaching" (ERT). As [1] explains, ERT is "a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances" whereas "online learning" draws upon an established body of best practices scholarship and includes an intentional design structure that requires time for planning. Independently and with varying degrees of support from university instructional designers, many faculty turned to existing established best practices for online teaching and implemented what they could in a limited timeframe.[2, 3] However, pre-pandemic online learning scholarship situates online learning in a particular educational space, one created for a distinct sub-set of learners who intentionally chose to learn through an online delivery system, often asynchronously and self-paced.

The COVID-19 pandemic dramatically changed the online learner profile: the vast majority of students had both expected and wanted in-person university instruction. Some features of established best practices for online learning, for instance those related to cognitive load and active learning, remained salient for this new learner profile. However, motivation is a key component of learning, whether online or on-ground, and the disruptive and forced nature of the

shift to online learning, coupled with the stress of the pandemic, impacted students' learning by their own accounts. By examining needs of students during unexpected and potentially stressful conditions, we may be able to improve future teaching for all students.

Recent scholarship examines COVID-19 pandemic ERT from a variety of perspectives. One approach explores the potential long-term impact of pandemic ERT on the future of online learning[3, 4, 5]: will the forced experience make students more or less receptive to bona fide online learning in the future? Another perspective examines lessons to be learned from ERT during this pandemic to improve continuing and future ERT.[2, 4, 5, 6, 7] Indeed, continual improvement of ERT is an ethical imperative.[4, 5, 8] This paper joins both efforts by examining student course evaluations during ERT, and it asks:

> 1) How does feedback of students who were forced into online learning during the COVID-19 pandemic align with established best practices for online teaching?
>
> 2) How did student feedback on course evaluations change during COVID-19 ERT?

Data from multiple surveys provide broad context for student feedback during the pandemic. End-of-semester student course evaluations use an established instrument that allows for comparison to pre-COVID-19 responses. Together, these data foreground student perceptions of their ERT experiences and can be examined in the context of best practices for online teaching. Self-Determination Theory (SDT) will be applied as a theoretical framework because it is a macro theory of motivation and thus useful for analyzing qualitative student feedback during this unexpected and extreme situation.

2. Literature Review

The literature review has three sections: the first section summarizes SDT; the second section notes some best practices for online teaching; and the third section summarizes three published surveys presenting student feedback on ERT, highlighting connections to SDT and best practices for online teaching.

2.1 Self-Determination Theory

Self-Determination Theory (SDT) is a macro theory of motivation that addresses three universal and innate psychological needs: autonomy, competence and relatedness.[9] SDT has been used to promote engineering students' intrinsic motivation to learn[10] and to aid in the retention of women in engineering.[11] Because motivation is a recurring theme in multiple surveys about COVID-19 ERT, SDT is an appropriate theory for analyzing student feedback. COVID-19 ERT represents a potentially extreme case situation for all three facets of the theory—autonomy, competence, and relatedness—which may provide additional insight.

2.1.1 Autonomy Autonomy concerns having a sense of volition, choice and self-determination. It is "accompanied by feelings of willingness and engagement."[12] While students may not have a choice about the shift to ERT, certain teaching strategies (such as active learning) would be more effective at fostering student engagement, supporting their sense of autonomy. On the other hand, high stakes assignments and perceptions of high workload or an activity's lack of relevance have been found to undermine students' sense of autonomy.[13] Online fatigue (or

"Zoom fatigue") has a physiological basis; however, autonomy can be considered an associated SDT need based on its connection to engagement, given the lack of both control and choice.[14]

2.1.2 Competence Competence "is the belief that one has the ability to influence important outcomes."[12] It relates to the ability to master material and general self-efficacy. Assignments and activities should be challenging but achievable to promote a sense of competence. Clear instructions and supportive, informative feedback both promote students' sense of competence.[13]

2.1.3 Relatedness Relatedness is feeling meaningfully connected to others. Collaborative assignments would seemingly support student perceptions of relatedness, but "communication issues and disagreements" within small teams and "limited interaction with the wider class" can potentially undermine relatedness.[13] Of course, during ERT, students may have experienced social isolation and disconnectedness for multiple reasons, such as quarantine policies and being away from their families without an in-person campus community; a goal, rather than a best practice, of online teaching is creating an inclusive classroom community.

2.2 Best practices for online teaching

Online learning has distinct cognitive loading and student engagement considerations. Traditional lecture courses need strategic adjustments to translate effectively in the online environment. To engage students, active learning techniques are advised.[15] "Chunking" time by having several shorter activities can reduce cognitive overload and maintain student engagement.[16] Direct instruction may shift toward facilitating.[17] Practical considerations include increased structure, small group work, low-stakes assignments, and alternative means of participation.[18] Course management best practices include clear and repeated documentation of course policies, due dates, and teacher-student communication channels.[19] Pre-COVID-19, [20] noted that many STEM active learning techniques can be adapted for online delivery.

2.3 Student Surveys during ERT

Three surveys of students about their perceptions of ERT during the COVID-19 pandemic will be discussed. Together, these three surveys provide a multi-scaled perspective of student feedback. The below summaries highlight feedback related to student motivation and best practices for online teaching.

2.3.1 National STEM student survey [5] conducted a national, random-sample survey of 1,008 undergraduates whose courses moved to ERT in Spring 2020. Students were asked to base their responses on one course, and 63% of the respondents based their response on a STEM course (8% engineering). Students answered 3- and 4-point scale questions and there were no open answer questions.

The survey identified eight "recommended practices for online instruction" and found student course satisfaction increased as the number of the practices used increased. Table 1 below maps these surveyed practices to SDT needs.

Recommended online teaching practice surveyed	**Primary Associated SDT need**
Personal messages to individual students about how they are doing in the course or to make sure they can access course materials	Relatedness
Using real world examples to illustrate course content	Autonomy
Assignments that ask students to express what they have learned and what they still need to learn	Competence
Work on group projects separately from the course meetings	Relatedness
Frequent quizzes or other assignments	Competence
Live sessions in which students can participate in discussions	Relatedness
Meeting in "breakout groups" during a live class	Relatedness
Breaking up class activities into shorter pieces than an in-person course	Autonomy

Table 1. Mapping of recommended online teaching practices to their primary associated SDT needs. Categories and phrasing of the left column are from [5].

Given its methodology of nationwide random sampling, the survey provides a broad context for student perception. It asks students to rate their satisfaction with their course before and after the move to ERT. Students rated their ERT course satisfaction "dramatically lower" than they rated the in-person portion of the same course, but there was no previous measurement.

2.3.2 Single university survey, undisclosed majors [21] administered an anonymous online survey to students mostly (89%) from a single public university on the east coast (n = 270) after the shift to ERT. The survey included 36 questions, using 4- and 5-point scales. Two open-ended questions provide qualitative data about "challenges…that affected your learning experience" and more general "positive aspects and or changes" not necessarily related to education.

A grouping of seven questions asked students to compare their pre-ERT motivation level for various factors with their ERT level of motivation for the same factor, using a four-point scale: student-reported motivation decreased from 3.19 before the shift to ERT to 2.27 after the shift to ERT. Response rates to individual questions are not provided, but the questions can be mapped to the needs of SDT (see Table 2 below).

Motivation-gauging factor asked about in survey	Associated SDT needs
Talking to classmates	Relatedness
Interaction with professors	Relatedness, Autonomy
Hanging out (eating, talking, studying, etc.)	Relatedness
School activities	Relatedness, Autonomy, Competence
Complete schoolwork	Competence
Interest in class topics	Autonomy
Finishing degree/program	Competence

Table 2. Mapping of survey questions used to gauge student motivation to their associated SDT needs. Categories and phrasing of the left column are from [21].

Overall, "the findings showed that motivation, self-efficacy, and cognitive engagement decreased after the transition" and that students preferred "face-to-face instruction over online education." Here, as in [5], there was no previous measurement for comparison.

2.3.3 College-wide engineering student survey [4] reports on the results of surveys given to both students (n = 627) and faculty (n = 110) across six engineering departments at a large California public university. Both surveys collected quantitative and qualitative data. The survey was administered after the end of the Spring semester. The student survey addressed "challenges with online instruction." The most commonly cited challenges can be connected to the needs identified by SDT (see Table 3 below).

Challenge of ERT	Percent of respondents	Primary Associated SDT need
Maintaining focus/experiencing Zoom fatigue	70%	Autonomy
Lack of engagement during online classes	64%	Autonomy
Feeling a lack of clear guidance or communication from instructors	60%	Competence
Feeling social disconnection from peers	55%	Relatedness

Table 3. ERT challenges noted by students mapped to primary associated SDT needs. Category identification, phrasing and response data in the left and center columns are from [4].

The paper suggests multiple teaching techniques to address these issues, including: "breaking down a long lecture into shorter segments with more frequent breaks, encouraging group discussion among students, [faculty] making themselves available during the exams, providing

students with a clear roadmap for the online course, making the recording of the live lectures available after the lecture is over." These techniques draw from established best practices for online teaching discussed above in Section 2.2. The survey asked only about challenges and not about any possible strengths of ERT instruction during Spring 2020.

2.4 Summary

The three elements discussed in this literature review are interconnected: SDT needs can be met by best practices for online teaching; and the surveys present student feedback related to both online teaching practices and SDT needs during ERT. All three surveys mentioned "lack of motivation" as a notable feature of student experience of ERT. "Motivation" is a very broad term, particularly in the context of learning. As a macro theory of motivation, SDT can provide a useful framework for analysis because it considers both internal motivation and external factors. During ERT, students experienced decreased choice and control over their educational environment, representing an extreme case scenario for applying SDT. The Discussion section will explore further connections between best practices for online learning and student comments on course evaluations in the context of SDT.

3. Methodology

Course evaluation data from multiple sections of an Advanced Communication for Engineers course at a major research university in California is examined for two years, from Spring 2019 to Fall 2020 semesters. Over those semesters, course evaluations for a single instructor were distributed to a total of 268 students. The response rate was 50% (n = 133) over the six semesters (Spring, Summer, and Fall both years). Individual class sections ranged from 13 to 19 students. The course is designated for engineering majors and the content is engineering-focused, but any major is allowed to enroll. The course evaluation questions and their formatting were most recently revised in Fall 2018. The course evaluation is administered as an anonymous online survey, so the demographic constitution of the respondents is unknown. IRB approval was obtained for using this data.

A thematic approach with inductive coding was used to categorize and tally student responses to open-ended questions.[22, 23] This approach was selected because the qualitative data was detailed and rich. The approach was iterative; for the final instrument, only categories that received at least two comments in a semester were included. Relative frequency was chosen to represent the data because the number of courses taught and the enrollment fluctuated over the two-year period.

4. Results

Inductive coding and a thematic approach were used to categorize and tally student responses to four open-ended questions. The questions are:

1) If you have selected at least a "Strongly Disagree" or "Disagree" option with one of the previous statements on COURSE DESIGN, INSTRUCTIONAL DESIGN, ASSESSMENT

PRACTICES or COURSE IMPACT, please describe a change that would improve that aspect of the course.
2) Is there any additional information or feedback that you would like to share with [the] instructor?
3) Please describe the MOST valuable aspect(s) of this course.
4) Please describe the LEAST valuable aspect(s) of this course.

Below is a relative frequency chart for comments, separated by positive and negative responses and grouped by SDT need. Individual students could state more than one item in each response.

THEMATIC CATEGORY	**S 19**	**Sm 19**	**F 19**	**2019**	**S 20**	**Sm 20**	**F 20**	**2020**	**2020-2019**
instructor helpful/caring	15.4%	8.3%	24.0%	17.3%	10.6%	0.0%	18.8%	11.6%	-5.7%
RELATEDNESS, positive subtotal	15.4%	8.3%	24.0%	17.3%	10.6%	0.0%	18.8%	11.6%	-5.7%
RELATEDNESS TOTAL	15.4%	8.3%	24.0%	17.3%	10.6%	0.0%	18.8%	11.6%	-5.7%
clear expectations	4.6%	8.3%	6.0%	5.8%	0.0%	0.0%	9.4%	2.7%	-3.1%
learned valuable skills	30.8%	25.0%	24.0%	27.3%	19.7%	21.4%	15.6%	18.8%	-8.6%
helpful feedback/fair grading	1.5%	0.0%	10.0%	4.3%	13.6%	14.3%	9.4%	12.5%	8.2%
COMPETENCE, positive subtotal	36.9%	33.3%	40.0%	37.4%	33.3%	35.7%	34.4%	33.9%	-3.5%
lack of clarity	4.6%	4.2%	2.0%	3.6%	3.0%	21.4%	18.8%	9.8%	6.2%
harsh/unfair grading	1.5%	0.0%	0.0%	0.7%	4.5%	0.0%	0.0%	2.7%	2.0%
COMPETENCE, negative subtotal	6.2%	4.2%	2.0%	4.3%	7.6%	21.4%	18.8%	12.5%	8.2%
COMPETENCE TOTAL	43.1%	37.5%	42.0%	41.7%	40.9%	57.1%	53.1%	46.4%	4.7%
valued/liked assignments	10.8%	20.8%	10.0%	12.2%	10.6%	7.1%	9.4%	9.8%	-2.4%
well organized	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.3%	6.3%
class was engaging/enjoyable	20.0%	16.7%	16.0%	18.0%	9.1%	7.1%	3.1%	7.1%	-10.8%
AUTONOMY, positive subtotal	30.8%	37.5%	26.0%	30.2%	24.2%	21.4%	21.9%	23.2%	-7.0%
low stakes as busy work	3.1%	8.3%	2.0%	3.6%	7.6%	21.4%	0.0%	7.1%	3.5%
disliked assignments	6.2%	8.3%	2.0%	5.0%	6.1%	0.0%	6.3%	5.4%	0.3%
poorly organized/scheduled	1.5%	0.0%	4.0%	2.2%	4.5%	0.0%	0.0%	2.7%	0.5%
heavy workload	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	3.6%
AUTONOMY, negative subtotal	10.8%	16.7%	8.0%	10.8%	24.2%	21.4%	6.3%	18.8%	8.0%
AUTONOMY TOTAL	41.5%	54.2%	34.0%	41.0%	48.5%	42.9%	28.1%	42.0%	1.0%
TOTAL COMMENTS									
Subtotal (positive comments)				84.9%				68.8%	-16.1%
Subtotal (negative comments)				15.1%				31.3%	16.1%

Table 4. 2019 and 2020 student comment data grouped by thematic categories for each semester, with annual totals. Figures are rounded to the nearest tenth of a percent.

5. Discussion

The surveys discussed in the Literature Review address broad conceptual issues—course satisfaction,[5] motivation,[21] and challenges to learning.[4] All were administered after the Spring semester shift to ERT and before the Fall semester. [5] and [21] asked students to rate their pre-ERT satisfaction on various items; as one-time surveys, there was no other means for comparing student satisfaction before and after the shift. The course evaluations reviewed above in Section 4, then, add two important elements: 1) they provide additional qualitative data; and 2) the data can be compared to data from the same instrument pre-ERT.

5.1 Research Question 1

Research Question 1 asks:

> How does feedback of students who were forced into online learning during the COVID-19 pandemic align with established best practices for online teaching?

Student feedback, from both positive and negative perspectives, largely supports the effectiveness of established best practices for online teaching.

As noted above (in 2.2), [5] found that the usage of best practices for pre-pandemic online teaching led to significantly higher student satisfaction levels during pandemic teaching than the courses that used fewer of them; the more strategies used, the higher the student satisfaction level. For the most part, however, the surveys reviewed here focused on challenges students faced during ERT. Only [21] asked whether the students experienced positive outcomes during ERT. The question was framed broadly, and the majority of responses were not related to online learning (for example, students cited "having more time with family" as a positive outcome).

Course evaluations include standardized questions about both the perceived strengths and weaknesses of the instructor and the course, but they do not ask directly about best practices for online teaching because the format was designed for in person instruction pre-ERT. However open-ended questions provide the opportunity for students to address salient features of their online learning experience. Table 5 below maps thematic categories of student responses, combining both the positive and negative feedback, to several best practices for online teaching.

Thematic category	**Relative frequency**	**Related best practices**
Instructor helpful/caring	11.6	Frequent use of teacher-student communication channels
Clear expectations or lack of clarity	12.5	Clear and repeated documentation of course policies and due dates; reminder emails
Helpful feedback or harsh/unfair grading	15.2	Frequent use of teacher-student communication channels
Liked or disliked assignments	15.2	Use of real world examples
Level of organization	9.0	Clear and repeated documentation of course policies and due dates; reminder emails

Engaging class	7.1	Time chunking; increased structure; small group work; alternative means of participation; synchronous class discussions; active learning techniques; facilitating over instruction
Low stakes work as busy work	7.1	Frequent low stakes assignments should be meaningful and not perceived as busy work

Table 5. Relative frequency of thematic categories (comprised of both positive and negative comments) identified by students during ERT (Spring, Summer and Fall 2020) mapped to some of the best practices of online teaching (see Literature Review section 2.3).

In addition to the aggregated frequency of similarly themed positive and negative comments, the most frequent negative and positive comments during ERT should be considered. Table 6 below notes the top three positive and negative comments and the associated SDT need, accounting for 65.2% of total comments.

Most common positive comments	**SDT need**	**Frequency**	**Most common negative comments**	**SDT need**	**Frequency**
Learned valuable skills	Competence	18.8%	Lack of clarity	Competence	9.8%
Helpful feedback/fair grading	Competence	12.5%	Low stakes as busy work	Autonomy	7.1%
Instructor helpful/caring	Relatedness	11.6%	Disliked assignments	Autonomy	5.4%

Table 6. The relative frequency of the most common positive and negative comments during ERT (Spring, Summer, and Fall 2020).

The top three most frequently noted comments, comprising 41.1% of total comments, all addressed the SDT need of competence. The two positive comments related to competence express students' sense of self-efficacy in mastering skills and tasks being achievable. The negative comment expressed to an unmet need for competence, reflecting frustration that tasks were unachievable because unclear. As noted in Figure 5 above, these three comments reflect best practices of online teaching (or their absence), in particular the practices of communication, clarity, and repetition of information. The third most frequent comment addressed instructor helpfulness and caring, which could also be connected to frequent communication, a best practice of online teaching. Notably, comments about the instructor being "helpful" (meeting outside of class, for instance) are categorized differently than comments about instructor feedback being "helpful" in the learning process: while both comments mention "helpful," the former refers to the instructor and represents student perception of the SDT need for relatedness while the latter refers to the best practice of both formative and summative assessment commentary on student work and represents student perception of the SDT need for competence.

The fifth and sixth most frequently noted comments both reflect students need for autonomy. When students perceive low stakes work as busy work, they do not see value or relevance in the activity; this perception can also be the case when students dislike larger assignments. Although using low stakes work is a best practice for online teaching, the task's relevance to a larger assignment should be stated explicitly and time spent during synchronous class periods should be carefully monitored not to exceed what is needed for most students to complete the task. Major assignments, in turn, need to be presented as relevant to the students' degree program and professional future. Students' need for autonomy is frustrated when they do not perceive the relevance of tasks, whether large or small.

Overall, through both positive and negative comments, feedback of students who were forced into online learning during the COVID-19 pandemic supports the use of established best practices for online teaching.

5.2 Research Question 2

Research Question 2 asks:

> How did student feedback on course evaluations change during COVID-19 ERT?

[24] AND [25] present large-scale studies comparing course evaluations before and during COVID-19 ERT: [24] compared data from 1,416,059 nationwide evaluations from Spring 2020 to data from 1,157,334 evaluations from Spring 2019; [25] reviewed a total of 26,804 course evaluations from Spring 2018 through Spring 2020 from a single, small private college. Both only examine quantitative data. Based on quantitative date regarding course satisfaction, both [25] and [24] find that overall student evaluation ratings of courses slightly improved during Spring 2020 ERT. In a companion study to [24], [26] examined qualitative data from the same 2019 and 2020 course evaluations and "found no meaningful differences in the average word count, proportions of negative and positive words, content of word clouds, sentiments, linguistic complexity, and readability." The above findings seem surprising in light of the data from the three surveys of students during ERT discussed in Section 2. The qualitative data from the course evaluations in Section 4 can add texture to these large-scale studies because each comment was coded, preserving greater context, albeit on a small scale.

The relative frequency of student comments in terms of SDT need categories remained fairly stable from 2019 to 2020, despite the upheaval in the educational environment. For both years, the fewest comments addressed relatedness, which fell an absolute 5.7% (but 33% relative to 2019) from 2019 to 2020. Relative frequency of comments related to competency rose an absolute 4.7% and 11% relative to 2019; relative frequency of comments related to autonomy rose an absolute 1% and 2% relative to 2019. The rank order of comment relative frequency by category remained unchanged: competence was followed closely by autonomy, with both well ahead of relatedness. Figure 1 below graphically illustrates this data.

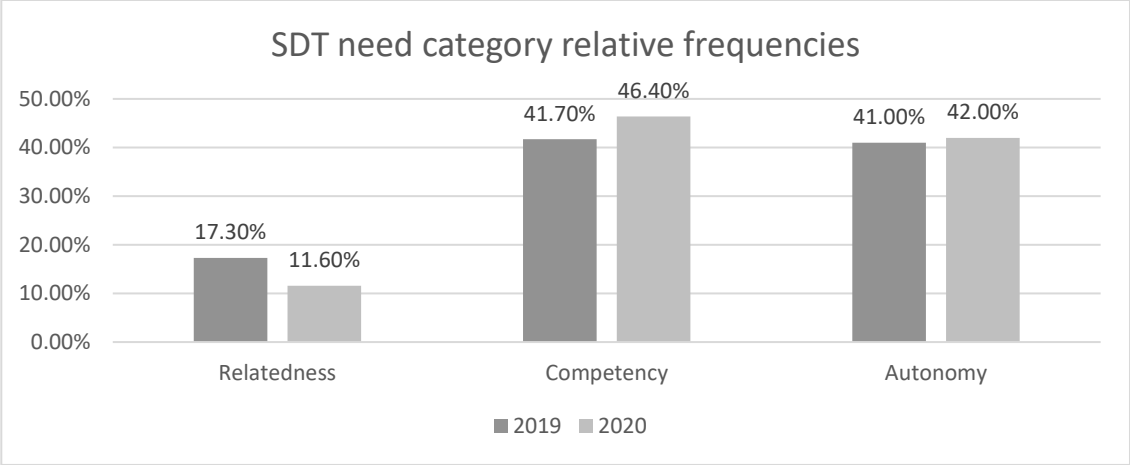
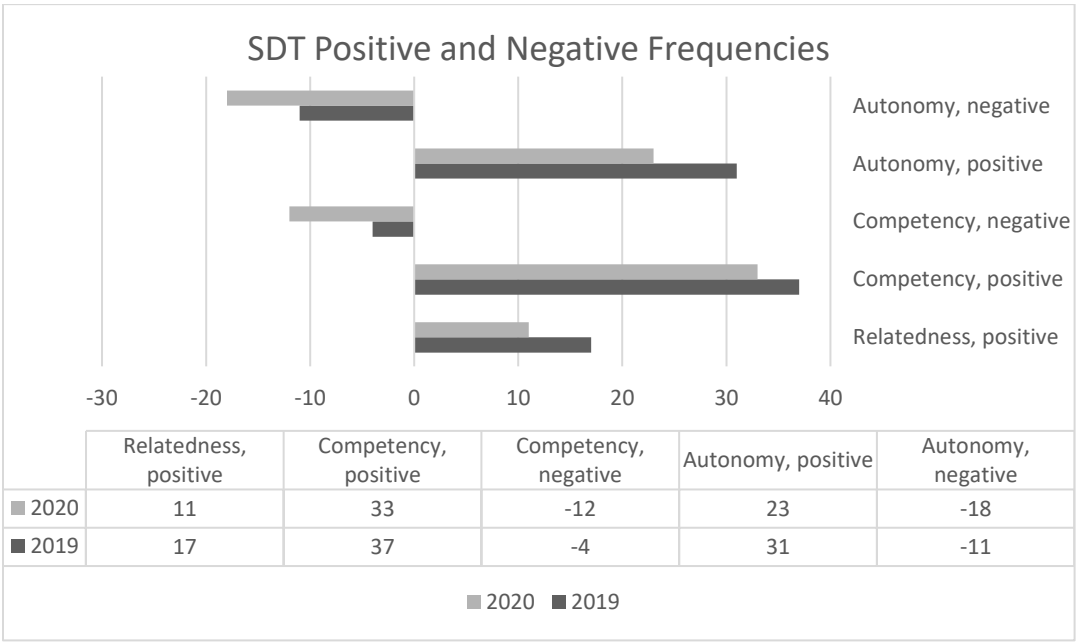


Figure 1. Comparison of relative frequencies of student comments as categorized by SDT needs, 2019 and 2020.

Student feedback on open-ended questions was more positive for all categories in 2019 (pre-ERT) than 2020 (during ERT), as shown in Figure 2 below.



	Relatedness, positive	Competency, positive	Competency, negative	Autonomy, positive	Autonomy, negative
2020	11	33	-12	23	-18
2019	17	37	-4	31	-11

Figure 2. Comparison of 2019 and 2020 positive and negative comment frequencies according to SDT categories.

Relatedness received only positive comments for both years, but the relative frequency was noticeably higher in 2019. While the relative frequency of positive comments regarding competency remained relatively stable from 2019 to 2020, the relative frequency of negative

comments increased three-fold. In both years, autonomy had the greatest relative frequency of negative comments, and in 2020 the positive comments significantly decreased while the negative comments increased.

Six comments had an over 5% absolute change in relative frequency from 2019 to 2020. Three positive comments deceased in relative frequency, two positive comments increased in relative frequency, and one negative comment increased in relative frequency, as shown below in Table 7.

Absolute frequency change	**Comment**	**SDT need**
10.8% decrease	Class was engaging/enjoyable	Autonomy (positive)
8.9% decrease	Learned valuable skills	Competence (positive)
8% increase	Helpful feedback/fair grading	Competence (positive)
6.1% increase	Well organized	Autonomy (positive)
6.2% increase	Lack of clarity	Competence (negative)
5.9% decrease	Instructor helpful/caring	Relatedness (positive)

Table 7. Student comments with at least 5% absolute frequency change from 2019 to 2020.

To sum up: in terms of relative frequency, fewer students commented that the class was engaging, they learned valuable skills, and that the instructor was helpful; in terms of relative frequency, more students commented the instructor gave helpful feedback, that the course was well organized, and that tasks lacked clarity.

5.3 Limitations:

A single coder reviewed the data, created the categories, and assigned data to the categories. The coder's awareness of the SDT context for analysis influenced category creation. Multiple coders may have reduced the possibility of coder bias. Another limitation of the study was its relatively small scale. The value of student course evaluations is the subject of on-going debate, which is beyond the scope of this paper; data are presented here as descriptions of student perspective.

Technological and access inequities impact the three basic needs identified by SDT and affect student learning even when best practices are employed. International surveys of student COVID-19 experiences were excluded from this paper because of great variances of technological access (for instance two surveys from Pakistan[27, 28] cite technology and access as major barriers to ERT implementation, while they are not reported as significant issues in surveys from South Korea and India[29] or Israel[30]). For the surveys and course evaluations discussed in this paper, the impact of such inequities is likely de-emphasized and under-represented because responses were collected online (as noted, too, by [21]). In their Recommendations, [4] suggests multiple ways for their institution to address technological inequities; however, it is beyond the scope of this paper to address these important issues.

5.4 Conclusion

Pre-pandemic online teaching catered to a distinct audience, specifically an audience that intentionally chose the benefits and drawbacks of online learning over the benefits and drawbacks of in-person learning. However, pre-pandemic online learners may have had personal, financial, or time stresses that led them to choose online learning in the first place. During COVID-19 ERT, nearly all students experienced additional stress of some sort, and in multiple surveys students note lack of motivation during COVID-19 ERT. However, in contrast to the portrait of struggling students painted by survey responses during-ERT, large-scale studies of student course evaluations show slight improvement in course satisfaction during ERT compared to previous semesters: this apparent contradiction remains unresolved and warrants further investigation. In effort to preserve the richness of student comments and offer more granular data, this paper used inductive coding and a thematic approach. Although this examination of student comments through the lens of SDT supports the value of best practices for online teaching during ERT, even with implementation of such practices, student comments on course evaluations shifted negatively during COVID-19 ERT for this small sample size study. Clearly, further research into student experiences during COVID-19 ERT is needed.

References

[1] C. Hodges, S. Moore, B. Lockee, T. Trust, and A. Bond. "The difference between emergency remote teaching and online learning." *Educause review* 27 (2020): 1-12.

[2] J. Xie and M.F. Rice. "Instructional designers' roles in emergency remote teaching during COVID-19." *Distance Education* (2021): 1-18.

[3] R. Garrett, R. Legon, E.E. Fredericksen, and B. Simunich. CHLOE 5: The Pivot to Remote Teaching in Spring 2020 and Its Impact, The Changing Landscape of Online Education, 2020. Retrieved from the Quality Matters website: qualitymatters.org/qa-resources/resource-center/articles-resources/CHLOE-project.

[4] S. Asgari, J. Trajkovic, M. Rahmani, W.Zhang, R.C. Lo, and A. Sciortino. "An Observational Study of Engineering Online Education During the COVID-19 Pandemic." (2020) *arXiv preprint arXiv:2010.01427*.

[5] B. Means and J. Neisler with Langer Research Associates. *Suddenly Online: A National Survey of Undergraduates During the COVID-19 Pandemic*. San Mateo, CA: Digital Promise (2020).

[6] C.M. Toquero. "Emergency remote education experiment amid COVID-19 pandemic." *IJERI: International Journal of Educational Research and Innovation* 15 (2021): 162-176.

[7] O.B. Adedoyin and E. Soykan. "Covid-19 pandemic and online learning: the challenges and opportunities." *Interactive Learning Environments* (2020): 1-13.

[8] A. Bozkurt and R.C. Sharma. "Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic." *Asian Journal of Distance Education* 15 (2020), (1): i-vi.

[9] C.P. Niemiec and R.M. Ryan. "Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice." *Theory and research in Education* (2009), (7)2.

[10] K.F. Trenshaw, R.A. Revelo, G.L. Herman. "Using Self Determination Theory Principles to Promote Engineering Students' Intrinsic Motivation to Learn." *International Journal of Engineering Education* (2016), (32)3: 1194-1207.

[11] E.M. Dell, Y. Verhoeven, J.W. Christman, and R.D. Garrick. "Using Self-Determination Theory to build communities of support to aid in the retention of women in engineering." *European Journal of Engineering Education* (2018), (43)3: 344-359. DOI: 10.1080/03043797.2017.1410522

[12] D. Stone, E.L. Deci, R. M. Ryan. "Beyond talk: creating autonomous motivation through self-determination theory." *Journal of General Management* (2009), 34(3).

[13] M. Hartnett. "Influences that undermine learners' perceptions of autonomy, competence and relatedness in an online context." *Australasian Journal of Educational Technology* (2015), 31(1).

[14] E.L. Deci and R.M. Ryan. *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press, 1985.

[15] J. V. Boettcher and R. Conrad. *The Online Teaching Survival Guide: Simple and Practical Pedagogical Tips*, 2nd ed., San Francisco, CA: Jossey-Bass, 2016.

[16] T. Tobin and K. Behling. *Reach Everyone, Teach Everyone: Universal Design for Learning in Higher Education*, West Virginia UP, 2018.

[17] R. Conrad and J.A. Donaldson. *Engaging the online learner: Activities and resources for creative instruction*, updated ed., San Francisco, CA: Jossey-Bass, 2011.

[18] V. Sathy and K. Hogan. "Want to reach all of your students? Here's how to make your teaching more inclusive," *Chronicle of Higher Education*, July 22, 2019.

[19] L. O'Keefe, J. Rafferty, A. Gunder, and K. Vignare. Delivering high-quality instruction online in response to COVID-19: Faculty playbook. Every Learner Everywhere. (2020, May 18). http://www.everylearnereverywhere.org/resources

[20] R. Felder and R. Brent. *Teaching and Learning STEM: A Practical Guide*. San Francisco: Jossey-Bass, 2016.

[21] A.P. Aguilera-Hermida. "College students' use and acceptance of emergency online learning due to COVID-19." *International Journal of Educational Research Open* (2020).

[22] D. Thomas. "A General Inductive Approach for Analyzing Qualitative Evaluation Data." *American Journal of Evaluation* (2006), (27)2: 237-246.

[23] L.S. Nowell, J.M. Norris, D.E. White, and N.J. Moules. "Thematic Analysis: Striving to Meet the Trustworthiness Criteria." *International Journal of Qualitative Methods* (2017), (16): 1-13.

[24] S. Benton. "Comparing Course Evaluation Quantitative Data During COVID-19." Available at: https://www.campusintelligence.com/2020/08/27/comparing-course-evaluations-quantitative-data-during-covid/

[25] G. Boysen. "Student Evaluations of Teaching During the COVID-19 Pandemic." *Scholarship of Teaching and Learning in Psychology* (July 2020). DOI: 10.1037/stl000222. Cited with permission.

[26] S. Benton. "Comparing Course Evaluation Qualitative Data During COVID-19." Available at: https://www.anthology.com/blog/comparing-course-evaluation-qualitative-data-during-covid-19

[27] M. Adnan and K. Anwar. "Online learning amid the COVID-19 pandemic: Students' perspectives." *Journal of Pedagogical Sociology and Psychology* (2020), (2)1: 45-51.

[28] Z.H. Khan and M.I. Abid. "Distance learning in engineering education: Challenges and opportunities during COVID-19 pandemic crisis in Pakistan." *The International Journal of Electrical Engineering & Education* (2021): 0020720920988493.

[29] H. Baber. "Determinants of Students' Perceived Learning Outcomes and Satisfaction in Online Learning during the Pandemic of COVID-19." *Journal of Education and e-Learning Research* (2020), (7)3: 285-292.

[30] A. Besser, G.L. Flett, and V. Zeigler-Hill. "Adaptability to a Sudden Transition to Online Learning During the COVID-19 Pandemic: Understanding the Challenges for Students." *Scholarship of Teaching and Learning in Psychology*. Advance online publication. http://dx.doi.org/10.1037/stl0000198.