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Low-income transfer engineering undergraduates' benefits and costs of online learning during COVID-19

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Online courses were a common and growing format for higher education even before the COVID-19 pandemic, but selection effects made it difficult to understand and generalize about low-income transfer engineering students' perceptions regarding online course experiences. However, the forced transition from face-to-face courses to online courses as a result of COVID-19 provided researchers and educators the opportunity to examine low-income transfer engineering students' online learning experiences without selection effects. Using a naturalistic method, the present study examined low-income transfer engineering students' ($N = 7$) communicated perceived benefits and costs of online learning during the pandemic. Analysis using inductive coding found three overarching themes of benefits and costs: *benefits and costs related to the learning environment*, *benefits and costs related to the format of instruction*, and *benefits and costs related to external factors*. Students named studying at their own pace as the most frequently occurring benefit of online learning. On the other hand, difficulty self-regulating was the most frequently named cost of online learning. Implications for theory, practice, and future work are discussed.

KEYWORDS

online learning, benefits, costs, videos, higher education, situated expectancy-value theory

Introduction

As a consequence of the COVID-19 pandemic, many college campuses around the world had to close and quickly move from face-to-face courses to online learning formats; furthermore students were required to move off-campus ([Times Higher Education, 2020](#)). This transition to online learning formats provided researchers the opportunity to better understand the average students' online learning experiences ([Moore and Kearsley, 2005](#); [Price, 2006](#); [Escueta et al., 2017](#); [McPartlan et al., 2021](#)). Prior to the pandemic, certain groups such as women ([Price, 2006](#)), older individuals ([Moore and Kearsley, 2005](#)), fully employed, and single parents ([Escueta et al., 2017](#)) were more inclined to opt for online courses as it allowed them the flexibility to balance family care, work commitments, and other responsibilities. However, with the onset of COVID-19, the self-selection process into online courses declined substantially, because most students had to take their courses in an online format, giving us the opportunity to investigate the reaction of a set of engineering undergraduates who would not typically take their regular courses online.

Furthermore, given the more general stress of all aspects of the pandemic's impact on higher education on minoritized students, we focused our study on minoritized low-income transfer engineering students. Although there has been some prior research on students' online learning experiences during COVID-19, most of the studies have focused generally on college students as a whole (e.g., Young and Norgard, 2006; Paechter and Maier, 2010; Otter et al., 2013); this may overlook specific challenges of students at particular institutions, who study particular subjects, or who are from minoritized groups. Engineering students, for example, might have faced different benefits and challenges than students in other majors, as their curriculums focus on helping students learn critical thinking and problem-solving skills by practical operations (Bourne et al., 2005). An engineering student might talk more about the challenges of not being able to fully grasp abstract concepts because of the lack of opportunity to gain hands-on experience than would an English student. Further, previous research has shown that students from minority groups, such as those from low socioeconomic status backgrounds, have higher withdrawal rates (Blackner, 2000; Jaggars, 2011) and lower grades (Mead et al., 2020). But not many studies have exclusively examined low-income students' perceptions of online learning. Such information can improve the quality of online learning for minoritized students, which is important for improving their academic success and progression through school (Jaggars, 2011). Finally, transfer students' perceptions of online learning during COVID-19 have mostly been neglected in the literature despite the growing number of transfer students in higher education (Lester, 2006; Tobolowsky and Cox, 2012; Greenfield et al., 2013). First-year transfer students might face more challenges in online learning environments compared to non-transfer students, because they have to navigate two new environments—a new school and the online space. Therefore, to address these gaps, we examined low-income transfer engineering undergraduates' perceived benefits and costs of online learning as they provide advice to peers via YouTube videos. The results of this study may aid educators in making pedagogical and policy decisions toward improving online education for low-income transfer engineering students.

Literature review

Situated expectancy–value theory as the framework

We frame our work under Eccles and Wigfield's Situated Expectancy–Value Theory (SEVT; 2020). Most of the prior studies have focused on categorizing students' perceptions of online learning as either a benefit or cost, but not as both a benefit and a cost (Almahasees et al., 2021; Bączek et al., 2021; Hou et al., 2021). In SEVT, different facets of subjective task values can be conceptualized as benefits and costs (Eccles et al., 1983; Eccles and Wigfield, 2020). Subjective task values are defined as an individual's desire to engage in a task, such as their work for a particular course or their schoolwork overall; there are currently four facets of subjective task values: intrinsic value (i.e., enjoyment gained from a task), attainment value (i.e., how central a task is related to one's identity), utility value (i.e., usefulness of a task), and cost (i.e., what one has to give up by engaging in a task). Intrinsic, attainment, and utility value are seen as benefits,

whereas the subjective task value of cost is seen as costs. Individuals consider the ratio of perceived benefits to perceived costs for the specific task being considered in light of their other available options to determine whether or not they want to ultimately engage in the task (Eccles et al., 1983; Eccles and Wigfield, 2020).

To fully comprehend the costs associated with online learning, it is essential to consider the corresponding benefits. According to Eccles and Wigfield (2020), both costs and benefits contribute to a student's persistence and are difficult to parse apart. It is possible to view reduced costs as a form of benefit, such as when a student chooses online courses and appreciates the convenience of studying from home instead of commuting. This reduction in cost becomes a benefit that enhances their perceived value of the courses. Furthermore, the same aspect of online learning that is seen as a benefit can also be perceived as a cost. For instance, even though an online course offers the advantage of developing self-regulation skills, it can also present challenges in terms of distractions that hinder self-regulation. Consequently, in our present study, we anticipated that what is perceived as a benefit in online learning could also be seen as a cost (and vice versa), both within individual students and across students as a whole.

SEVT offers a comprehensive framework for gaining insight into the costs and benefits associated with online learning, particularly in relation to the presence of instructors. Research has consistently shown that students highly value an instructor's presence in online courses, encompassing aspects such as clear communication of course requirements, timely feedback, and the utilization of diverse mediums to facilitate course discourse (Sheridan and Kelly, 2010; Martin and Bolliger, 2018; Wang, 2022). Nevertheless, students do not perceive all components of an instructor's online presence as beneficial. For instance, although timely responses to questions and engagement with student reflections were deemed helpful for fostering connections with professors, synchronous lecture sessions and interactive syllabi were not seen as effective for forming interpersonal connections (Martin et al., 2018). These findings highlight the nuanced nature of instructor presence within online learning, where certain components are perceived as valuable whereas others may be considered costly or ineffective. Therefore, SEVT serves as a practical and theoretical framework that aids in understanding the crucial role played by socializers, such as instructors' presence, in shaping the perceived benefits and costs of online learning for students.

Instructors' presence in online learning

As college students increasingly enroll in online courses, instructors have raised concerns over the quality of online education, and its impact on academic outcomes, including course performance (Figlio et al., 2013; Alpert et al., 2016), engagement (Kamble et al., 2021), and retention (Bettinger et al., 2017). One important aspect related to how content should be delivered in online courses is instructor presence (Regan et al., 2012; Richardson et al., 2016; Li et al., 2021). Given that students' perceptions of instructor presence in online courses is associated with their engagement and performance in the course (Ma et al., 2015; Park and Kim, 2020), we focused on students' perspectives on the benefits and costs of online learning as opposed to instructors' perspectives.

Students' perceptions of benefits and costs of online learning

Empirical evidence has shown that students express perceiving both benefits and costs of online learning. One of the most widely reported benefits of online learning is the flexibility and convenience it offers (Song et al., 2004; Mukhtar et al., 2020; Almahasees et al., 2021). In addition to the flexibility of where and when students can do their coursework, students highlight the benefit of convenient access to learning materials, including recorded lectures, at any given time (Song et al., 2004; Mukhtar et al., 2020; Almahasees et al., 2021). On the other hand, the most widely reported cost of online learning focuses on technical issues (Adnan and Anwar, 2020; Aguilera-Hermida, 2020; Blizak et al., 2020; Octoberlina and Muslimin, 2020; Hou et al., 2021). For example, students often report finding themselves having a difficult time connecting to the Internet (Hou et al., 2021). Furthermore, students report facing challenges with self-regulating their learning, especially because instructors are not actively monitoring them (Lee and Choi, 2011; Yan et al., 2021). Self-regulated learning refers to the process through which students actively control, monitor, and regulate their own learning through various cognitive, metacognitive, and motivational strategies (Zimmerman, 1990, 2002; Pintrich, 2004). Yet, in an online learning context, students are faced with many distractions in their immediate environment, such as family members or others in the same household (Gonzalez-Ramirez et al., 2021; Hou et al., 2021), video games, and social media (Octoberlina and Muslimin, 2020), which can be costly to sustaining their self-regulation.

Even though previous research primarily concentrated on the benefits and costs of online education for students in general, there is a growing body of work that explores these benefits and costs of online education specifically for students, such as those from low-income backgrounds (Mead et al., 2020), transfer students (Metzgar, 2021), and within specific domains like engineering (Manea et al., 2021). For example, Manea et al. (2021) showed that engineering students, like other students, appreciated the ability to review recorded lectures at any time and the possibility to participate in class from anywhere. Going further, Usher and Barak (2018) looked at the quality of peer feedback and the quantity and accuracy of peer grading among project-based engineering courses in three different learning environments: on-campus courses, small private online courses, and massive open online courses. They found that students in massive open online courses benefited from more peer feedback and were more open to evaluating projects than students in the other two learning environments. With regard to cost, Baltà-Salvador et al. (2021) found that engineering students perceived the quality of online courses to be negative, with over half of the students reporting that their academic development suffered more and they felt less connected to their professors and peers during online classes.

To a lesser extent, there has been some research on the costs associated with online for low-income and transfer students. For example, Mead et al. (2020) found that even though low-income students tend to receive lower course grades than non-low-income students in both online and in-person biology courses, the grade disparity was larger in courses using an online format. Likewise, Metzgar (2021) found that transfer students in an online economics course had lower final course grades than transfer students who completed the same course in-person.

Although previous studies have documented students' perceptions of the benefits and costs of online learning, there are contradictory findings regarding whether something is a benefit or a cost across different studies. One contradiction is whether online learning offers financial benefits or induces financial hardships. Almahasees et al. (2021) and Bączek et al. (2021) found that students benefited from saving money because they did not have to travel to and from school. Whereas Hou et al. (2021) found that students faced the costs of having to pay for better Internet service and equipment, such as a good desk set-up. In addition to whether online learning is seen as a financial benefit or cost, various studies have viewed the development of self-discipline as a benefit or a cost when learning online. For example, Almahasees et al. (2021) pointed out that students were able to develop self-discipline skills through online learning. In contrast, Bączek et al. (2021) discussed how students did not benefit from online learning, because they lacked self-discipline and presumably did not develop these skills by the end of the course. Thus, we particularly probed possible discrepancies in students' perceptions of benefits and costs of online learning across studies.

An alternative way to understand students' perceptions

The most common methodology used to investigate students' perceptions of benefits and costs of online learning is surveys (Young and Norgard, 2006; Gonzalez-Ramirez et al., 2021; Safura, 2021). Even though surveys allow researchers to gather large datasets relatively quickly, they are limited in detecting participants' deeper interpretations and explanations (Denzin and Lincoln, 1998). Participants often do not have the option to explain their choices or are limited in their options for choice (e.g., Paechter and Maier, 2010). Open-ended survey questions, for example, can offer some insights into participants' experiences and unique viewpoints, but can still be limited in understanding the full complexity of their experiences and interpretations as they tend to have either low or not thorough responses (Reja et al., 2003). In order to alleviate this concern, a few studies have utilized interviews to gain a deeper understanding of students' perceived benefits and costs of online learning (Kim et al., 2005; Mukhtar et al., 2020). However, interviews can be prone to response bias, in which participants answer in a way that seems to be the most desirable to the interviewer (Williams, 1964). Moreover, leading questions from investigators might lead participants to answer a certain way to fulfill the investigator's expectations (Berkowitz and Donnerstein, 1982). New methods are needed that can allow students to present their perceptions unhindered by survey constraints and reduce researcher expectations. For example, pragmatic measurement, where participants are free to express themselves with few situational constraints, would minimize the resources required for data collection while maximizing the quality of the data (Kosovich et al., 2017). We suggest peer advice as one of these methods and analyze student-created YouTube videos in order to understand students' perceived benefits and costs of online learning in a more naturalistic way. Students are in a situation where they are not guided by specific questions or in the presence of an interviewer because they are self-filming, which can reduce researcher expectations.

TABLE 1 Demographic characteristics of students.

Participant pseudonym name	Age	Gender	Race/ethnicity	Year
Ali	20	Male	White	Junior
Adam	22	Male	White, Hispanic/Latino	Senior
Michael	20	Male	White	Junior
Hillary	23	Female	White	Junior
Nancy	23	Female	Asian	Senior
Kristin	20	Female	Asian	Junior
Eduardo	23	Male	Hispanic/Latino	Junior

All students transferred from community college to a four-year university. Year refers to their current year standing at the four-year university.

Current study

Building upon previous literature, we aim to contribute to the online learning literature by examining low-income transfer engineering students' perceived benefits and costs of online learning during COVID-19 using YouTube videos. Our context and method allow us to avoid selection effects inherent in much pre-pandemic research on online learning and to provide insight into students' perceptions without limitations of traditional survey or interview methods. We investigated the following research questions (RQs):

RQ1: What benefits of online learning were perceived by low-income transfer engineering students after the shift to online learning due to COVID-19?

RQ2: What costs of online learning were perceived by low-income transfer engineering students after the shift to online learning due to COVID-19?

Method

Participants

Seven transfer engineering students from community college (20–23 years of age; 43% women) at a large research-intensive university in California filmed a YouTube video about online learning during COVID-19 in the 2019–2020 academic year to promote engineering community college students' persistence; student-created videos will be later used for a psychological intervention (see Table 1). All of the students from our sample were from low socio-economic backgrounds in that they either qualified for the Pell Grant or the Stafford Loan in their Free Application for Federal Student Aid (FAFSA). Three students were White, two identified as Asian, one identified as Hispanic/Latino, and one identified as mixed races/ethnicities. At this particular university, all students transferred fully online from in-person learning in late March 2020 in a quarter system.

The YouTube videos were filmed right after their last quarter of the academic year from June to July 2020, in which they experienced their first full quarter of online learning.

Procedure

Successfully transferred low-income engineering students filmed four 5- to-10-min YouTube videos to current engineering students at community college as part of a larger study (see Lee et al., 2023 for more information). These participants were recruited because we believed that they had the ability to serve as role models with their success in transferring and how far they came to where they are now in their engineering pathway. All participants received a scholarship to continue on with obtaining their bachelor's degree in engineering. The intent of the scholarship was to reduce the financial burden for low-income transfer students so that they can focus on their academics. As part of the scholarship agreement, 17 students filmed YouTube videos to current engineering students at community college.¹ Transfer engineering students were informed that the purpose of the study was for them to serve as role models and promote persistence for other engineering students like them. Students were prompted to create videos containing information that they thought was important for community engineering college students to know, but the exact topic was up to them. The YouTube video-making process involved students creating an outline for each video that was then followed by filming, editing, and uploading the videos. For the purposes of this study, we focused on video topics that revolved around students' experiences of online learning during COVID-19. Therefore, seven students were included in the final sample for the present study. The study was approved by the college's Institutional Review Board. Pseudonyms were used for confidentiality purposes.

Coding and analyses

We used an inductive or bottom-up approach, characterized by creating codes based on the data itself, to identify thematic patterns in the data (Saldaña, 2016). All seven YouTube videos related to online learning during COVID-19 were transcribed in their entirety before starting data analysis. First, coders (i.e., the first and second authors) read through all the transcripts to begin to understand the patterns in the data. Then they re-read each transcript and identified statements that explained how students perceived the benefits and costs of online learning relative to their perceptions of in-person courses. Items were coded as a benefit if they referred to anything gained from or that was positively related to learning online compared to learning in-person. Items were coded as a cost if they referred to anything lost from or negatively related to learning online compared to learning in-person. Using *in-vivo* techniques, coders used the actual words of the students within the transcripts to define our codes (Saldaña, 2016). For our first round of coding, these codes were assigned to each benefit and cost

¹ Students had the option to talk with the research team for an alternative task if they had a concern about participating in this project.

statement related to online learning. A second round of coding consolidated related codes into broader categories.

Once these codes were established, the first and second authors independently coded each transcript for benefit and cost statements related to online courses. Then coders met four times during a two-week period to discuss issues, such as code distinction and discrepancies in codes amongst coders. There was 91% inter-rater reliability (i.e., percent agreement) amongst the coders.² The created codes were shared with the larger author team for consensus. Codes were further modified to distinguish between categories and recorded down in Word documents before finalizing the data analyses.

Results

Transfer engineering undergraduates ($N=7$) discussed more costs than benefits of online learning in their YouTube videos to other engineering students. Out of the 63 statements that were categorized as either a cost or benefit of online learning across the students, benefits were mentioned in 37% ($n=23$) of the statements and costs were mentioned in 63% ($n=40$) of the statements. From these, we identified three overarching themes that emerged across all of the students' YouTube videos: *benefits and costs related to the learning environment*, *benefits and costs related to the format of the instruction*, and *benefits and costs related to external factors*. Each overarching theme consisted of at least one benefit and one cost of learning online relative to learning in-person.

Benefits and costs related to the learning environment

Benefits and costs related to the learning environment were identified as anything gained (or positively related) or lost (or negatively related) from changing one's learning environment to an off-campus online space (e.g., home living room) from an on-campus face-to-face space (e.g., classroom). Five sub-themes were classified as *benefits related to the learning environment*: learning self-regulation skills, saving time, saving money, closer to family, and working in the comfort of home (see Table 2). Three sub-themes were classified as *costs related to the learning environment*: hard to self-regulate, lack of feeling connected, and rough on body (see Table 2).

Out of the 27 statements in which *benefits and costs related to the learning environment* were addressed, hard to self-regulate sub-themes were mentioned the most—41% ($n=11/27$) in the statements among four students. This sub-theme was characterized by students' remarks of their difficulties staying focused and concentrating on their academic work when learning online. For example, Michael noted, "It's very hard to study in the same room that you watch TV and normally play games."

On the other hand, some students described how challenges in self-regulation could have benefits toward learning self-regulation.

This sub-theme was characterized by students' remarks regarding learning how to self-regulate as a consequence of being in an online learning environment and was mentioned in 7% ($n=2/27$) of the statements among one student. For example, Ali expressed the benefits of learning these self-regulation skills by saying, "I felt like some things that I learned—some habits that I gained would have been the fact that anything I was doing online, I had to be on it."

Although more statements were made about the *costs* ($n=18/27$) compared to the *benefits related to the learning environment* ($n=9/27$), students still felt the benefits of online learning, such as saving time and saving money. Out of the 27 statements in which *benefits and costs related to the learning environment* were addressed, saving time sub-themes were mentioned in 11% ($n=3/27$) of the statements among three students and saving money sub-themes were mentioned in 7% ($n=2/27$) of the statements among one student. Students noted saving time because they did not have to travel between home and school. For example, Eduardo simply said, "you do not have to travel." Similarly, students saved money because they did not have to pay expenses related to traveling, such as gas, on-campus parking, and housing. This was alluded to by Nancy when she described how much money was saved, "The \$40 gas per week was also saved since I did not have to drive to school. This means that I can save up to \$670."

The second most mentioned *cost related to the learning environment* was lack of feeling connected. Out of the 27 statements in which *benefits and costs related to the learning environment* were addressed, lack of feeling connected was mentioned in 19% ($n=5/27$) of the statements among four students. Students expressed how they felt less motivated to work online because there was a lack of physical social presence. For instance, Kristin said, "Being around motivated people just keeps you motivated as well. Although I could not be around these people much due to social distancing." On the contrary, Hillary mentioned that others can feel closer to family, especially international students who are far away from home. She discussed how "some people were back with their families." This benefit sub-theme was mentioned 4% ($n=1/27$) in the statements related to the *learning environment* among one student.

Finally, students described both the physical benefits and costs of working from home when learning online. Adam, for example, spoke about "the comfort of working from your own home" as a *benefit of the learning environment*. This sub-theme of working in the comfort of home was mentioned in 4% ($n=1/27$) in the statements related to the *learning environment* among one student. Yet, Adam also talked about how working from home "can be a little rough on your body" as a *cost of the learning environment*. This sub-theme of rough on body was mentioned 7% ($n=2/27$) in the statements related to the *learning environment* among one student.

Benefits and costs related to the format of instruction

Benefits and costs related to the format of instruction were identified as anything gained (or positively related) or lost (or negatively related) from how information was presented and taught on the online learning platform. Two sub-themes were classified as *benefits related to the format of instruction*: studying at own pace and easier to obtain a better grade (see Table 2). Four sub-themes were classified as *costs*

² Reliability was calculated by first dividing the number of discrepancies with the total number of benefit and cost statements related to online learning and then averaging the number of coders.

TABLE 2 Themes of benefits and costs.

Themes	Benefits/ costs	Sub-themes	Example quotes	Number of occurrences by videos	Number of occurrences by participants
Benefits and costs related to the learning environment	Benefits	Learning self-regulation skills ^a	“I felt like some things that I learned - some habits that I gained would have been the fact that anything I was doing online, I had to be on it.” (Ali)	2	1
		Saving time	“I can save up to two hours per day since I used to have to spend two hours for a round trip from home to school and school to home.” (Nancy)	3	3
			“I feel like online classes are getting more and more popular because you know, you do not have to travel. You do not have to wait” (Eduardo)		
		Saving money	“The \$40 gas per week was also saved since I did not have to drive to school. This means that I can save up to \$670.” (Nancy)	2	1
		Closer to family ^b	“Some people were back with their families.” (Hillary)	1	1
		Working in the comfort of home ^c	“Another pro about working from home is that you get to work from the comfort of your own home.” (Adam)	1	1
				Total: 9	Total: 7
	Costs	Hard to self-regulate ^a	“I have to find a way to get rid of all the distractions and focus on my studies.” (Ali)	11	4
			“It’s very hard to study in the same room that you watch TV, and normally, play games.” (Michael)		
		Lack of feeling connected ^b	“Being around motivated people just keeps you motivated as well. Although I could not be around these people much due to social distancing.” (Kristin)	5	4
			“It’s not you are living together to do work with your friends.” (Hillary)		
Rough on body ^c	“Another con that I think is coupled with work from home is that it can be a little rough on your body.” (Adam)	2	1		
				Total: 18	Total: 9
Benefits and costs related to the format of instruction	Benefits	Studying at own pace	“All the lectures for all the classes I’ve been in have been recorded. So you could watch them at any time.” (Michael)	10	6
			“One thing I really did like about having online classes was that the videos were recorded. For me, I would watch the videos twice. Once live where I was actively listening and then secondly, I would rewatch it and rewrite down notes.” (Kristin)		
		Easier to obtain a better grade	“A lot of teachers are really understanding of the situation, and I feel like they are happier to hand out better grades. You might get a better grade online than you would in-person.” (Michael)	3	2
“One of my professors gave us a bonus quiz to help boost our overall grade. Another professor altered the curve based on what he saw.” (Kristin)					
				Total: 13	Total: 8

(Continued)

TABLE 2 (Continued)

Themes	Benefits/ costs	Sub-themes	Example quotes	Number of occurrences by videos	Number of occurrences by participants
	Costs	Making learning harder	“The contents [<i>sic</i>] very heavy. It’s difficult. You know, there’s a lot of math, physics formulas involved. Just think about you are doing all that in a series where you need to see it in front of your desk for like one hour - just watching a video.” (Eduardo)	9	5
			“One of my professors had a hard time creating and organizing lecture slides to give the most information to students. And this class called the most confusing I ever had since the material was hard to understand.” (Nancy)		
		Hard to monitor exams	“Most professors are keep kind of changing the plans for the exams, because to be honest, I do not think that there is a way that it’s a hundred percent fair in like all aspects to have an exam online. It’s really hard to manage that.” (Hillary)	2	2
			“Harder to monitor the time during the quiz and exam because I, and all the students, work on them at home - the open notes and textbook were allowed; the tests given were longer and harder than usual.” (Nancy)		
		Technical issues	“But professors had to figure out how to use Zoom, how to share the material all through Zoom, which took a quite time to get to know. Some of my professors are able to use [it] fluently for two weeks but some others took a lot more time to be able to use it.” (Nancy)	4	2
“Some students cannot reach out to the Google Doc because it says that it’s already having too many students at the same time.” (Hillary)					
Little interactive media	“It will be better to improve engineering online education quality if we had more like interactive media.” (Eduardo)	1	1		
				Total: 16	Total: 10
Benefits and costs related to external factors	Benefits	Learning about risk management for housing ^d	“It’s really good for you as a professional to start learning about risk management and taking.” (Eduardo)	1	1
				Total: 1	Total: 1
	Costs	Housing concerns ^d	“I wasn’t sure if I was able to like break my lease. I wasn’t sure if I will [<i>sic</i>] be able to get housing.” (Eduardo)	4	2
			“I have to figure out about the lease breaking or what I’m going to do with my furniture.” (Hillary)		
		Facing financial issues	“I faced a hard time in finance, seeing my both parents get laid off due to the COVID-19.” (Nancy)	2	2
				Total: 6	Total: 4

Pseudonym names were used for all participants. Superscripts refer to a sub-theme that is directly opposite of the other sub-theme.

related to the format of instruction: making learning harder, hard to monitor exams, technical issues, and little interactive media (see Table 2).

Out of the 29 statements in which *benefits and costs related to the format of instruction* were addressed, studying at own pace sub-themes were mentioned the most, in 34% ($n = 10/29$) of the statements among

six students. This sub-theme was characterized by students' remarks of how online learning affords them the ability to watch and rewatch lectures at their own pace because they were recorded. For example, Kristin said:

One thing I really did like about having online classes was that the videos were recorded. For me, I would watch the videos twice. Once live where I was actively listening and then secondly, I would rewatch it and rewrite down notes.

Another *benefit related to the format of instruction* was that learning online made it easier to obtain a better grade. This benefit of online learning was described by Michael who said:

A lot of teachers are really understanding of the situation, and I feel like they're happier to hand out better grades. You might get a better grade online than you would in-person.

Because students had to rapidly transition from in-person learning to online learning due to the pandemic, they felt that professors were more accommodating. This sub-theme of easier to obtain a better grade was more context-specific to COVID-19 and mentioned in 10% ($n = 3/29$) of the statements related to the *format of instruction* among two students.

After the sub-theme of studying at own pace, the sub-theme of making learning harder occurred the most frequently related to the *format of instruction* theme. Out of the 29 statements in which *benefits and costs related to the format of instruction* were addressed, making learning harder sub-themes were mentioned in 31% ($n = 9/29$) of the statements among five students. Eduardo, for example, expressed how hard it is to learn online:

The contents [sic] very heavy. It's difficult. You know, there's a lot of math, physics formulas involved. Just think about you're doing all that in a series where you need to see it in front of your desk for like one hour—just watching a video.

Students also mentioned the costs of “monitoring the time during quizz[es] and exam[s]” as well as managing “the fair aspects” of having an exam online. The lack of having someone physically present during an exam made it hard to monitor. This sub-theme was mentioned in 7% ($n = 2/29$) of the statements related to the *format of instruction* among two students.

Moreover, students described the costs of technical issues, when the instructors had a difficult time using certain platforms to teach, or the students, themselves, had a difficult time connecting to their spotty Wi-Fi. Instructors, for example, had a hard time using Zoom as discussed by Nancy:

But professors had to figure out how to use Zoom, how to share the material all through Zoom, which took a quite time to get to know. Some of my professors are able to use [it] fluently for two weeks but some others took a lot more time to be able to use it.

This sub-theme of technical issues was mentioned in 14% ($n = 4/29$) of the statements related to the *format of instruction* among two students. Related to technology, one student, Eduardo, talked about the little interactive media engineering online courses have,

which he believes is an area for improvement to get people more engaged.

Benefits and costs related to external factors

Benefits and costs related to external factors were identified as anything gained (or positively related) or lost (or negatively related) from the impact of the pandemic on students' lives, which may in turn, impact their school performance, but was not as direct an impact on schooling like the above two themes. One sub-theme was classified as a *benefit related to external factors*: learning about risk management for housing (see Table 2). Two sub-themes were classified as *costs related to external factors*: housing concerns and facing financial issues (see Table 2).

Most students went back home and left either their on-campus or near-campus off-campus housing. This situation left them with the responsibility of having to figure out how to “break their lease” for those that lived near but off-campus and where to store their furniture and other items for both those who lived either on- or off-campus. This sub-theme of housing concerns was mentioned in 57% ($n = 4/7$) of the statements among two students related to *external factors*. At the same time, a student also mentioned the benefit of “learning about risk management” for housing, because he had to break his lease.

As these transfer engineering students came from lower socio-economic backgrounds, they also described the challenges their family faced financially due to COVID-19. This sub-theme was referenced by Nancy who said:

I faced a hard time in finance, seeing my both parents get laid off due to the COVID-19.

Out of the seven statements on *benefits and costs related to external factors*, facing financial issues sub-themes were mentioned in 29% ($n = 2/7$) of the statements among two students.

Discussion

Summary and implication of the findings

Past research has suggested that students in online courses have difficulties self-regulating in an online environment (Broadbent, 2017; Aljarrah et al., 2018; Chuang et al., 2018). However, the results of most of these studies could not be discussed without selection effects, because students who took online courses pre-pandemic were often associated with certain demographic characteristics (McPartlan et al., 2021). In this study, we find evidence that hard to self-regulate, a sub-theme related to the online learning environment, was the most frequently occurring cost for students. This finding also aligns with prior studies that investigated students' perceptions of online learning in the COVID-19 context where they had difficulties concentrating due to how easily accessible things like video games, social media, and talking with friends or family are in an online environment (Octaberlina and Muslimin, 2020; Hou et al., 2021). Prior work has found that students had a difficult time adapting to online learning because of the distractions and overall lack of structure and routine

they faced learning from home (Hensley et al., 2022). Hard to self-regulate might be the most recurring perceived cost of online learning, particularly because our students are from a low socioeconomic background. Low-income students might not have access to an appropriate studying space compared to non-low-income students, and may therefore lack a structured learning environment, which can be detrimental for their self-regulated learning. Therefore, educators should think of ways in which they can help students focus during class considering the vast number of distractions surrounding their environment. For instance, instructors of the class might want to increase their presence more in the course activities to help keep students accountable for their learning and promote greater engagement (Lynch and Dembo, 2004; Wandler and Imbriale, 2017). Instructors can also focus on keeping students engaged by providing pacing support (e.g., guides for assignment due dates), and utilizing instructional materials, such as interactive dashboards, that allow instructors to monitor student engagement (Rice and Carter, 2016; Carter et al., 2020). Course instructors might also want to consider gamifying parts of their lessons to bolster students' interest so that they are not distracted by other competing tasks at home (see Nah et al., 2014 for a review). Prior research has shown that both instructors and students perceive instructor-student interactions as one component of online learning that promotes engagement and persistence with online learning (Li et al., 2021). Therefore, instructors can work on increasing their presence in online learning through different strategies, including sending out regular reminders and announcements, facilitating discourse between students, and providing timely feedback to students, thereby promoting students' motivation and engagement with online courses (Martin and Bolliger, 2018; Wang, 2022).

Although students identified some costs that prior research on online learners has identified (e.g., financial hardships), students also discussed the engineering-specific costs associated with the format of online instruction. Specifically, students discussed how online courses made learning of STEM courses like engineering more challenging. Research has shown that challenges in subjects like math, an important role in developing engineering students' conceptual understanding, can lead to increased stress and anxiety in the subject, thereby decreasing achievement and persistence (Harris et al., 2015; Jamieson et al., 2021). These challenges may be made worse by the online nature of the course. Therefore, it may be especially useful to have engineering students discuss their specific challenges in those courses in order to understand what challenges they face, as well as how they perceive those challenges to impact their academic experience. Understanding the course-specific challenges that engineering undergraduates face during online learning may be particularly useful for instructors designing online courses. By knowing what challenges engineering undergraduates face in online STEM courses, instructors can better promote a learning environment that promotes students' motivation and success.

On the other hand, results showed that the most frequently perceived benefit of students learning online was the ability to study at one's own pace, a sub-theme related to the format of instruction. Consistent with previous studies, students valued the opportunity to manage their own study time and not have to be forced to follow a certain schedule (Bali and Liu, 2018). In particular, students liked that they had the option to watch or rewatch lectures at their disposal (Almahasees et al., 2021; Hou et al., 2021). Implications for online learning include continuing to provide students the flexibility and

convenience that online courses afford as well as the autonomy to go back to lectures to refresh the topics discussed. Supported by attribution theory (Weiner, 1985) and self-determination theory (Deci and Ryan, 1985; Ryan and Deci, 2020), students benefit from feeling like they are in control and have the freedom of choice. In addition, students also described the benefits related to the learning environment of saving time and money. As the cost of higher education has increased, low-income students have found that college has become less affordable to them (Perna and Li, 2006). To offset these costs, low-income students often have to work in order to afford the cost of their courses, leading to decreased academic performance (Soria et al., 2014). Therefore, understanding the benefits that low-income students discuss about online learning may be particularly salient for promoting their success.

Our findings also provide important theoretical implications. We found that a perceived benefit of online learning for one student could be seen as a perceived cost of online learning for another student and/or that a reduced cost can be seen as a benefit. For instance, a student reported that they learned self-regulation skills, but also had a hard time self-regulating during class. Similarly, a student enjoyed working from the comfort of home, but also felt this environment was rough on the body. Additionally, results showed that being closer to family was a perceived benefit of online learning, but the lack of feeling connected was a perceived cost of online learning. Some students liked that they were able to go back home, in order to be closer with their family members, especially if they came from a distant place. Yet, some students felt a lack of connection with others, especially because they were no longer physically surrounded by their peers. This tight interconnection between benefits and costs shows that positively-valenced values (i.e., benefits: intrinsic, attainment, and utility) and costs (i.e., cost) from SEVT work together to influence students' motivation. In other words, these findings speak to the cost "debate" within SEVT in that cost should be considered part of the positively-valenced subjective task values (i.e., benefits) rather than being a separate component of the model (Barron and Hulleman, 2014; Eccles and Wigfield, 2020).

Not only does a reduced cost being seen as a benefit have theoretical implications for SEVT, but it also has implications for practitioners. Instructors can ask students in their online courses to write down their perceived costs of online learning and then present examples of the same topics around costs as benefits. For example, if a student wrote that they are having a difficult time keeping up with the lectures before an exam due to procrastination, then the instructor could ask the student to watch another student talk about the benefits of being able to rewatch the lectures to study for exams. This video of another student can further elaborate that the costs of online learning will start to outweigh the benefits of online learning if students misuse the benefits of online learning, such as using the flexibility and convenience benefits of online learning as a way to not effectively use one's time for the course.

Methodological implications

The present investigation was the first known empirical study to understand students' perceived benefits and costs of online learning using student-created videos. The videos allowed us to collect data about students' personal experiences with few limitations because

students are able to freely discuss their experiences (Kosovich et al., 2017). Low-income transfer engineering students were able to openly talk about their perceptions of online learning in the context of advising a peer. The advantages of using video data are that students were not constrained by forced choice options like in many surveys (e.g., Paechter and Maier, 2010) and did not have to be in the presence of an interviewer, which can increase socially desirable responses (e.g., Williams, 1964). Our method allowed students to openly discuss both the benefits and costs of online learning, in which we were able to find further support for the following statement: “the relative value of various options must be looked at to understand choice” (Wigfield and Eccles, 1992, p. 279). Students’ benefits and costs of a task, in this case, online courses, are highly interconnected. The pragmatic free-form measure of our data collection permitted students to discuss these interconnected concepts as they appeared salient to them, without the constraints of surveys forcing benefits and costs into distinct positive task value or negative cost frameworks.

Limitations and future directions

Although our study provides useful insights for researchers and practitioners on students’ perceived benefits and costs of online learning without selection effects, it is not without limitations. The current study was a case study of seven low-income transfer engineering students in a scholarship program at a large research-intensive university in California. We do not expect that the students in our sample represent all low-income transfer engineering students. However, results were still able to provide important insights on how instructors can improve students’ online learning experiences based on students’ perceived benefits and costs. More work should be done to gain a deeper understanding regarding whether certain benefit and cost themes of online learning are specific to low-income transfer engineering students or can be applied to other students.

Students also filmed these YouTube videos after their first term experiencing the pandemic. The timing of the study allowed us the opportunity to learn about students’ online learning experiences when they first encountered this shift from a face-to-face to an online learning environment, allowing both their online and immediately prior face-to-face experiences to be fresh in mind. As students get more accustomed to their environment, their perceptions about the learning environment might change over time. Therefore, we recommend that future studies investigate students’ perceived benefits and costs of online learning over time, in order to understand which beliefs might be more (un)stable. One possibility is that students might experience more benefits than costs over time because they have learned what self-regulation skills and methods work best for them when learning online.

Finally, although video data offer us the advantage of not being constrained to limited response choices or can reduce researcher expectations, they do not allow for follow-up questions to further clarify students’ experiences in online courses. Future studies can combine different sources of data, such as survey, video, and interview data to triangulate evidence. Moreover, the survey data can be used to supplement the video and interview data. For example, surveys can ask students about their prior online learning experiences, which can then inform interpretation of the themes discussed in the videos and

interviews. Students who had prior online learning experiences might have more positive attitudes toward online learning than students who never had any online learning experiences (Lee et al., 2001; Young and Norgard, 2006).

Conclusion

With a greater number of students taking online courses, researchers and practitioners should focus on improving the quality of online education by increasing the benefits and reducing the costs of online learning. Given that low-income engineering transfer students face unique challenges in online learning, such as facing more distractions at home that negatively affects their self-regulation, researchers and instructors should focus on teaching these students relevant strategies that enable them to overcome those challenges. In assessing students’ perceived benefits and costs of online learning during COVID-19 using peer advice-related YouTube videos, this current investigation added to the growing body of literature by using an alternative method of examining students’ perceptions and addressing many of the selection effects of prior studies on online learning in higher education. The results of this study suggest that difficulty self-regulating was the most frequently occurring perceived cost of online learning, whereas the ability to study at their own pace was the most frequently occurring perceived benefit of online learning. Also, findings showed that benefits and costs of online learning were greatly interconnected, where benefit themes were directly the opposite of cost themes. Instructors can provide various materials to help students reduce the cost of online learning and create activities in which students reframe costs as benefits, leading to greater positive motivation toward their online courses.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the college’s Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

HL: conceptualization, methodology, formal analysis, investigation, resources, data curation, writing—original draft, writing—review and editing, visualization, project administration, and funding acquisition. KY: formal analysis, investigation, and writing—original draft. TR: conceptualization, writing—original draft, and writing—review and editing. KR: data curation and writing—review and editing. JE: conceptualization, writing—original

draft, writing—review and editing, and funding acquisition. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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