Experiencing the Transition to Remote Teaching and Learning during the COVID-19 Pandemic

Chun-Hua Tsai[1], Guillermo Romera Rodriguez[1], Na Li[2],
Jenay Robert[2], Alex Serpi[2], John M. Carroll[1]

Center for Human-Computer Interaction[1],
Teaching and Learning with Technology[2],
Pennsylvania State University
University Park, Pennsylvania 16802 USA
{ctsai, gkr5144, nzl5264, jrr296, alex.serpi, jmcarroll}@psu.edu

Abstract. The sudden onset of the COVID-19 pandemic severely disrupted universities around the world. In the two weeks following a shelter-in-place order, all the actors of the educational system were forced to transition to remote education. This shift required a new reliance upon technologies that these individuals might never have adopted at all, often with significant difficulties. In this paper, we present a qualitative study on a university-wide survey dataset describing student and faculty experiences of abruptly transitioning to remote teaching and learning during the spring 2020 semester at the Pennsylvania State University. We performed an inductive thematic analysis to identify the challenges and opportunities that arose during the transition. Our findings contribute to building better tools, curriculum, and supports for remote education, particularly during an unexpected crisis.

Keywords: Education, COVID-19, Pandemic, Transition, Experience, Survey, Qualitative Research, Remote Learning

1 Introduction

In the early months of 2020, COVID-19 became a global pandemic. Millions became ill; hundreds of thousands died. Life was disrupted at every scale. Many people could no longer work as they had because of the risk of transmitting infection. Some were able to work from home, but many people lost employment. Those in public service worked under extreme conditions of medical risk for months.

Universities around the world were severely disrupted. Most work in universities is not solitary; it takes place in large lecture halls packed with students, in labs where teams of students and faculty work shoulder-to-shoulder for hours at a time, and in studios and sports fields where people dance and run - and breathe hard. In the context of a highly infectious global pandemic, these settings and activities are unsafe. In the early spring of 2020 many universities throughout the world shut down in various ways.

In many cases, this shutdown became a mass migration to online teaching and learning. Digital infrastructures and tools such as Zoom were rapidly appropriated,

transforming learning interactions almost overnight. There already is an online revolution in education underway; during the past two decades online learning has become a huge and impactful paradigm in education at the university level [17]. However, this on-going revolution was instantly dwarfed by what happened in spring of 2020. In some universities, all teaching went online with less than 3 days of planning. That's a revolution.

In this paper we contribute to the effort to understand what happened: How was this revolution experienced by students and faculty? What were key challenges and problems? Were there positive outcomes, insights or lessons? How might the abrupt transition from face-to-face to online education that occurred in spring of 2020 affect teaching and learning of the future?

These are important questions. In the past, faculty and students mostly self-selected online teaching and learning, but in 2020, in many places, everyone was forced to adapt to online education. Thus, from the standpoint of investigating online learning, 2020 provided a less biased participant sample. And, perhaps more pointedly, since nothing has changed with respect to conditions that precipitated the COVID-19 pandemic, we should expect another pandemic. Thus, we need to learn to master pandemic accommodations such as online education.

The goal for this study is to identify the challenges and opportunities that can be found in remote learning. Identifying these could further contribute to building better tools and appropriate coursework for remote learning and research. Moreover, it could open new venues of investigation and provide new design ideas for further exploration.

2 Background

2.1 COVID-19 Pandemic Outbreak and Higher Education

In 2019, the novel coronavirus was initially found in Wuhan (China) and spread quickly to the world, gaining scholars' attention internationally [6]. On March 11, 2020, the novel coronavirus was classified as a COVID-19 pandemic by the World Health Organization [22], which indicated the serious spreading severity and the growing cases crossing international boundaries. Considering the situation, many universities around the world announced that they would move to rapid curriculum redevelopment for fully remote education [8], which seriously impacted the education and mental health of students and faculty [27].

Information technology has played a central role in many aspects of the pandemic transition, especially moving face-to-face teaching to synchronous online teaching using conference software and other online systems [5]. Individuals' and organizations' "digital maturity" (e.g., internet connection stability in office or at home) has partially determined the flexibility and success during the transition [12]. However, the transition could seriously impact students' exam performance and competency, especially those that involve discipline-based practices such as in medical school [1] or those in developing countries with limited digital infrastructure [10]. Researchers have conducted analyses of the aspects of the transition implications, finding digital

inequalities, communication, societal disruption, and digital educations [10,12,5]. Quantitative studies have also pointed out the pandemic education transition experience among students and educators, e.g., concerns, challenges, and strategies [29,23,11]. However, the literature has not yet examined the collective transition experience of students and faculty. Our study is motivated by this research gap and aims to understand how, during the COVID-19 pandemic, the main actors at the same higher education institution response to the transition.

We center our research at Penn State University, a public university in the United States. Starting on March 16, 2020, the university moved all in-person classes to remote education [3]. Penn State has over 17,000 faculty and 100,000 students across 23 physical campuses and one online campus (the World Campus, where asynchronous learning programs are delivered). Few faculty at Penn State had ever taught synchronously online before the pandemic. The transition to remote education posed great challenges to both faculty and students who had little experience with online learning and teaching before. Our work aims to unpack the collective transition challenges and opportunities for both faculty and students to improve their teaching and learning experience.

2.2 Remote Learning and Teaching

The transition to remote education brought both challenges and opportunities to faculty and students. An exhaustive literature review of publications after the year 2000 illustrates student and faculty attitudes toward remote education as well as potential pathways to improve student and faculty satisfaction with synchronous remote education. For example, a transition to remote education can grant more flexibility for students to learn and work at their own pace. Flexible learning allows students to choose from multiple dimensions of learning, allows teachers to be responsible for teaching content, and allows students to take responsibility for their own learning [15]. Sahin and Shelley [26] found that the great flexibility remote education brought to students played a key role in removing the intrinsic and extrinsic barriers to e-learning, and students were likely to improve their engagement and enjoyment in remote education if they found it to be useful and flexible. Additionally, the flexibility of remote education allows adult learners to balance their work, life, and learning [30].

Tabata and Johnsrud [30] studied the attitudes of faculty toward remote education. Two variables were shown to be positively correlated with faculty's willingness to participate in remote education. First, faculty needed the instructional skills to teach online. Second, faculty needed to feel that the quality of remote education was as good as in-person teaching. Howland et al. [16] found that students with positive attitudes towards remote education are good at self-directed learning, while students with negative attitudes toward distance education are less able to understand content without guidance from teachers. Factors such as self-management, self-monitoring, and motivation play important roles in the success of students' online learning [16].

Synchronous online teaching platforms such as Zoom have become widely used in higher institutions in the US. Zoom enables videoconferencing that allow students to connect with each other, which helps them maintain a sense of community and reduces their feelings of isolation [2]. After transitioning to remote education, it is of great

importance to help faculty deliver effective course content when they teach synchronously online. Kuo et al. [18] suggested that teachers should explore how to use different features of technology tools to promote the interaction between remote learners. Additionally, teachers should prepare pre-class training for students to make sure that they have basic knowledge of online learning technology feature to enhance students' remote learning and interaction.

In sum, the online education studies mentioned above summarized the attitudes of faculty and students toward remote education and the usefulness of technology tools that can be integrated into remote education. However, none of them accounted for the crisis factor which has posed extra challenges to students and faculty. Challenges associated with remote learning are potentially more serious when people are forced to experience the remarkable transition from in-person to remote education without any preparation. These are important considerations, and approaches to improving remote learning during the COVID-19 pandemic are still under-explored. Our aims to understand the challenges and opportunities arising from remote education during the pandemic. The results of this research will lead to the design of support mechanisms that help both faculty and students transition and adapt to online education more efficiently and smoothly.

3 Methodology and Data

This paper is a collaborative project with *Teaching and Learning with Technology (TLT)*, a center for teaching and learning that aims to support Penn State's instructors through instructional technologies, instructional design, faculty development, and research. TLT conducted two separate university-wide surveys to collect student and faculty feedback about the pandemic transition [24]. These surveys provided a holistic lens for us to explore the collective challenges and opportunities for both students and faculty at the same institution, which is underexplored in previous COVID-19 related education studies [29,23, 11]. Specifically, we utilized the data collected by TLT to answer two research questions: 1) What were some of the challenges faced by students and faculty at Penn State during the abrupt shift to remote education? 2) What were some of the positive opportunities afforded to students and faculty at Penn State during the abrupt shift to remote education?

The survey questions for both students and faculty were nearly identical, but many questions were contextualized for the appropriate respondent role (i.e., student or faculty). The student survey had 5 demographics questions, and the faculty survey had 6 demographics questions. The student survey had 9 closed-ended questions, and the faculty survey had 10 closed-ended questions. Both surveys had the same 2 open ended questions. The survey can be divided into four parts:

1. **Demographic Data:** This section collected demographic data such as primary role, campus, college/academic unit, and number of courses. Below are sample questions for students with response options omitted. The contextualized components for faculty are presented in parentheses.
   - Q1-1: What is your primary student (work) role?

- Q1-5: How many courses are you taking (teaching) in Spring 2020?

2. **Remote Teaching and Learning Experience:** This section contained questions regarding the challenges and concerns after the transition to remote learning. These questions are closed-ended questions (multiple choice and multiple answer) with an *other* option allowing opened-ended user input. Below are sample questions for students and the prompted options to the respondents. The contextualized components for faculty are presented in parentheses.
   - *Q2-3: What are your biggest concerns with the transition to remote learning (teaching) so far? (Check all that apply.)*
     - □ My learning (Student learning)
     - □ Changes to grading structures
     - □ Communication with my instructors (my students)
     - □ Online privacy, protection of my personal data (student data)
     - □ Assessment of learning (Evaluations of my teaching effectiveness)
     - □ Impacts to timeline to graduation (Impacts to tenure eligibility)
     - □ (Translation of course lessons or activities to a remote environment)
     - □ (Online security for exams)
     - □ Other [please specify]
   - *Q2-4: Which of the following have been challenging for you in completing your course work remotely (in adapting course design and/or assignments to remote learning)? [Check all that apply.]*
     - □ My level of familiarity with online applications
     - □ My personal time or energy to effectively adapt
     - □ Access to course materials [student only]
     - □ My knowledge for online course delivery [faculty only]
     - □ My knowledge for holding synchronous online class [faculty only]
     - □ Instructors' (Students') responsiveness to communication
     - □ My (Students') availability for synchronous class sessions
     - □ Other [please specify] sessions
3. **University Resources and Supports:** This section included closed-ended questions about the usage of university resources, communication methods, and online services. Below are sample questions for students with response options omitted. The contextualized components for faculty are presented in parentheses.
   - Q3-1: What University resources have you been using during the shift to remote learning (instruction)?
   - Q3-2: What is the best way for the University to inform you of resources for learning (teaching)?
4. **Optional Opened-Ended Questions:** This section allowed the respondents to submit their opinions about any topic of their choosing. Below are the two questions for students, and the contextualized components for faculty are presented in parentheses.
   - Q4-1: Optional: Please describe any positive aspects of the shift to remote learning (teaching) that have not been addressed elsewhere in this survey.
   - Q4-2: Optional: Please describe any challenging aspects of the shift to remote learning (teaching) that have not been addressed elsewhere in this survey.

The first survey was distributed to Penn State students via Canvas (Penn State's learning management system), Penn State Go (the official all-in-one mobile app for all students, faculty, and staff), and email between April 24, 2020 and May 1, 2020 (8 days). Out of 4,911 responses, 3,787 met inclusion criteria for the study (enrolled in at least one course, answered all closed-ended questions), representing 4% of the Spring 2020 Penn State student population. The second survey was distributed to Penn State faculty via Canvas and email from April 26, 2020 to May 8, 2020 (13 days). There were 576 respondents who met the inclusion criteria of 1) teaching at least one course and 2) answered all closed-ended questions. For both student and faculty surveys, 23 campuses and every academic discipline at Penn State were represented (Pennsylvania College of Technology is an autonomous affiliate Penn State campus, and it is not represented in our data). Both surveys were approved by the university's human participant research board.

To address the research questions, we performed an inductive thematic analysis [4] on the collected survey data for both student and faculty. Four researchers participated in this process, of reading the dataset to obtain an initial understanding of its content. We held weekly meetings over four weeks to discuss our general impressions of the dataset as well as the specific question of the faculty and student feedback in the data. Our initial data exploration uncovered the two major themes of the data, i.e., the *challenges* and *opportunities* of the transition to remote education. With these two themes in mind, each of us then individually returned to the dataset to develop initial codes. Subsequently, we met again to discuss those codes and resolve our disagreements, resulting in a unified code book. Next, we refined the code book, generating larger themes for both student and faculty submitted survey data. This was an iterative process where we held frequent discussions and went back and forth between our codes and data until we reached a satisfactory thematic scheme.

We decided to focus on questions 2-3 (the "Other" option that given opened ended responses), 4-1, and 4-2 from both surveys (a total of six questions analyzed). We chose these questions because they 1) allowed the respondents to provide opened-ended feedback in free-text form, 2) were most relevant to our interest in exploring the transition to remote education, and 3) revealed common ground between student and faculty experiences. After filtering the data based on inclusion criteria (as previously described), 1,881 student respondents and 334 faculty respondents were further selected from the dataset for meeting our new inclusion criterion of having answered at least one of the open-ended questions for our analysis,

4 Findings

The COVID-19 pandemic has been shifting universities from normal operations to remote education. The transition was initially unexpected and abruptly halted all in-class interactions, which greatly impacted all students and faculty. Here, we detail the challenges and opportunities of the abrupt shift to remote education experience for Penn State students and faculty.

4.1 Challenges with the transition to remote education

Challenges with the transition to remote education refers to the barriers and difficulties that students and faculty faced at the onset of the shift to remote education as well as the recognized challenges of remote education [13,21]. Based on questions 21 and 30, our final thematic scheme included four overarching themes: *1) Learning Resources and Technology Challenges:* the challenges of lacking necessary technical skills and resources for online learning; *2) Course Adaptation and Performance Assessment:* the issues of lacking online teaching experience and organizational supports and the concerns of performance and learning assessments; *3) Class Engagement and Communication:* the barriers of shifting to maintaining the same level of engagement while shifting from in-person to remote education; *4) Mental Burden and Other Pressures:* the issues of mental burden and related pressures due to the abruptness of the shift to remote education and the surrounding global crisis.

Learning Resources and Technology Challenges. Immediately upon shifting to remote education, both students and faculty needed to have extra computer skills, software/hardware supports and a stable internet connection. Due to the unexpectedness, short notice, and short preparation time, many students and faculty were less prepared than necessary for the required learning resources. For instance, a senior undergraduate student shared her experience of losing internet access to attend online classes, due to the shelter in place orders [20].

> "*I have found the shift to remote learning to be extremely stressful... Before going remote I would simply drop my son off at daycare and go to the library for the day to work on my online class and other course work. After COVID-19 went full swing and we switched to remote, I no longer had access to free internet at the library or a daycare to keep my son so I was able to focus*."

By definition, students can attend online classes *anywhere* if they have a stable internet connection. The pandemic caused this student to lose access to the library's internet connection as well as the *uninterrupted* learning space to study. This data suggests that students who previously depended on the availability of similar learning resources on or around campus (e.g., computer labs, libraries, classmates, borrowed devices, etc.) may have encountered novel barriers since leaving campus. Notably, even students who had a stable internet connection at home may have faced such challenges. For instance, a first-year undergraduate studying education described this phenomenon.

> "*The WiFi at my house is very good and I have been having lots of issues while using zoom where I will just drop out of the class because my WiFi is not working and the professor or whoever is talking will freeze or the audio will go in and out and I will miss the content that the professor is teaching*."

Zoom was widely adopted at Penn State during the shift to remote education as it has been in many online classes [14]. Some instructors offered synchronous teaching through Zoom, which required superior broadband services as well as hardware such as a webcam. Although Zoom supported many useful functions for remote teaching, faculty still found it difficult to immediately integrate the software into their classes. A faculty member in Earth and Mineral Sciences shared this experience.

> "*While I'm very adept with computer systems and software even I had difficulties figuring out how to make my course as seamless as possible. It would have been good to know if there were actual hardware resources available: Perhaps webcams, tablets, writing tablets (quite cheap), whiteboards, and so forth. Software is easy to get, but figuring out how to use that to the best effect is only easy to those who have never tried it.*"

Instructors who have relatively strong computer skills might be able to adopt new systems and software if proper hardware devices are provided. However, those who are not familiar with computer skills may face additional challenges. For example, an instructor who taught in Arts and Architecture shared the difficult of adopting new online systems.

> "*no one in my dept understood how to teach me what to do to make ZOOM work initially. All use Mac's not PC and the dept head uses a PC but struggled to define the working steps*."

Although Zoom software is relatively simple to use, this data indicates that some faculty faced technical difficulties adapting to the new remote teaching platform, perhaps suggesting the need for more organizational support.

Course Adaptation and Performance Assessment. The transition to remote education gave both students and instructors very little time to react. In this theme, we introduce experiences related to course adaptation and performance assessment. Obvious challenges are time constraints and the lack of required skills for adapting in-person classes to remote learning. An instructor from the College of Liberal Arts mentioned the transition experience.

> "*First, let me say - I realize it had to be done, but it often felt like we have been flying the plane while building it. For example, taking a single large course of over 300 students and asking to shift to a completely different learning environment, where neither the instructor or many of the students have acquired the required skill set necessary to do so successfully. Now imagine having multiple courses consisting of roughly 500 students combined, and requesting this to be accomplished, synchronously, in less than a week. It was asking for the impossible*."

In this example, the instructor felt there was not enough time and training to prepare the remote version of the course. In particular, if the instructor needed to manage multiple large enrollment courses. It is not surprising to see that such rapid changes impact students. A graduate student who was also a teaching assistant in the College of Liberal Arts provided her opinion about the workload, expectation, and adjustments.

> "*Extremely unimpressed with the very short notice given to instructors and students - over what was supposed to be our spring break... The lack of consistency in standards and expectations between departments and even between instructors within the same department has been really frustrating - some have been lightening workloads and adjusting the syllabus, while others have been adding additional amounts of work beyond what was original scheduled, increasing the burden and stress on students*."

We observed multiple challenges expressed by students about workload, learning assessments, and conflicting messages about new expectations. A second year undergraduate from the College of Information Science and Technology described these issues.

> "*My biggest problem is professors loading on course work heavier because we a lot more free time because of the quarantine. It makes sense that professors would want students to get deeper into material to keep them occupied, but I believe students have options for occupying their extra spare time. Adding on additional (not a normal level pre-quarantine) coursework, assignments, and readings has negatively impacted me fairly hard.*"

Remote learning may have granted this student more "free time", but the increase in course work created new challenges in addition to the global crisis.

These challenges could impact the academic performance of the student. Remote education also has its constraints related to specific majors and disciplines. For instance, the *hands on* experience was hard to replicate via videoconferencing. A third-year undergraduate who majored in music provided a typical challenge in her music performing class.

> "*In the School of music, there is an inability to perform due to cancelled performances and an inability to collaborate in music-making due to the technology's inability to act perfectly synchronously. We have experimented with the zoom technology in class, and because everyone? internet is different speeds, the variances in attempting to play together can be quite dramatic. It cannot be controlled over a live call. The videos of this being accomplished that are posted online as ensembles performing remotely are greatly edited and do not give an example of a live ensemble.*"

Both students and faculty expressed that they needed more support in order to prepare for the transition to remote education. As a faculty member from Health and Human Development stated, the "*transition has been very time consuming, in addition to the uncertainty and anxiety that the COVID-10 pandemic has brought*".

Class Engagement and Communication. Another primary challenge related to the transition to remote education was class engagement and communication between students and faculty. Remote engagement is different from in-person interaction, and challenges related to motivation and engagement in remote instructional environments are well-known [21]. The forced and abrupt to remote education due to the pandemic made it even more challenging for students and faculty to maintain the same level of class engagement they had in in-person classes. An instructor from the psychology department shared the attendance rate in her class.

> "*Attendance dropped off sharply, especially toward the end of the semester (for example, for my 8am introductory course, attendance dropped from about 75%, or around 18-20 out of 25 students, to 25%, around 5-6 out of 25 students). This was really disheartening for me, and it was difficult to find motivation to lecture in 'real time' when classes were so small and participation was a struggle.*"

There are many *techniques* that an instructor can use to motivate students to attend class and engage in in-person class discussion. However, it may be more difficult to employ these techniques in the remote learning environment. For instance, institutional policies at Penn State prohibited faculty from requiring students to appear on webcams during synchronous classes. An instructor from the business school shared her challenges trying to motivate and engage students in a discussion-based class.

> "*Usually in face-to-face teaching, I ask them to put their phones and laptops away to minimize distraction. That is not possible now - and they are distracted now (they tell me they have trouble keeping their attention to the discussion/lecture when distractions are within reach). Further, not everybody can and/or wants to put their webcams on, so that they don't feel they are accountable/they don't have to pay attention. In case the majority does not do this, it becomes the norm not to do this, and students who want to turn their webcam on as it helps themselves pay more attention actually choose not to do so. All in all, this harms discussion-based classes like mine.*"

This data indicates that it was more difficult for faculty to control "distractions" during synchronous remote classes, potentially relying more on students' self-discipline to maintain the same level of class engagement. A similar challenge extends beyond the synchronous learning environment. Faculty and students reported that it was harder to communicate with each other remotely. A first-year undergraduate student from the nursing school shared her experiences interacting with her professors.

> "*I understand that everyone is experiencing this change, but personally I did not and never would sign up for online classes willingly. I am struggling to grasp material and communicating with professors. Some of them become very irritated when we ask them questions, then we get upset and flustered. Many of them do not realize that these grades can dictate our future. I wish that there was less tension and more communication.*"

Other data suggested that remote learning limited opportunities for students to interact with each other. Our respondents found it challenging to replace social, in-person communication after the shift to remote learning. A second year undergraduate studying engineering expressed the desire to interact with other classmates in-person.

> "*I miss my peers. Not the jokes or the games or the recreational aspect, but the social aspect related to school I didn't even notice we all had. In between classes the chit chat about what homework questions were hard and how to study them, what online resources helped most, what study methods worked best, and on and on. I think this aspect of school- my peers- is the second most essential thing to my success. Week one was a hard transition, by week two we started texting each other, but it's not the same. Its like we only text each other in high need situations. 'wait when is the exam?' instead of 'is this the method you used on problem 3?'. I miss my peers.*"

This student feels that interaction with peers is essential to academic success and facilitates the learning experience. This quote suggests that the communication between students is more than social networking; it is a learning opportunity as well.

Mental Burden and Other Pressures. The transition to remote education brought mental burdens and pressures in different aspects to both students and faculty, even

beyond the pedagogical challenges. We observed students worrying about their academic performance and post-graduation career plan. A third year undergraduate who majored in education shared her worries about the transition.

> "*This has completely annihilated my mental health. I am concerned that I am not going to get as much out of my classes as I need, as it is hard to replicate in-person discussion on a discussion board or through Zoom. Considering I need this information when I take my teaching certification test, I am afraid I won't pass them due to this pandemic. I also don't like how Penn State won't allow teachers to just post recordings and make us have class during regular class time. My sleep schedule has been impacted by how much I have to look at screens, so I am often not in a position to participate fully, as I am exhausted*."

In this example, the student expressed that the transition to remote learning impaired her learning experience, potentially jeopardizing the required certification test in her discipline. The increase in screen time also influenced her study-life balance, harming her mental and physical health. The faculty also expressed challenges related to mental burden. In addition to the teaching load, faculty reported that they were asked to attend more events and provide services through video conferencing. A faculty from the liberal arts college mentioned her duties as well as the challenge of work-life balance.

> "*... the insistence on holding events that could have been consolidated or put off until after the semester is over has been burdensome. I have spent whole days doing nothing but sitting in ZOOM meetings ... otherwise burdened with dealing with student health and technological issues, reporting on students progress in STARFISH, finding adequate supplies at home, and caring for family members and extended isolated friends. I was receiving up to thirty [..] emails a day ... that it was deleterious to my overall functioning. Have you ever had to sit in one place online and lecture to a whole class behind the electronic burqa and be on point from 9 am until 4:20 pm with only short breaks? It is mentally exhausting and physically strenuous*."

Another pressure expressed by respondents is related to the value of education and financial security. The students paid regular tuition before the shift to remote education. Many students expressed concerns about "learning quality". A fourth-year undergraduate from agricultural sciences described the relationship between tuition and the remote learning.

> "*My learning has definitely decreased significantly since the shift to remote learning... I am sure that this phenomenon is being experienced by many students, and is one reason that we should not be required to pay the normal tuition. This situation is not normal, and asking students to pay the same amount that they would be required to pay for in-person classes implies that the value of the education we are receiving has remained the same throughout this transition to an online format*."

This example illuminates the student's perception of the relationship between tuition and teaching mode, even if universities needed to spend more money than usual to cover the unexpected expenses associated with transitioning to remote education. The extra cost was not visible to the students, who perceived the quality of remote teaching to be the same or inferior to the quality of in-person teaching. We also observed that

instructors felt pressure related to job security, performance review, and promotion and tenure. A faculty member in education described these concerns.

> "*I worry, however, about not getting notice that I'll need to make these changes until late summer. This will create so much additional stress. I know there are a lot of moving parts, but I wonder if giving faculty time to prepare for a move online will reduce stress and create better learning experiences for students. I'm afraid to start doing the work now because nothing has been announced and it feels like a a poor use of my time as a pre-tenure faculty member.*"

4.2 Positive Aspects from the transition to remote education

After the inductive thematic analysis conducted on question 29 we identified three major and overlapping themes about the positive aspects that students and faculty noted during the transition to remote learning. The first theme identified was *Family and Community Support*, with a total of 62 responses among faculty and students. This theme was coded from those responses that identified how family and the Penn State community helped through the remote learning transition. The second theme was *Flexible Learning and Performance*, with 136 response in total. This theme was created from those responses that identified the flexibility and the performance change that students and faculty experienced during the remote learning period. The last theme, *Digital Pedagogy and Technology*, with 69 responses total, was comprised of responses that noted the changes and tools that helped through the transition. These three major themes were made up of smaller sub-themes that were identified and discussed during the process of thematic analysis we conducted. Each of the overlapping themes and sub-themes helped us find common ground between students and faculty and understand the possible opportunities during this remote learning period.

Family and Community Support. The first major theme, *Family and Community Support*, encompassed those responses from faculty and students that mentioned how the period of remote learning allowed them to spend more time with their families, how Penn State helped them throughout the transition and how, in the case of students, faculty helped them bear through the transition. We defined family support as the perception that an individual was being cared for or felt valued by family [9]. Based on those guidelines this theme was comprised of three smaller sub-themes. Two of those related to students: *stay with family*, and *support from faculty*; and one related to faculty: *multiple sources of support* from Penn State.

The sub-theme *stay with family* focused on those responses from students that mentioned how being with their family helped them get through the transition. Upon Penn State's transition to remote education, students were able to go back to their homes with their families. Previous research [25] has shown that family support has a positive impact on students' learning processes. Accordingly, we found some students did indeed appreciate the remote learning period to spend time with their family while being able to continue with their course work. For example, a first year undergraduate student whose primary field of study is in education mentioned this family relationship.

"*It has truly been nice to spend time with my family and also continue my coursework*."

The second sub-theme *support from faculty* encompassed responses from those students that noted how their faculty helped transition to remote learning. Students appreciated the support they received from faculty and mentioned they would have had a harder time were they not helped by their instructors. A participant who is a second year undergraduate student in the agricultural sciences noted the following.

"*My professors have almost all been on their A-game in terms of communicating with us and working hard to make things that worked in-person work on-line. The level of commitment set forth by my professors set a standard that online classes were to be taken seriously. There has also been a very appropriate amount of leniency, which has helped me to adjust as I don't do well with managing my time at home*."

The last sub-theme found in this category relates to faculty: *multiple sources of support* from Penn State. Similar to students, we observed that some faculty members noted support from their departments and other staff at Penn State. Even though the transition was a novel situation for everyone involved, many respondents still felt supported by the university and their departments, colleges, and campuses. A non-tenure-line faculty member who teaching undergraduate students noted the tremendous support received from the institution and how it helped learn new tools that went unnoticed during face-to-face classes.

"*The [redacted] campus in particular did a tremendous job of getting faculty up-to-speed very quickly and efficiently when the transition happened. I felt incredibly supported and knew exactly where to go for what anytime I had a question or concern. I also feel that the shift has forced me to learn more about technologies available to me that I didn't otherwise know about, and I can see ways I may use these tools in my face-to-face instruction going forward*"."

Flexible Learning and Performance. The second major theme within our analysis of the positive aspects from the transition to remote education, *Flexible Learning and Performance*, is comprised of responses that acknowledged how flexibility and performance changed due to the remote learning transition. We define flexible learning as those situations that allow students and faculty more free time and use of technologies to create an environment focused on learning [7]. Research has found that in the case of faculty, flexible learning has been a motivator to teach online courses [17]. On the student side this theme was made up of three sub-themes

The first sub-theme from students, *save time from commute*, incorporated the responses from students that noted time saved by eliminating the need to commute. Students reported using time saved from commuting (and even other social activities) to spend more time studying. In this sub-theme, a first-year engineering undergraduate student wrote:

"*I am a student that commutes to and from campus. I would commute about an hour and a half everyday. Shifting to remote learning has given me that extra time to study and finish homework*."

The second theme found within the student responses, *more flexible learning*, grouped responses from the students who indicated that remote learning gave them more flexibility and ability to work by their own schedule. During this period, Zoom lectures where given both synchronously or asynchronously. Students reported that asynchronous course content afforded them more flexibility to manage their own schedules and learn at their own pace. A first year liberal arts undergraduate student responded:

> "*I have personally performed very well with remote learning. I like doing things on my own time, for example, I can do a lot of work one day and then relax the next day and just alternate. I only have one class that meet on zoom at class time, therefore I have the freedom to get ahead with my classes when I want to*."

The last sub-theme in this section was *more sleep*, which grouped together those responses from students who appreciated the opportunity to sleep more and be in a more familiar environment. These students indicated that their new sleep schedules made it easier to wake up for class. A fourth year undergraduate in the College of Information Sciences and Technology described the comfort of the home learning environment.

> "*It's easier to get up from bed and to be in a very familiar an comfortable environment and attend class, also there are no excuses of leaving assignments at home*."

Faculty also recognized that the increased flexibility offered by remote education improved students' overall performance and communications through increased engagement in virtual office hours. We observed faculty further reported that flexibility helped improve their feedback and assessment practices. For instance, a tenure-line faculty member from the College of Arts and Architecture described these positive aspects of remote teaching.

> "*Flexibility in offering reviews on student work, larger audience for studio reviews, thesis/dissertation defenses*."

Digital Pedagogy and Technology. We refer to digital pedagogy as those activities made or designed with the intent of enhancing learning [19]. We also discuss digital pedagogy in light of the positive effects that technology can bring in the context of pedagogy and education [28]. This theme groups all of those responses, from both faculty and students, that acknowledged the positive technological changes that came with the transition to remote education. This theme is comprised of three sub-themes, one from students - *re-watch videos* - and two from faculty - *technology helps the transition to remote teaching* and *improve online teaching*.

For the first of the sub-themes, *re-watch videos*, we found that students liked the ability to view their classes asynchronously and re-watch their lectures multiple times. Some students also noted how this characteristic allowed them to be better prepared for their assignments and exams. A second year undergraduate medicine student noted the following.

> "*I like being able to re-watch parts of lectures that are confusing for me and having the ability to pause the lecture recordings to look at my textbook or previous notes to understand the material better*."

In the sub-theme *technology helps the transition to remote teaching*, faculty reported that technology helped them re-evaluate their teaching methodologies and create a good learning experience for their students. Faculty referenced tools such as Zoom and Kaltura, another application used at Penn State to record course content. One faculty member wrote:

> "*I feel the shift to online has made me more creative in my teaching and has made me critically evaluate how I teach. I am now more versed in the tools that can be used to engage students remotely, and enhance their learning experience*."

The final sub-theme, *improve online teaching*, had some overlap with (*technology helps the transition to remote teaching*), but the focus in this sub-theme was on those faculty members that reported an improvement in their teaching techniques due to teaching in a web-based environment (as opposed to technology tools). In addition, we observed cases from faculty that mentioned how they would keep some of these practices and techniques learned during the remote education period once things returned to normal. A tenure-line faculty member who teaches arts and architecture wrote:

> "*Created clarity in weekly modules. I had to rethink how to explain what assignments were without being able to answer questions freely in class. Forces me to codify the weekly lessons. This also simplified some lessons, but did help create a structure to deliver the content*."

5 Discussion

In this paper, we reported on a qualitative study of the student and faculty's transition experience during the COVID-19 pandemic. We identified four types of challenges with the transition to remote education: learning resource and technology, course adaptation and performance assessment, class engagement and communication, and mental burden and other pressures. We also investigated three positive aspects during the transition: family and community support, flexible learning and performance, and digital pedagogy and technology. Next, we discuss in detail the collective transition experience during the COVID-19 pandemic, articulating the practical implications for online education research and practices.

Our findings depict the collective challenge through a unique lens during the pandemic, i.e., both students and faculty were forced to adopt the "new normal" that may stay with us in the future [5]. We observed that both students and faculty members struggled in the transition due to the pandemic. One major reason is that the transition was unexpected and sudden, giving them very little time to react and limiting access to resources such as technology and curriculum materials. The abrupt transition impaired the flexibility that remote education can offer to students and faculty [15] and also created extra burden and stress for practitioners. Some faculty reported that they did not receive sufficient support to develop new curriculum or course content, and they did not receive the necessary technical training for remote learning, which has been identified as a key variable for successful remote education [30]. The disarrangement possibly

caused difficulty in communication between the students and instructors, which further undermined the students' attitudes toward remote education [16].

Our study of the learning and teaching experience also revealed the positive aspects of the transition to remote education. We concluded that the pillars of a positive remote learning and teaching experience are the various supports as reported above and digital maturity [12]. Support from family and the institution could play a critical role in the smooth transition to remote education for students and faculty [25]. With such support, students and faculty could benefit from the flexibility in instructional materials (e.g., re-watching presentations if needed) and time management (e.g., to participate in the class from home or to have a larger size faculty meeting) provided by remote education. Prompt technological and pedagogical support from the institution could reduce the faculty's burden in developing a new curriculum. The institution's capability to offer multiple, timely supports could be seen as the level of digital maturity that determines the individual or institution's capacity and competence in adopting remote education. Digital maturity goes beyond providing stakeholders with technical tools and infrastructure; it also involves supporting digital pedagogy by preparing the curriculum to be digitally adaptable and available. In this way, course materials are not just placed on line but are transformed to remote education, fully promoting and supporting remote student engagement, interaction, and learning.

Our study findings show how students and faculty rapidly developed awareness about challenges and opportunities during the transition. We see three design ideas for transitioning to online education in the post-pandemic era. First, from this spring 2020 experience, we have seen how learner and instructor can interact with each other remotely. Still, we cannot assume that crucial learning elements such as in-class discussion and engagement will just happen spontaneously. A successful remote learning transition should consider the lager education system including student and faculty collective experience, which is still an underexplored research question in the remote education domain. Second, no one wants to see another pandemic happen, but we may need to get used to a new normal since the conditions that precipitated the COVID-19 pandemic are still present [5]. We need to investigate digital maturity or resilience in transitioning conventional curriculum to a remote or mixed-mode learning environment. This will help us cope with a possible sudden transition to remote education in the future. Third, we need to understand further the impact of current events on post-pandemic learning and teaching; the pandemic may permanently change expectations of future learners and instructors. Face-to-face educational processes are crucial for the economy and higher education. Our study could be seen as an early attempt to understand the student and faculty's collective awareness and experience during the transition, which could be used to describe possible actions and proposals more comprehensively in the future.

6 Conclusion

In this paper, we presented a qualitative analysis of university-wide survey data from Penn State University, a public university in the United States. We performed an inductive thematic analysis to uncover and identify the challenges and opportunities

during the COVID-19 pandemic transition from regular operation to remote education. Based on the study, we identified four themes that refer to the challenges that the students and faculty faced following the shift to remote education as well as the recognized challenges of remote education. We further identified three themes describing the positive aspects of the transition to remote education. We discussed the possible design implications that could also contribute to building better tools and appropriate coursework for remote learning and research as well as potential future transitions.

References

1. Ahmed, H., Allaf, M., Elghazaly, H.: Covid-19 and medical education. The Lancet Infectious Diseases (2020)
2. Akarasriworn, C., Ku, H.Y.: Graduate students' knowledge construction and attitudes toward online synchronous video conferencing collaborative learning environments. Quarterly Review of Distance Education 14(1) (2013)
3. Barron, E.J.: All penn state classes to take place remotely beginning march 16 (2020), https://news.psu.edu/story/611757/2020/03/11/academics/all-pennstate-classes-take-place-remotely-beginning-march-16
4. Braun, V., Clarke, V.: Using thematic analysis in psychology. Qualitative research in psychology 3(2), 77–101 (2006)
5. Carroll, N., Conboy, K.: Normalising the "new normal": Changing tech-driven work practices under pandemic time pressure. International Journal of Information Management p. 102186 (2020)
6. CDC: Identifying the source of the outbreak (2020), https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/aboutepidemiology/identifying-source-outbreak.html
7. Collis, B., Moonen, J.: Flexible learning in a digital world: Experiences and expectations. Psychology press (2001)
8. Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P., Lam, S.: Covid-19: 20 countries' higher education intra-period digital pedagogy responses. Journal of Applied Learning & Teaching 3(1), 1–20 (2020)
9. Demaray, M.K., Malecki, C.K., Davidson, L.M., Hodgson, K.K., Rebus, P.J.: The relationship between social support and student adjustment: A longitudinal analysis. Psychology in the Schools 42(7), 691–706 (2005)
10. Dwivedi, Y.K., Hughes, D.L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J.S., Gupta, B., Lal, B., Misra, S., Prashant, P., et al.: Impact of covid-19 pandemic on information management research and practice: Transforming education, work and life. International Journal of Information Management 55, 102211 (2020)
11. Fiorino, G., Colombo, M., Natale, C., Azzolini, E., Lagioia, M., Danese, S.: Clinician education and adoption of preventive measures for covid-19: A survey of a convenience sample of general practitioners in lombardy, italy. Annals of internal medicine (2020)
12. Fletcher, G., Griffiths, M.: Digital transformation during a lockdown. International Journal of Information Management 55, 102185 (2020)
13. Galusha, J.M.: Barriers to learning in distance education. (1998)
14. Girten, N., Heyward,G., Vance, E.: The students of zoom university (2020), https://washingtonmonthly.com/magazine/september-october-2020/thestudents-of-zoom-university/

15. Goode, S., Willis, R.A., Wolf, J.R., Harris, A.L.: Enhancing is education with flexible teaching and learning (2007)
16. Howland, J.L., Moore, J.L.: Student perceptions as distance learners in internetbased courses. Distance education 23(2), 183–195 (2002)
17. Hunt, H.D., Davies, K., Richardson, D., Hammock, G., Akins, M., Russ, L.: It is (more) about the students: Faculty motivations and concerns regarding teaching online. Online Journal of Distance Learning Administration 17(2), 62–71 (2014)
18. Kuo, Y.C., Walker, A.E., Belland, B.R., Schroder, K.E., Kuo, Y.T.: A case study of integrating interwise: Interaction, internet self-efficacy, and satisfaction in synchronous online learning environments. International Review of Research in Open and Distributed Learning 15(1), 161–181 (2014)
19. Loveless, A.: Technology, pedagogy and education: reflections on the accomplishment of what teachers know, do and believe in a digital age. Technology, Pedagogy and Education 20(3), 301–316 (2011)
20. Martineau, P.: What's a 'shelter in place' order, and who's affected? (2020), https://www.wired.com/story/whats-shelter-place-order-whos-affected
21. Murray, B.: What makes students stay? concern over quitters has online programs stepping up retention strategies. eLearn 2001(10), 1 (2001)
22. Organization, W.H.: Who director-general's opening remarks at the media briefing on covid-19 - 11 march 2020 (2020), https://www.who.int/dg/speeches/detail/who-director-general-s-openingremarks-at-the-media-briefing-on-covid-19—11-march-2020
23. Paudel, P.: Online education: Benefits, challenges and strategies during and after covid-19 in higher education. International Journal on Studies in Education 3(2), 70–85 (2020)
24. Ramsay, C.M., Robert, J., Sparrow, J.: Promoting pedagogical agility in learning spaces: Toward a comprehensive framework of faculty support and innovation. Journal of Teaching and Learning with Technology 8(1), 60–75 (2019)
25. Román, S., Cuestas, P.J., Fenollar, P.: An examination of the interrelationships between self-esteem, others' expectations, family support, learning approaches and academic achievement. Studies in higher education 33(2), 127–138 (2008)
26. Sahin, I., Shelley, M.: Considering students' perceptions: The distance education student satisfaction model. Journal of Educational Technology & Society 11(3), 216–223 (2008)
27. Sahu, P.: Closure of universities due to coronavirus disease 2019 (covid-19): impact on education and mental health of students and academic staff. Cureus 12(4) (2020)
28. So, H.J., Kim, B.: Learning about problem based learning: Student teachers integrating technology, pedagogy and content knowledge. Australasian Journal of educational technology 25(1) (2009)
29. Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F.: Effects of covid-19 on college students' mental health in the united states: Interview survey study. Journal of medical internet research 22(9), e21279 (2020)
30. Tabata, L.N., Johnsrud, L.K.: The impact of faculty attitudes toward technology, distance education, and innovation. Research in higher education 49(7), 625 (2008)