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Transition from the F2F to the Online Teaching Method During Emergency Status (Engineering Emergency Remote Learning)

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TRANSITION FROM THE F2F TO THE ONLINE TEACHING METHOD DURING EMERGENCY STATUS

(Engineering Emergency Remote Learning)

Abstract:

In this work, a systematic study was conducted to measure the degree of success of the emergency transition of teaching from face to face (f2f) to entirely online for several engineering courses due to COVID-19 Pandemic. Hands-on/lab activities were treated differently to accommodate the course requirements and available technology. The original and altered course structures, evaluation, and assessment tools were listed and discussed from the alignments with the required ABET learning outcomes. Several digital resources were used to provide direct and indirect learning tools for each course. An anonymous pre-change survey had been used to get immediate feedback and connection with students at a point when no one had a clear idea where the pandemic was heading. These fast connection channels helped the instructor understand the fears and challenges from the students' perspective. An anonymous post-course survey was implemented to receive in-depth and practical feedback about student experiences and the degree of success of implementing the adopted changes. The degree of success varied with the course type and the course level. Most students showed some reservations against the changes and considered the f2f method to be better than the online method. Different levels of satisfaction were demonstrated for the effectiveness of the implemented changes and the technology used. Also, computer communication technology and the availability of sufficient internet bandwidth were adequate. The students' feedback shows the importance of having direct interaction with the instructor affected by their experiences with the online portion of the semester. In conclusion, education is strongly dependent on a trust-building process between the instructor and the learners. The students can follow-up and are involved positively in any modification of class format or methodology if they believe in their coach's (instructor's) competency.

1. Introduction:

COVID-19 pandemic hit unexpectedly during spring 2020. All life sectors were impacted significantly, including health, economics, and education. Based on the health and social distancing orders and regulations for the pandemic, the universities and other education institutions mostly left the new situation's micro handling to the faculty and students. A considerable effort was made by most of the faculty and students to complete the course requirements according to a modified emergency plan that maintains the integrity of the course objectives and students' learning outcomes. The level of success of handling this situation varies according to the course type, technology availability, and faculty and students' readiness to work as a team to adapt to these changes.

The studied classes in this research are part of a Batchelor of Science in Engineering Program with Mechatronics Specialization (BSE-Mechatronics) which are: Engineering Graphics (freshmen/sophomore level with extensive hands-on learning), Virtual Machine design (a junior-level class with lab), Engineering of Manufacturing Processes (a junior-level class with lab), and Industrial Robotics (a senior-level class with lab). For each course included in this study, the instructor modified the course structure rapidly and adopted new methodologies to account for the course delivery method's changes.

2. Course Structures and Implementation:

2.1 EN363/L Virtual Machine Design Course

The virtual machine design course is a three credit course offered to junior students (2 hour lecture and 2 hour lab) focused on the analysis of stresses due to applied loads, static failure theories for ductile and brittle materials, fatigue, and analysis of mechanical components, such as shafts, fasteners, gears, etc. [1].

A Project-based multi-objective sequential teaching strategy is used to teach this course [2]. During the semester cycle the students work on three sequential design projects. The used approach introduces the design procedures and concepts using a single multi-level design problem as a semester-long project. An Excel spreadsheet for the design analysis was created by each student and was updated repetitively during the course to achieve new design specifications and criteria, Figure 1. In addition, the students built a numerical model for the same project using Finite Elements Method (FEM) and gradually updated the model during the semester using evaluation tools and design libraries in SolidWorks. The instructor briefly introduced FEM and helped students create a basic 3D model. Then, students used the model to add the required material type, loads, and the geometrical constraints under the instructor's supervision. The main goal is to introduce the students to the simulation-based design process.

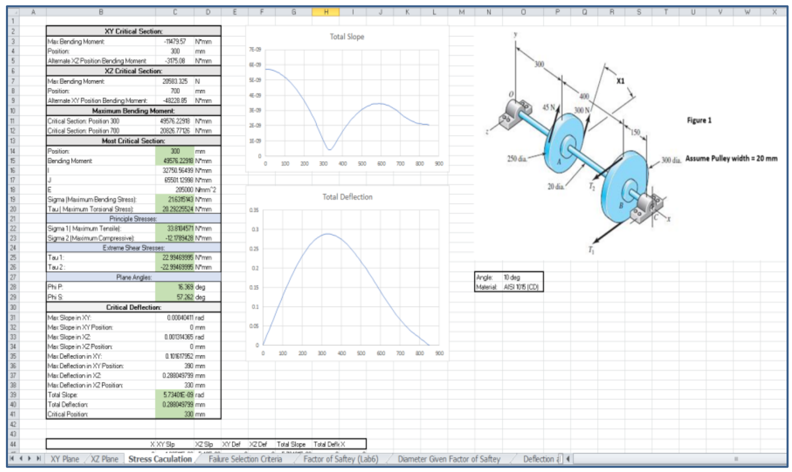


Fig. 1 Design project worksheet

2.2 EN107 Engineering Graphics Course

The Engineering graphics course is a two credit hours course offered to sophomores. It focuses on introduction to the preparation of engineering drawings using computer aided design (SolidWorks) software package. This course is categorized as an engineering science course. Engineering Graphics course provides an opportunity to use the techniques, skills, and modern engineering tools that are necessary for engineering design and analyses. In addition to the hand drawing and lab assignments, the students work on a final project, including full working drawings for a specific product, including creating part and detailed

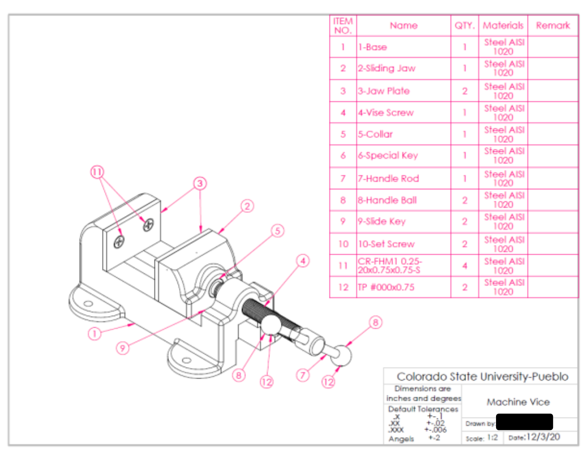


Fig. 2 Machine vise project

drawings for each component and the assembled product with parts list according to the ANSI drafting standards. Figure 2 shows the assembly drawing for the final projects.

2.3 EN441/L Engineering of Manufacturing Processes Course

In the Engineering of Manufacturing Processes course, students are exposed to the principles and concepts of traditional and nontraditional manufacturing. In general, the Engineering of Manufacturing Processes is a cornerstone foundation course in many engineering programs. The traditional objective of this course is to engage students with the principles and concepts of traditional and nontraditional manufacturing.

Fig. 3 Wolf head nutcracker project

The course includes a description and basic analysis of many manufacturing processes like product assembly, casting, metal forming, machining, welding, and semiconductor manufacturing[3]. Engineering department at Colorado State University-Pueblo university offers the Engineering of Manufacturing Processes course with lab (4 credit hours) for junior students including three contact hours of lecture and two contact hours of lab. A part of learning activities during this course are student's mini lectures. Each student (or a group of students) prepares a 15-to-20-minute presentation to show his/her/their essential findings related to the selected manufacturing process. The micro-lectures focus on the important features and applications of the selected manufacturing process. Video segments and simulations can be used to enrich students' understanding of the manufacturing process. Peer evaluations are used to evaluate micro-lectures in addition to the instructor's evaluation. Participation in peer evaluations and discussions is necessary for the final assessment of the micro-lectures [4]. For the lab, the project is designed to provide students with hands-on experience in several manufacturing processes to create the final product (a wolf head nutcracker), as shown in Figure 3. The project includes cost analysis and a production plan, including different types of machining, casting, metal forming, welding, plating, and assembly processes.

2.4 EN462 Industrial Robotics Course

The Industrial Robotics course is a three-credit hour, senior-level, regular, one semester course offered to about 20 engineering students enrolled in the BSE Program with Mechatronics Specialization. The course includes two hours of lecture and two contact hours of laboratory exercises per week. This first course in robotics is intended to enable students to design, control, and maintain robots and robotic-based systems. The course provides engineering students with both the theoretical and practical experiences dealing with robots. Traditionally (before the pandemic) the teaching modes included f2f lectures, demonstrations, and in-house labs. The theoretical aspects of the course include topics like spatial descriptions, homogeneous transformations, Denavit-Hartenberg notation, forward and inverse kinematics problems, Jacobians, and manipulator dynamics problems well described in [5]. In the lab, two seven-week projects are assigned and completed: one using Mindstorms NXT Lego robot kits with associated graphical programming environment to perform a number of autonomous robot motions solving a task modeled by the DARPA's Urban challenge [6 and 7] and the other one dealing with programming of ABB IRB 120 industrial robots using an industrial-grade robotic integrated development environment (IDE), RobotStudio. However, due to the pandemic, both lab projects were quickly modified. The "Mini Urban Challenge" Lego project was completed without physical contacts between teams (pairs), with Zoom meetings, and videos of successful robot runs. As time progressed and all courses were moved to the online mode of delivery, the second robotic lab project had to change. All students were required to download the RobotStudio IDE (shown in Figure 4) and perform few off-line programming tasks within a simulated robotic environment. One part of the project that required students to perform lead-through programming of industrial robots was abandoned since it required physical contacts with robot controllers in the lab, and the lab was closed for student instruction.

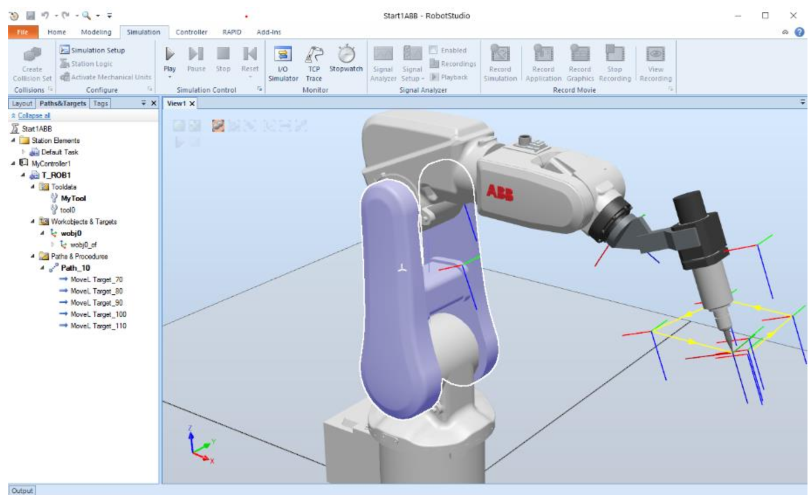


Fig. 4 ABB's RobotStudio IDE with IRB 120 robot

3. Challenges of moving f2f classes to online teaching methods during COVID-19 pandemic

Here, the challenges of transforming courses from f2f to online modes of instructions are classified into three main types: (1) technological challenges, (2) online teaching and learning pedagogical challenges, and (3) morale challenges. Namely, not all students have adequate network bandwidth or adequate programming environments (computer hardware and software) to be successful learners in cyberspace. While the teacher's presence and students' presence are guaranteed in f2f activities, special activities are implemented in online teaching to assure the teacher-to-student and student-to-student presence and bonding are achieved. Faculty unaccustomed to online teaching must adapt quickly to online specific concepts and best practices. The lack of physical presence in online courses may cause loss of confidence in some students since they are not used to this mode of course delivery. The three challenge types are further discussed next.

Challenge One: Technology

Online teaching modes have certain technological requirements imposed on students. However, some students do not have access to (somewhat powerful) computers with the required software (MS Excel, SolidWorks, RobotStudio) and adequate connectivity bandwidth for following online synchronous activities. The course instructor and/or students may not have stable internet connections at home due to poor connections or the online needs of other family members.

Sometimes the students (or the instructor) are not well trained in using the digital tools available on the schools' learning and management system (LMS) like course assignments and tests. Some students are not disciplined enough to check their school emails regularly.

Since students are not able to have direct access to labs to complete hands-on experiments and projects, they are often instructed to use online tools. Some of these tools and programs are difficult to install and may be computer dependent.

Challenge two: teaching and learning methodology

The course's learning activities were originally based on direct f2f student-instructor and student-student interactions to achieve the designated course learning outcomes. However, in cyberspace, the students need to be proactive and must possess adequate time management skills to use remote/recorded lectures without direct guidance from the instructor.

In online labs, it is likely that students work individually on lab assignments (e.g., development of the Excel sheet required for the given design project) without much support from the instructor and low interactions with other students.

Challenge three: morale

Students and instructors have gone through a sudden shock of COVID-19 pandemic that made them less self-confident about their future and how this event affects their studies and life in general in the short and long term. In addition, students or instructors (or their families) may become infected by the virus.

In this work, to address the above-mentioned challenges systematically and timely and ensure a smooth transition process, students were formally and directly involved in the transition process. A pre-change anonymous survey was designed and delivered to the students; the survey includes the challenges from the technology/ teaching and learning methods/morale aspects.

The pre-change survey questions and students' responses are shown in Figure 5 and Table 1. This survey was part of students' assignments in the Engineering Graphics (19 students), Virtual Machine Design (12 students), and Engineering of Manufacturing Processes courses (17 students). For the students enrolled in the Industrial Robotics course (21), this was an off-line voluntary survey that 13 students filled. The total number of students who completed the survey was 53 students.

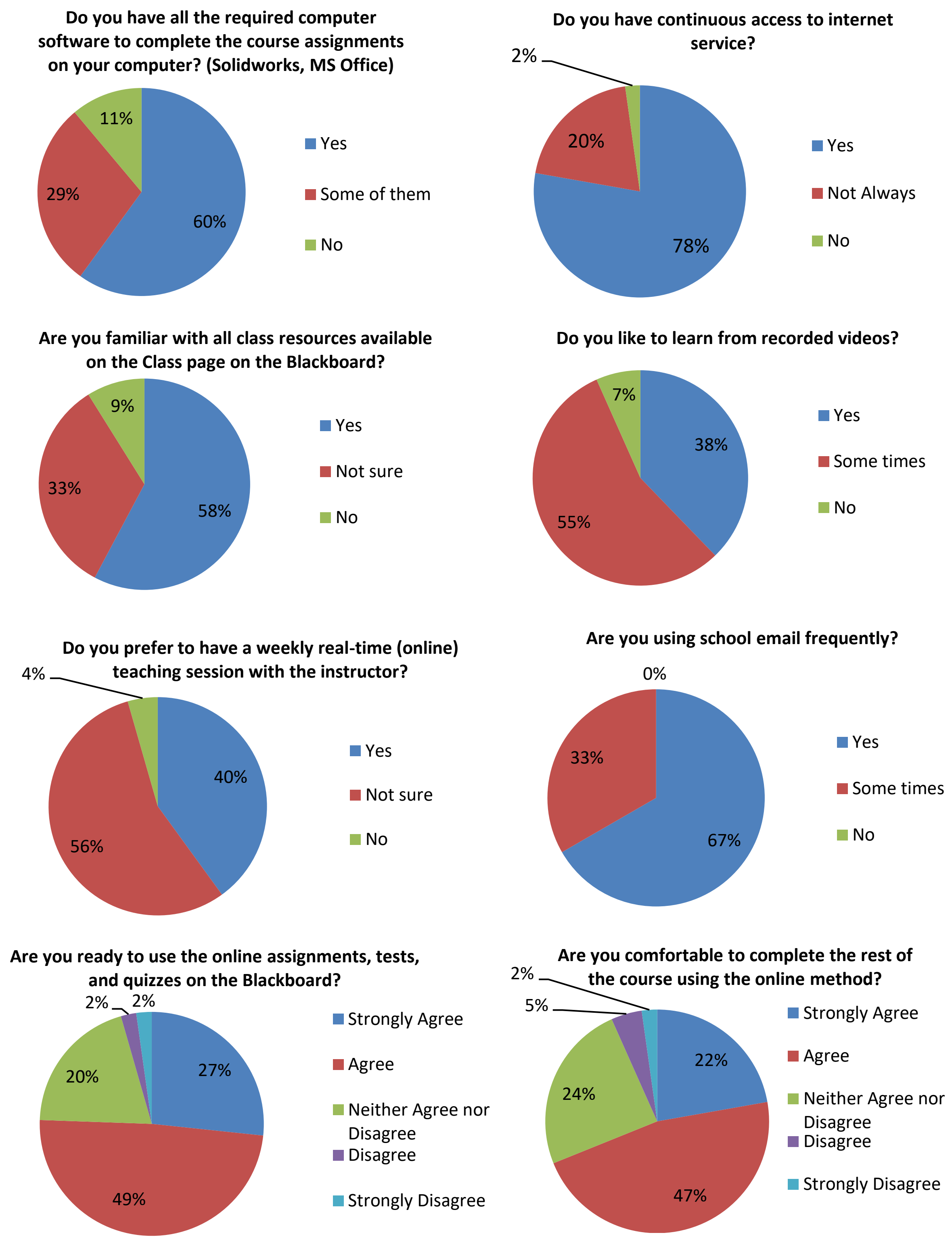


Fig. 5 Pre-course change survey questions and students' responses.

Table 1. Selected students' comments (verbatim) about teaching the rest of the semester remotely

Course Name	Student's feedback
Engineering Graphics	• ***It took me sometime to get everything situated*** *but i believe im good now and will be ready for the exam Thursday.* • ***I don't have access to any computer or internet access in order to complete SolidWorks assignments, I will try my best to do other things or find a way to get a computer internet access and SolidWorks but it's not a guarentee is there anything that I can do?*** • *I am trying to get SolidWorks on my home computer but I have* ***awful home internet so I am still trying to figure out how to get everything to process*** • *I was able to download some of the components to SolidWorks,* ***but I do not have access to some tools and features of the program.*** *I also was made aware that some files saved of the SolidWorks program I have does not transfer over nicely to the SolidWorks at school, so some things that were done for a grade are and con not be seen.* • *Im* ***currently living in Alaska with shaky Internet*** *so please be a bit patient with me.*
Virtual Machine Design	• *This course and the lab section shouldn't be too horribly difficult to complete remotely,* ***I am mostly worried about lack of software or hardware being an issue.*** • ***Only thing I don't have is SolidWorks.*** • *Update BlackBoard as soon and as often as possible****. Also maybe use our personal emails rather than school emails. I do not use my student email as much as I do my personal one.***
Engineering of Manufacturing Processes	• ***Blackboard is unreilable****, I believe we should use as much other resources, email, Zoom, skype, etc. as possible to make sure there's no outages that keep us all from being able to work.* • ***I will be in Brazil for the rest of the semester and there is a big time difference.*** *So it would be nice if I could watch the classes at my own time instead of live.* • *I am good to go with online,* ***my attendance will improve significantly****! I will email questions I have, also the discussion boards could be a useful tool to go over real time lessons.* • *I don't have any special requests. I just feel for our portion as students in this degree field it's hard without learning in person.* ***We all need to adapt and overcome as engineers, I understand and will try as hard I can to focus on the quizzes and problems and tackle them with the best of my ability.*** • ***I use my personal email more frequently than my school email. Also, update as much and as soon as possible to blackboard.***
Industrial Robotics	• *I have taken online classes in the past and I didn't learn as well as I do in face-to-face lectures.* • ***I hope Blackboard works*** *throughout the semester.*

The survey results (Table 2) reflect the following facts for each challenge and the possible impact on the program quality.

Table 2. Possible impact on program quality with respect to challenge type

Challenge type	Facts	Possible impact on the program quality
Technology	• About 40% percent of students have difficulty preparing the hardware and software, and internet service required to complete the course online. Also, about 42% of students are not familiar with using online resources on the Blackboard. About a 33% of students are not always using the school email. • Time zone differences. • Stability of the LMS. • Concerns about getting the required technical experiences and supporting hands-on skills and lab assignments	• Department's ability to provide adequate laboratories with associated equipment to support the attainment of the student outcomes and provide an atmosphere conducive to learning may be jeopardized. (modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and support program needs (ABET Criterion #7 Facilities).)
Teaching and Learning methodology challenges	• 96% of students prefer having real-time (synchronized) lectures with the instructor. 93% of students are using recorded video in learning. • Concerns about the ability to follow-up course scheduled assignments without direct interaction with the instructor. • Students' ability to communicate effectively using online tools	• Developing student's ability to communicate effectively with a range of audiences may be jeopardized. (ABET Criterion #2 Student Outcome #3) • The timeline and the type of assignments and assessment and evaluation process will deviate from the original course design. This may affect learning course outcome (ABET Criterion #1 Students) and program continuous Improvement (Criterion #4)
Morale challenges	• Only 7% of students are not comfortable completing the rest of the course using the online method, while • about 24 % of students feel neutral about the transition and the rest are either feeling good (or extremely good) about course transition to online	• Some students may lose learning and development motivation as the situation with the pandemic gets worse

4. The developed solutions and tools:

Instructors developed and implemented different teaching strategies and activities to overcome the possible negative impact of moving from f2f to online mode with respect to the course and program outcomes. The following paragraphs describe activities used according to the type of challenge.

Challenge one: technology:

Instructors addressed technological problems by implementing various solutions. In one example, the instructor provided one-on-one Zoom support for students to overcome technical problems that could arise due to the use of personal computers. In the Engineering of Manufacturing Processes course, a set of videos for the manufacturing processes (required to complete the final project) were recorded, edited, and developed to work through a private YouTube® channel, as shown in Figure 6. For each lab assignment, the students were required to watch a video segment and then take a quiz related to the manufacturing operation included in the video. In another example, the instructor used more than one communication platform to overcome the expected load on the available LMS (Blackboard®). Namely, the instructor created a sheared Google Drive® folder for each student. In most cases, instructors implement synchronized lectures and labs during regular Zoom weekly meeting times. Sessions were recorded in consideration of students' internet availability and time zone differences for out-of-state and out-of-country students.

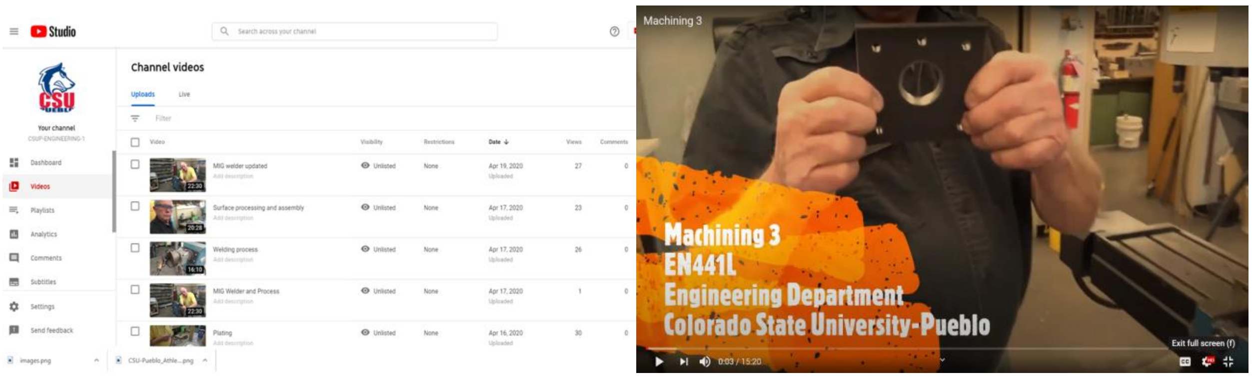


Fig. 6 The YouTube channel

Challenge two: teaching and learning methodology

First, the teaching faculty unaccustomed to online teaching were made aware that online and f2f teaching pose different challenges. Then, these challenges were addressed during special training sessions for faculty. Finally, the students' acceptance of various online pedagogical best practices was sought. For example, in one course, a weekly study plan was developed and sent by email to all students as early as possible, as well as it was announced through the LMS. This helped keep students updated (promptly) with a clear understanding of the type of work and assignments expected for each week. Most faculty allowed higher flexibility in homework assignments due dates to accommodate the uncertainty in each student's learning environment and technology. Some instructors used multiple communication platforms to reach students thus minimizing the dependence on campus computing resources.

Challenge three: morale

Having students feedback early and continually during the course transition period helps students to adapt and react positively and without fear of the COVID-19 pandemic. Providing to the students the knowledge that the instructor is close enough to help them complete the course requirements and that the instructor is available for support helps keep the students involved both academically and emotionally.

5. Course implementations: results and discussions

To measure the impact of the adopted tools and teaching methodologies, the authors used anonymous post-course surveys to get direct feedback and evaluations from students. The survey results are shown in Figure 7. Also, some constructive comments from the students are listed in Table 3. The number of students who responded to the post-course survey are as following: Engineering Graphics course (13 out of 19 students in the class), Virtual Machine Design course (12 students out of 12 students in the class), Engineering of Manufacturing Processes course (14 students out of 17 students in the class), and Industrial Robotics (11 students out of 21 students in the class). The total number of students who completed this survey was 50 students. Because the number of students taking the survey (except for Industrial Robotics) was well over 50% for each course, as well as that survey was anonymous, one could consider that the surveyed student population was mostly unbiased. In addition, all questions with quantitative answers were written in an unbiased manner.

In this discussion, the focus is placed on the negative feedback to understand the reasons behind such feedback. About 20 percent of students showed that the transition from f2f to online mode was "difficult" to "very difficult." This is in alignment with an answer that about 20 percent of students who responded had some problems in getting the required hardware and software to complete the course in the online mode. In addition, about 8 percent of students claimed that their internet service was not completely stable.

Although most of the implemented learning activities (like online quizzes, students' mini-Lectures (SMLs), and the real-time sessions with the instructor) were rated positively from the students, about 74 percent of students replied that the online course delivery mode was worse than the f2f course delivery mode. This could be attributed to several factors. Firstly, the students were not prepared technically and/or emotionally for this change. Secondly, the faculty had little time to migrate from f2f to online course delivery. Thirdly, at the beginning of the pandemic, there was an insufficient amount of training and understanding of the online teaching technologies and pedagogy.

About 80 percent of students mentioned that the assigned weekly study plans were clear and useful. Given a choice, about 36 percent of students would not be willing to enroll in online classes in the future. This seems reasonable considering that students had to go through these emergency transitional learning experiences. The question is somewhat biased because the emergency transition to online delivery does not provide the structure or the learning experience of regular online courses.

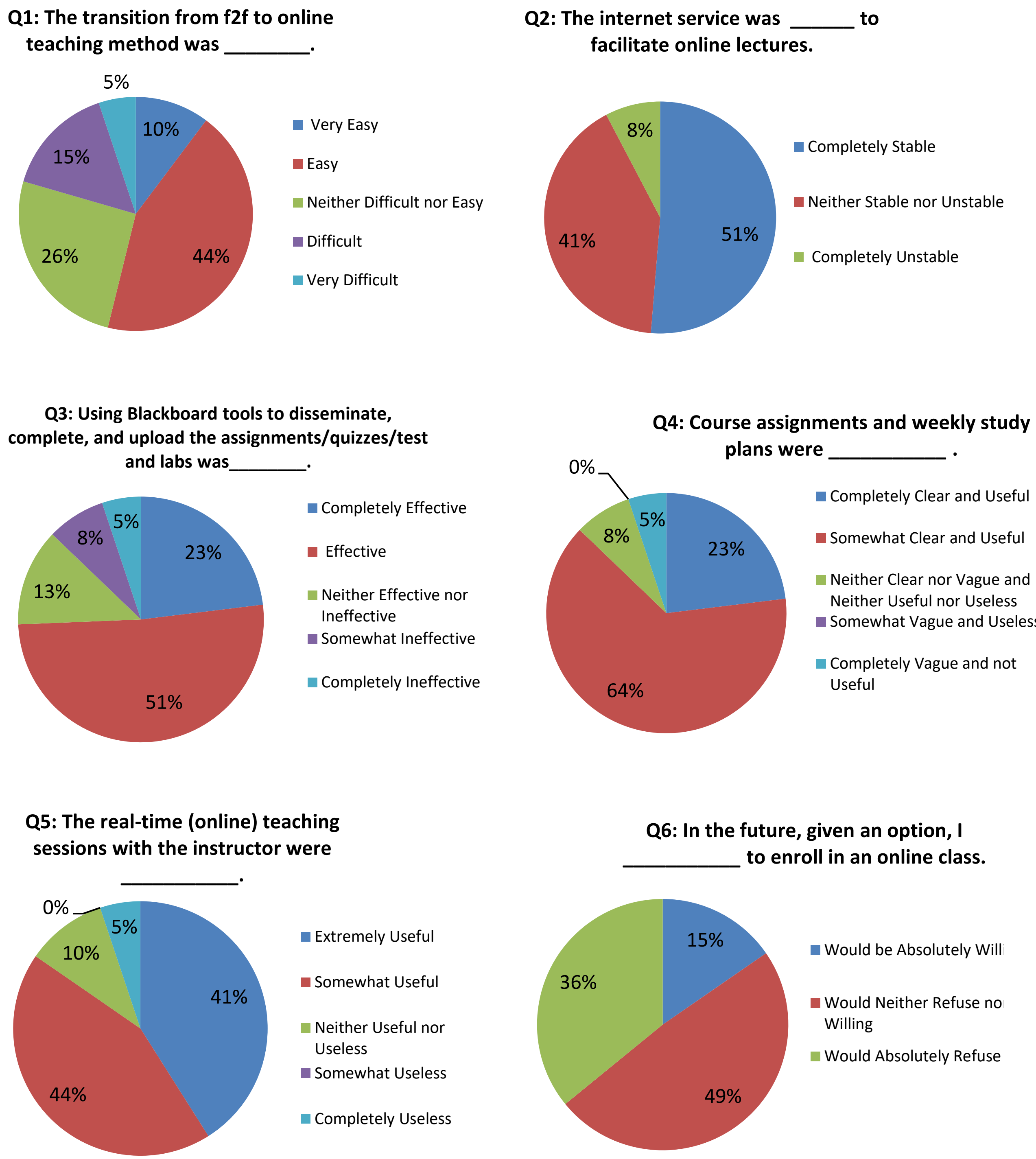
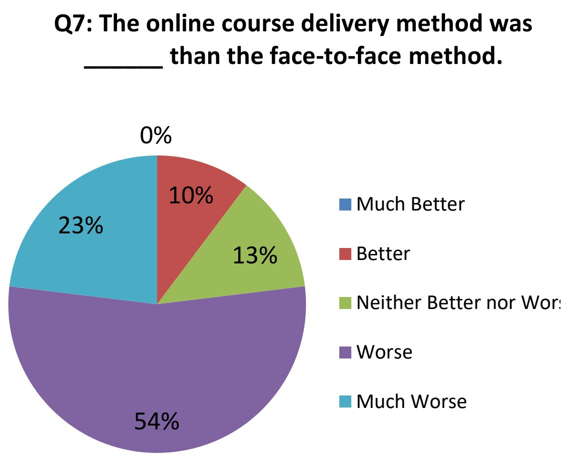
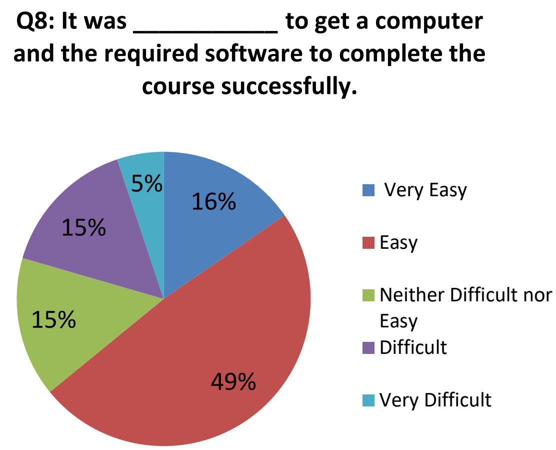
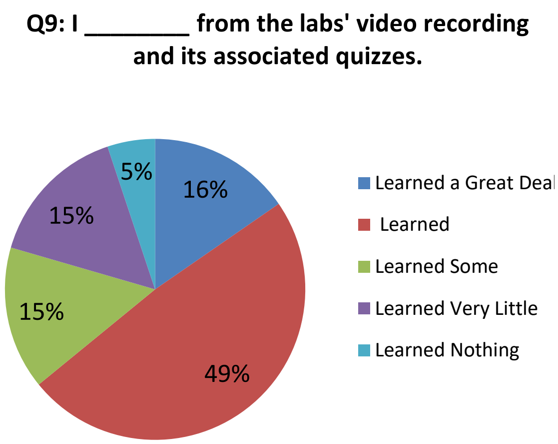
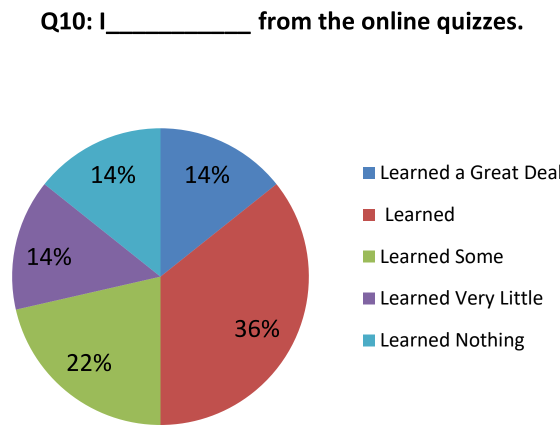


Fig. 7 Post-course survey results









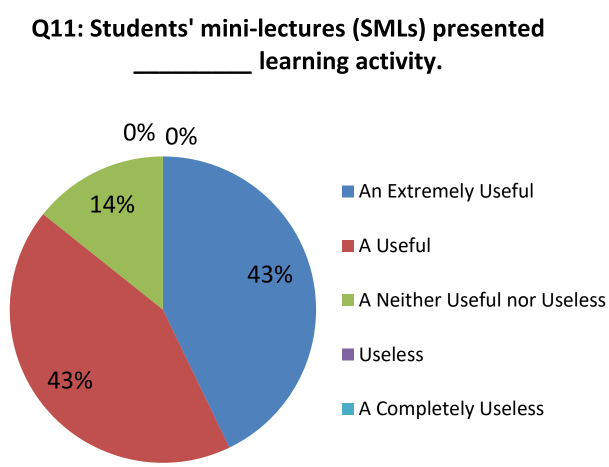


Fig. 7 Post-course survey results (cont.)

Table 3. Students' comments (verbatim) at the end of the semester

Course Name	Student's feedback
Engineering Graphics	• *The ability to do face to face interaction was an all around better expierence because it is* ***too hard for me to be able for me to get to a place that has internet or be able to use the SolidWorks program. Other than this whole transition to the online class work the class was a very fun expierence and made college better for me in persuing my degree but this switch has honestly discourage me.*** • ***A class about learning SolidWorks is very difficult for me to do online.*** *It is really beneficial to have help from peers and the professor in person.* • *For me personally,* ***this class was better as a face to face class because it was easier to get help in person*** • ***The transition from face-to-face to online was not to difficult for this class, as we did most of our work on a computer.*** *The labs were fine but the homework i was confused on how to get that since i don't own a printer.*
Virtual Machine Design	• *I think that* ***the online lectures made the midterm project difficult****.* • ***I prefer face-to-face interaction. I think that the professor is more effective in a face-to-face formatting because he is able to use both powerpoint and whiteboard side-by-side. I think that this class transitioned successfully to the online teaching methods, however it was better when the professor used the whiteboard. I think there is some disconnect with the class using this method. I am thankful that the professor was able to perform virtual lectures.*** • ***I feel personally I did not learn as well online than I do face to face … The largest issue I faced with online learning was the lack of personal connection, it is a much different experience learning material from a screen rather than a physical person standing in front of you*** *… The most successful part of the online transition was* ***the weekly topic updates that the professor sent out each week, this was excellent for getting a great overview of what to pre-study for the week****.* • *The one thing that* ***I would say was an issue was at times there was a slight lag in the online classes and that the sound would sometimes go in and out …*** *The one thing that I'd appreciate was* ***the fact that you were quick to responding to people's questions whether it was on the online lectures or through email****.* • ***Doing the lectures online was easy to follow, but if we started doing the labs online right away it would have been tough to get the handle of.*** • ***The zoom teaching sessions were probably what worked best for me,*** *because to really understand the material I need to be able to watch a lecture and take notes.* ***The lab projects and midterms were also executed well, and I really felt like I was understanding the subjects more in a practical sense****.* • *I feel as though the Virtual Machine lab portion of the course was very hard to do online because it wasn't explained as he had done in person* ***(plus we were able to work with eachother).*** *I feel as though* ***the lecture portion was better well suited for the online meeting*** *and I don't think that F2F (Face to face) would have made much of a difference for my personal learning style if it was in person or on the computer.*
Engineering of Manufacturing Processes	• ***I thought the online classes were very useful and I believe I learned a lot from this class and experience.*** • *I think that this class was successful with the transition to being online.* ***Exams were more difficult to complete within the timeframe*** do to internet connection and technology issues. ***The lab was more effective when it was face-to-face***

	• ***Before the switch to online format I was very much enjoying the SML projects. I feel that having students teach others helps to teach everyone involved, and it always helps to practice presentation skills.*** *When the SMLs continued into online formats I was nervous about how well this would work out. To be honest, I found myself unfocused during a few of these presentations most likely due to the lack of face-to-face communication … By far I think the biggest problem when this class switched to online was the impact to the lab section. I was thoroughly enjoying being back in a shop class, … Despite the issues and disappointment I felt, I think* ***the videos and quizzes were definitely the best way to handle the situation****. I really believe that Paul should quit as a lab technician and start a Youtube channel.* • ***Doing this class online was pretty much the same as doing it in person****, which I really appreciated.* ***The only disappointing part was not being able to finish the lab in person,*** *and getting experience with the machine shop tools.* • *The transition to this class being online wasn't all that bad.* ***The lectures were easy to follow. The SMLs were great online.*** *The pace wasnt too bad, but the exercises weren't super easy to follow.* • ***Even though we did have a few changes in the SMLs, it was well planned and I think it taught us as students the material well … I think that the SMLs worked very well and I enjoyed this portion of the class and the importance of each portion of this.*** • ***The class was pretty informative and useful up until we went online. Very hard to follow along and learn.***
Industrial Robotics	• *I found useful how we still met with* ***the zoom platform, it helped me to focus more on the class material.*** • ***The online PDF going through problems were extremely beneficial*** *because they allowed me to go through problems step by step and work through them at a pace that was comfortable for me to understand.* • *I liked the way Dr. Jaksic* ***used the bamboo paper and white board*** *to take online lectures.* • *I liked the pencast files as* ***I was able to replay the activities****.*

6. Student academic performance assessment

This study involves four regular undergraduate engineering courses vertically distributed from freshmen to seniors. Students' knowledge gains and skill developments were measured using various quantitative evaluation tools such as numerical grading of homework assignments, lab performances and reports, projects, and student-run micro-lectures. While some of the lab experiences had to be moved from on-campus to off-campus within the change to the online delivery mode, the faculty teaching these courses did not notice a decline in meeting the course student learning outcomes and/or ABET defined program objectives. For example, in one of the courses, the average course grade increased from 80 percent to 88 percent.

In some cases, the emphasis was changed. For instance, in a robot programming lab, the use of a pendant connected to the robot controller for a lead-through programming experience was replaced by an in-depth off-line robotic programming experience which is just as valid in developing students' robotic programming skills.

An improvement was noted in the development of students’ communication skills since now students had to employ various computer communication technologies including the use of LMS (Blackboard), e-mails, discussion groups, uploading/downloading files, Zoom meetings, screen sharing, remote access, digital presentations, YouTube videos, etc. In general, fast, and academically guided transition process was successful in a way that the performance indicators that were originally designed for the f2f delivery method were still applicable, therefore, it was not necessary to redesign the program's assessment and evaluation plan and schedule.

In general, the authors did not find any noticeable indicators of unethical behavior because most of the assignments and tests were created internally, were specially designed by the instructors, and were tailored for each student individually. The work in remote groups (e.g. labs in the Industrial Robotics course) was also specifically created with many anti-fraud features.

7. Lessons learned and conclusions:

According to the pre-and post-course surveys and feedback from the students, the following key lessons and recommendations could be derived from this unusual learning situation due to COVID-19 pandemics:

1. Keeping the interpersonal connections and empathy for students is essential in creating a thriving learning community. The students and the instructor need to feel they are a part of the same community and can persevere due to early and on-time communication to reduce the effect of lacking direct communication due to this teaching method shift.
2. Providing enough training and development opportunities to the faculty members can help them deal autonomously with difficult and new situations without much support from the institution.
3. Using the current situation, an instructor may add new and creative learning tools to ensure that the students' learning outcomes are met within the given online learning environment. Fast adaptation in teaching styles helped maintain the quality of the program outcomes and eliminated the need to update students' performance indicators since the instructors were able to introduce new online class/lab learning activities that have similar learning outcomes as the ones originally designed for the f2f teaching mode.
4. Technology availability is important, but Instructor’s confidence and competency are more important when dealing with students' emotional and educational impact. Instructors should emphasize increased students’ involvement within in-class activities. The technology can support active and passive activities that can be used to reach student learning objectives for the course.

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