



Teaching AutoCAD in E-learning and Face-to-Face Styles for Undergraduate Engineering Technology Students During and after COVID-19 Pandemic

Suleiman Obeidat (Assistant Professor)

Ulan Dakeev (Assistant Professor)

Junkun Ma (Associate Professor of Engineering Technology)

Faculty working for Sam Houston State University with education background and interest in Mechanical Engineering , Manufacturing, and Mechanics of Materials

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Online teaching has been used in most schools in the world during the Covid-19 pandemic. The world has started going back to normal in teaching face-to-face (F2F) in the classroom since Fall 2021. The switch from F2F teaching to online teaching has changed the way of interaction between the instructors and students. This research is aimed mainly to compare the learning styles in the traditional F2F to e-learning formats in teaching software-based Engineering Graphics course after going back to F2F mode of teaching. This study addresses the main features of each learning mode and its impact on the academic performance of the Engineering Technology students in a public school in Texas. This paper involves samples of Engineering graphics grades during the pandemic (fall 2020 and spring 2021) and after the end of the pandemic (fall 2021). Two instructors have taught this course during and after the pandemic, while one instructor has only taught the course after the pandemic. Analysis of Variance (ANOVA) is used in the data analysis. It is noticed that the performance of the students in classes delivered in the F2F mode is better than that in online mode, even with the change in the instructors and the change of the grade distribution in a specific semester.

Keywords: Online education; Face to Face education; Student performance; Software-based teaching; Engineering graphics.

1. INTRODUCTION

Since the COVID-19 pandemic began, most colleges, schools, and even businesses shifted to some forms of online communication. The colleges and schools adopted online education (synchronous and asynchronous) to reduce the impact of this pandemic on the students and instructors. Online education creates a simple and quick way of communication between the students themselves and with their instructors. In addition to this, there is no need for the physical classroom space to give the lecture. But there are some drawbacks for online education, such as lack of social communication, which has a great role in the stress relief the students might have. In this paper, we compare the performance of the students between during the Covid-19 pandemic and after the pandemic. We are going to perform this study on one of the courses that we teach in one of the Engineering Technology Departments in a public school in Texas. The course that we are going to perform the study on is Engineering graphics which is taught using a CAD software. This course used to be taught in the face to face (F2F) before mid of the spring 2020 when most of the schools in the country shifted to online teaching mode. In fall 2020 and spring 2021 this course was taught totally online. The students were asked to use their computers to access the CAD software to complete their assignments and exams. All type of communication was through online meeting platform and the blackboard where the instructor posts all the lecture materials, homework, projects and anything related to the course material. Online office hours also were one of the ways of communication between the instructors and their students. In fall 2021, we moved back to F2F teaching mode where everything went back to normal in terms of teaching in physical classrooms. The students started using the computers in the lab since then where the software is already installed, and the students can do their classwork and homework assignments in class. Also, they have the option to do the homework on their computers sine they can install a free educational version of the software on their computers.

2. LITERATURE REVIEW

Many researchers have studied the impact of this pandemic on education quality. Jin et al. (2021) studied the desire of the U.S.-based college-level world language educators to teach online, face to face, or hybrid of both. The results indicated that the educators were positive to adopt online language teaching after the pandemic ends even though many preferred hybrid teaching if they were given the option. Hong et al. (2021) predicted the students' practical performance anxiety using Neuroticism and Extraversion through Internet and academic self-efficacy. Wang et al. (2020) used "computer foundation" course to explain the process of shifting to online teaching. They used the concept of enhanced design of interaction, learning theories, and problem-based learning (PBL) in this study. They used the learning management system (LMS) to collect students' behavior data to help in the enhancement of online teaching strategy. They used the students' test scores as an indication of the best indicators that are highly related to the students' performance in the online teaching of this course which in turn helped them in redesigning the course for the next semesters. Daumiller (2022) studied the faculty members' attitudes towards shifting to online teaching, and they examined their motivations and engagement and their effect on students learning. They used the students' evaluations in these studies to support their results.

Bergiel et al. (2022) explained the advantages and disadvantages of online education for instructors and students. Some of the advantages for the students are accessibility of time and place, affordability, and more individual attention. While some disadvantages are the inability to focus, technology issues, and a sense of isolation. De Sousa and Sixpence (2021) used interactive simulation software in online physics education. They used a virtual lab model to implement their strategy to create interactive simulation experiments in physics class. After assessments, they found that the students liked this way of teaching labs virtually. Gormaz-Lobos et al. (2022) designed a course for instructors on how to adapt to the new transition of online teaching during the Covid19 pandemic. Goni et al. (2022) found that teamwork performance is not affected in both face-to-face and online modalities of teaching. This might be because of the easy communication technology that we have in the 21st century. Balta-Salvador, R. et al. (2022) studied the emotional impact of Covid 19 lockdown and the transition to online teaching on the students. They studied this impact on the second, third- and fourth-year engineering students. Asgari et al. (2022) studied the performance of the students during the Covid19 pandemic. Some of the problems that the students suffered from were lack of engagement in class, focus loss, and Zoom fatigue for students who attend multiple Zoom sessions a day. Kanik (2021) found that the engagement and achievement of the students were better during the covid 19 pandemic when they shifted to online teaching.

As noticed from the research done so far, there are some benefits for online teaching as well as face-to-face teaching. The world now is shifting back to “NORMAL”. Face to Face teaching is back.

3. METHODOLOGY

We compare students’ performance during the covid19 pandemic and after the pandemic. We will apply this study to a software-based Engineering Graphics course taught using AutoCAD software. This course has been taught by three different instructors, Instructor A, B, and C. This study is divided into two parts; in the first part, we study the difference between the students’ performance during the pandemic (fall 2020 and spring 2021) where the course was taught online by two instructors (B and C) and after the pandemic (fall 2021) where the course was taught in the F2F mode by three instructors (A, B, and C). In the second part of the study, we study the performance of the students after the covid 19 pandemic (fall 2021) in F2F mode with different instructors where the grade distribution is different for each instructor. Analysis of Variance (ANOVA) is used to compare a pair of groups. The control (F2F) group was compared with one treatment group, considering one individual variable.

4. RESULTS AND DISCUSSION

In the first part of this study, we study the impact of teaching mode (online and F2F) on the students’ performance for two instructors (B and C). Both instructors taught the same course in fall 2020 and spring 2021 (online) and in fall 2021 (F2F). Instructor B set up a different grade

distribution than Instructor C. Instructor B distributed the grades into homework assignments (20%), classwork (10%), attendance (10%), group project (10%), in-class quizzes (10%), midterm exam (15%) and final exam (25%). Instructor C set up the grade distribution into 10 – 11 assignments (80% of the grade) and the final exam (20%). The F2F mode (fall 2021) is used as a control group to compare with the online treatment groups (fall 2020 and spring 2021). For each graded individual, the student grades were normalized (out of 100%), then the mean scores were calculated accordingly. The data normality and homogeneity of variances were checked and satisfied all conditions with a 95% confidence interval. Table 1 explains ANOVA analysis for instructor B based on the grade distribution used.

By comparing spring 2021 and fall 2021 P values, it is noticed that with a 95% confidence interval, the P values are higher than 0.05 except for attendance, final exam, and overall grade. The mean value of the attendance is higher in spring 2021 (online) than the mean value of attendance in fall 2021 (F2F). This indicates that it was easier for the students to receive the attendance grade in online than F2F since they used the online platform to attend the class, and they did not need to go to school for attendance. The final exam and the overall grade for F2F were higher than that of the spring 2021 (online) grade. This indicates that the students do better in F2F class than online in terms of overall performance. In this kind of course (CAD software-based), the students need more help, and they ask more questions if they have the chance. They don't have that chance in online teaching mode. It is easier for the instructor to clarify the concept more in the classroom. Most of the time, the instructor needs to go to the students' workstation and help them with doing a specific exercise. There are a lot of commands in this kind of software where the students can't grasp all the information needed without active interaction with the instructor. When we compare fall 2020 (online) with fall 2021(F2F), we can find that the P values are lower than 0.05 in the attendance and final exam parts. This is an indication that it was also easier for the students to attend the class over the online teaching platform. For the final exam, it is noticed that the students also do better in the F2F teaching mode since, as mentioned above, there are more interactions with the instructor, which means more questions from the students and more clarifications from the instructor. Figure 1 shows the overall grades for the three semesters for instructor B.

Table 1: Instructor B ANOVA analysis for online and F2F teaching modes

Course		Fall 2021	Spring 2021	Fall 2020		
		F2F (Control Group)	Online (Treatment Group)	Online (Treatment Group)		
		N=23	N=20	P value ^a	N = 21	P value ^a
Inst. B	Class work	71.59	66.01	0.505	73.71	0.801
	Homework	62.13	57	0.596	65.65	0.691
	Quizzes	80.74	67.6	0.253	75.18	0.592
	Midterm	80.22	63	0.128	76.52	0.717
	Project	62	69	0.569	76.65	0.203
	Attendance	74.28	95	0.002	100	0.000
	Final Exam	94.7	48	0.000	64.05	0.002
	Overall	81.9	63	0.018	73.17	0.25

Note: mean scores out of 100; ANOVA: Analysis of Variance; F2F: Face to Face, Value α less than 0.05 indicates significant difference.

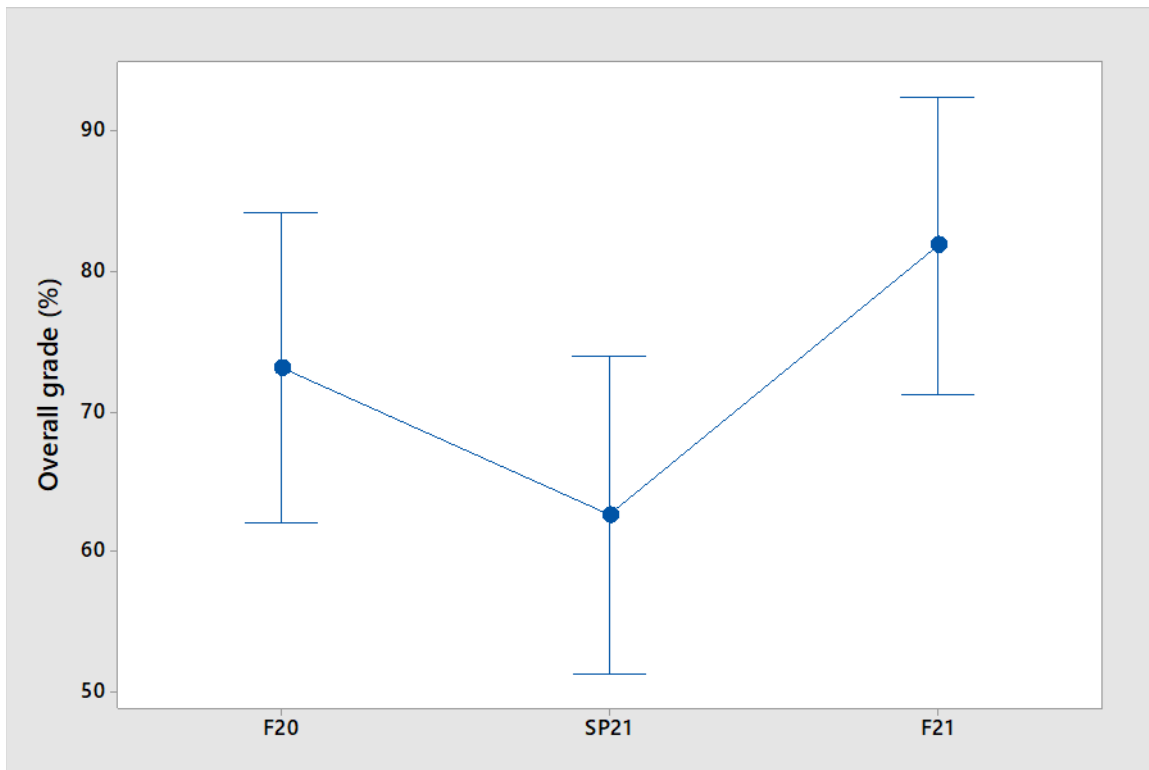


Figure 1: Instructor B overall grade change for F20, SP21, and F21

Table 2 shows the same comparison as in table 1 but for a different instructor. The data collected in table 2 is for the same course taught by instructor C. As explained in that table, the grade distribution is different. While instructor C assigned 10 – 11 assignments with overall weight of 80 % and 20% for the final exam towards overall grade, instructor B distributed the grades into homework assignments (20%), class work (10%), attendance (10%), group project (10%), in class quizzes (10%), midterm exam (15%) and final exam (25%). By comparing the P values in table 2, it is noticed that there is no significant difference between fall 2020 (online) and fall 2021 (F2F), but there is a significant difference between the classwork and homework assignments part and the overall grades for spring 2021 (online) and fall 2021 (F2F). Again, the performance of the students in the F2F teaching mode is better than that of the online teaching mode, even with the change in the instructor and the change of the grade distribution. Figure 2 shows the overall grades for the three semesters for instructor C.

Table 2: Instructor C ANOVA analysis for online and F2F teaching modes

Course	Fall 2021		Spring 2021		Fall 2020	
	F2F	Synchronous		Sync		
	(Control Group)	(Treatment Group)		(Treatment Group)		
	N=24	N=24	P value ^a	N = 24	P value ^a	
Inst. C	Class & homework	82.3	69.15	0.046	82.60	0.954
	Final Exam	78.7	61.04	0.086	75.83	0.686
	Overall	81.6	67.52	0.048	81.26	0.951

Note: mean scores out of 100; ANOVA: Analysis of Variance; F2F: Face to Face, Value α less than 0.05 indicates significant difference.

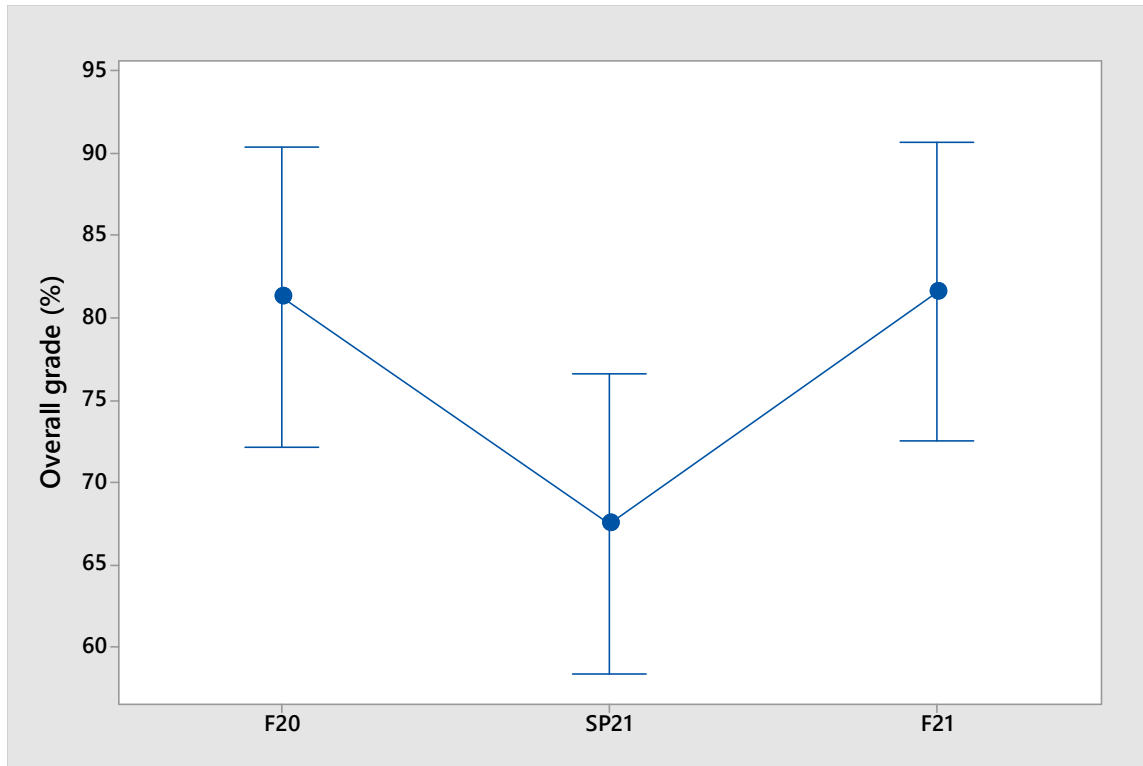


Figure 2: Instructor C overall grade change for F20, SP21, and F21

Table 3 explains the second part of this analysis, which focuses on the performance of the students after the covid 19 pandemic (fall 2021) in the Face to Face (F2F) mode with different instructors with different grade distribution for each instructor. We selected the common parts of the grades distribution from the three instructors. By comparing P values for the students taught by three different instructors, it can be noticed that there is no significant difference between the students' overall performance.

Table 3: ANOVA analysis with different instructors in F2F teaching mode

		Inst. A	Inst. B	Inst. C		
		(Control Group)	(Treatment Group)	(Treatment Group)		
		N=22	N=23	P value ^a	N = 24	P value ^a
Fall 2021	Class and homework assignments	69.61	65.29	0.596	82.31	0.058
	Final Exam	70	94.7	0.002	78.68	0.284
	Overall	72.89	81.9	0.21	81.58	0.160

Note: mean scores out of 100; ANOVA: Analysis of Variance; F2F: Face to Face, Value α less than 0.05 indicates significant difference.

5. CONCLUSION

In this research work, we compared the students' performance for software-based engineering graphics course during the covid-19 pandemic, during which the course was taught online and after the covid-19 pandemic when the course was taught the F2F mode. In addition to that, we studied the effect of the grades' distribution and the instructors on the overall students' performance in the F2F teaching mode. Analysis of Variance (ANOVA) is used in this work. From this analysis, it is concluded that teaching software-based courses in the F2F mode is more beneficial to students, and the overall students' performance is better than that of the online teaching mode. This is due to the students having more chances to ask questions and to interact with the instructors, especially in the software-based courses. It is also concluded that there is no significant effect on the overall students' performance when changing the instructor or the grade distribution.

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