Study on Moving Face-to-Face CS Courses to Online in Pandemic

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Abstract: - UH-Victoria has offered both face-to-face sessions and online sessions to the students for most of computer science courses. However, COVID-19 has forced nearly all students including those who initially selected face-to-face sessions to online instruction during pandemic time. In this paper, we conducted a survey in five different courses to find out what students thought of moving from face-to-face to online learning, what kinds of challenges and problems they met, and what kinds of resources or tools they need.

Key-Words: - Face-to-Face, online instruction, pandemic, teaching resources and tools

Received: August 27, 2021. Revised: April 20, 2022. Accepted: May 21, 2022. Published: June 16, 2022.

1. Introduction

In recent years, fully online or hybrid/blended online instruction courses are increasing exponentially at many higher education institutions in the United States and worldwide [18]. And [13] showed that 89 percent of four-year higher education institutions offered courses taught fully online, or hybrid/blend online. Of all students enrolled in higher education in 2017, 33.5% enrolled in some form of distance education/online learning courses [4].

In their paper, [11] defined the online instruction as "distance education is teaching and planned learning in which teaching normally occurs in a different place from learning, requiring communication through technologies as well as special institutional organization" (p2). Even it is hard to use a uniform definition in rapidly changing online instructional education, but all agree that online instruction has the following advantages over traditional face-to-face instruction [6]:

- To reduce the time and costs for travel.
- To increase opportunities to access and collaborate with expert professionals.
- To provide students with flexibility at their convenience.
- To allow the adjustments to subjects and content.

As computing becomes mainstream in the increasing range of academic disciplines in higher education, it is unavoidable that more online learning courses are required in computer related degrees. However, programming courses are generally regarded as difficult, especially in the online environment [5]. In 2020, the Covid-19 pandemic has pushed thousands of colleges and universities into remote learning, 98% of institutions had moved most in-person classes online and 43% of institutions had invested in new online learning resource [4].

2. Literature Review

Traditional instruction is a structured education program that focuses on face-to-face (f2f) contact with students in a classroom [2]. The instructor plays the central role in helping students learn through organized lectures. Students who enroll in lecture classes consistently expressed several reasons for preferring lecture in a classroom, according to national data collected by [8]. They preferred to learn by watching an instructor present the material and being able to ask questions during the presentation of the material; they valued the human interaction. Students also pointed out that they frequently benefited when another student asked the instructor a question and they were able to listen to the instructor's response. Students in lecture courses preferred these types of interactions to the opportunity for more individual attention than in an online course [1].

2.1 Online Instructional Education

Online instructional education has grown rapidly in higher education [12]. Online learning has become a major alternative approach to traditional instruction by offering great opportunities for anyone who wants to learn something from the internet, with the advantages to learn anytime and anywhere [17]. Some other

benefits of online learning are its ability to utilize various forms of multimedia such as texts, audios, and videos, more flexible self-responsible learning pace, and lower costs [3].

However, studies [10, 19] show that traditional face-to-face learning provides real and meaning interactions among students and teachers. Most students and parents do not feel that the cost for online tuition should be the same as the traditional face-to-face classes [4]. There are concerns and complaints on online instruction including: poor course content, little collaborative learning, inconsistent instruction, no access to professors, poor instructor preparation, and technical or network problems.

2.2 Online Learning in Programming Courses

The growing interest in student-directed learning and the rise in popularity of online learning have also resulted in relatively steady growth in computer science majors, including the programming courses [9]. Studies show that programmers spend between 20%-30% of their time online for acquiring information and code, even more time than the time spend on coding [21]. A widely adopted online resources such as concrete code examples, some program paradigms, and video tutorials to show a step-by-step guide of how programming solution can be implemented to help students to learn more effectively and efficiently [14].

However, programming courses are generally regarded as difficult, and often have the highest dropout rates [15]. Appropriate pedagogies and teaching approaches are essential for effective teaching and learning [5].

2.3 Purpose of the Study

Established in 1973, the University of Houston – Victoria has a main campus located in the city of Victoria, Texas, as well as an instructional site in Katy, a Houston suburb. UHV has a proud history of offering affordable and engaging online courses. In 2017, UHV was awarded on top-10 list for best Texas online college education. "UHV leaders realized early on that significant number of our students were unable to take a traditional face-to-face class schedule. The university has spent a lot of time and energy coming up with effective ways to teach online." Said by David Cockrum, UHV provost [20].

For Computer Science (CS) and Computing Information System (CIS) programs, UHV has offered both traditional face-to-face session as well as online session for most of the courses at the same time, students could select the instructional format that they believe will best support their learning style. However, is online instruction better, worse, or as good as traditional instruction? What are the reasons some students insisting on the traditional face-to-face format? In the future, will traditional instruction be totally substituted? How could an institution assist students in selecting the instructional format that will be best suited for them?

In March 2019, as thousands of colleges and universities in the United States, UHV transitioned all face-to-face classes to online learning because of the coronavirus disease 2019 (COVID-19) pandemic. Students who prefer the traditional face-to-face format were forced to change to online learning environment, the COVID-19 pandemic has affected their learning at many levels. In this paper, we conducted a survey in four fundamental programming CS courses and one CIS course trying to find out:

1. Do f2f student accept the online learning format?
2. What challenges the f2f students face in transition from face-to-face format to online learning format?
3. Compared to online students, what are the reasons they want to select f2f learning format?
4. In the future, will the online learning instruction completely replace f2f instruction?

3. Research Design and Survey Results

The goal of this study is to find out the learning habits of F2F preferences computer science students and programming practitioners, with the purpose of understanding why they prefer to F2F learning format and what are the challenges when they are forced to switch to online learning format. The study context consists of a survey delivered to five CS courses in Spring 2020 to Fall 2020.

- COSC 1336: Programming Fundamentals I (F2F class)
- COSC 1337: Programming Fundamentals II (F2F class)
- COSC 3317: Object Oriented Programming (both F2F session and online session)

- COSC 3325: Information Systems in Organizations (both F2F session and online session)
- COSC 3333: Data Structures and Algorithms II (F2F class)

Among them, both COSC 3317 and 3325 have both F2F and online sessions at the same time, and COSC 1336, COSC 1337, and COSC 3333 had only F2F sessions. All F2F sessions in Spring 2020 to Fall 2020 are moved to hybrid format (Synchronized Team online class and Blackboard course platform). COSC 1336, COSC 1337, COSC 3317, and COSC 3333 are heavily programming involved class, but COSC 3325 is not a programming related class.

3.1 Enrollment Preference

Students have very different preferences such as how, when, where and how often to learn, according to [16]. Numbers and percent of students enrolled in online sessions vs. F2F sessions for some heavily programming involved classes such as COSC 3317, 3331, and 3333 over the years 2015-2020 are listed in Figure 1.

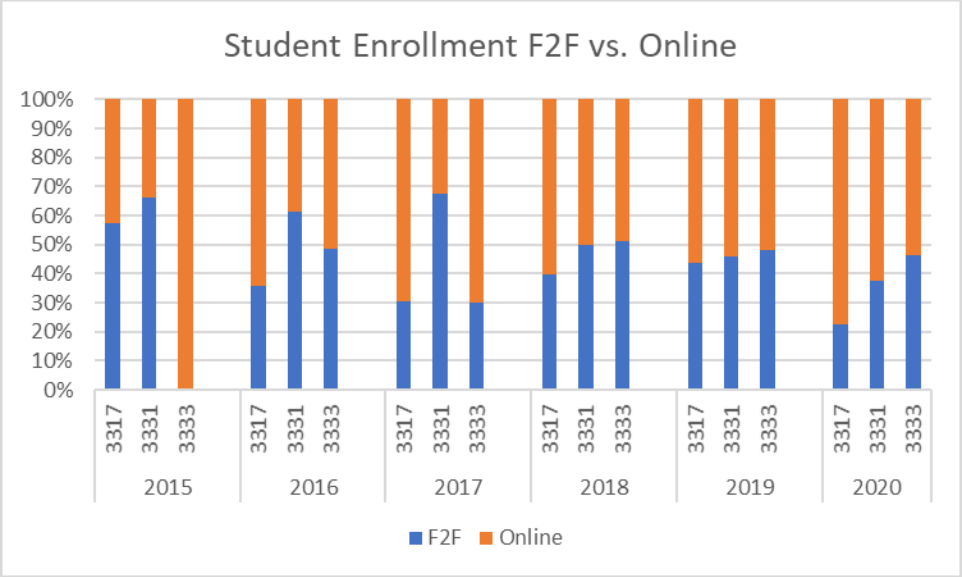

Figure 1 Percent of Students Enrolled in F2F vs. Online for Some Courses from 2015 to 2020

For classes 3317, 3331, and 3333, we offered at least one or two times with multiple sessions in each year from 2015-2020 (except in sessions between 2015-2019. The F2F percentage dropped in year of 2020 probably because of the COVID-19. According to [4] of a survey of current students, "97% of college students have switched to online instruction".

3.2 Acceptance Rate

In March 2019, UHV transitioned all face-to-face classes to synchronized online learning because of the COVID-19 pandemic. Students who prefer the traditional face-to-face format were forced to move to online learning environment. At UHV, traditionally nearly 50% 2015, we did not offer F2F COSC 3333). From Figure 1, data reflects those students from UHV select almost equally between F2F and online students select F2F session, especially for heavily programming related class such as COSC 3317, COSC 3331, COSC 3333. COVID-19 pandemic has forced them to change the learning habits from F2F into online, so what do they think?

In 2020, we have conducted a survey in five courses listed above, 1336, 1337, and 3333 have only F2F sessions, 3317 and 3325 have both F2F and online sessions, both are using the same teaching materials/platform/methods, just F2F has a synchronized Microsoft Team session. And 1336, 1337, 3317, 3333 are heavily

programming related, but 3325 is not. In survey, we asked "In your opinion, this transition to fully online classes has made the learning process: a, easier; b, easy; c, no difference; d, hard; e, harder".

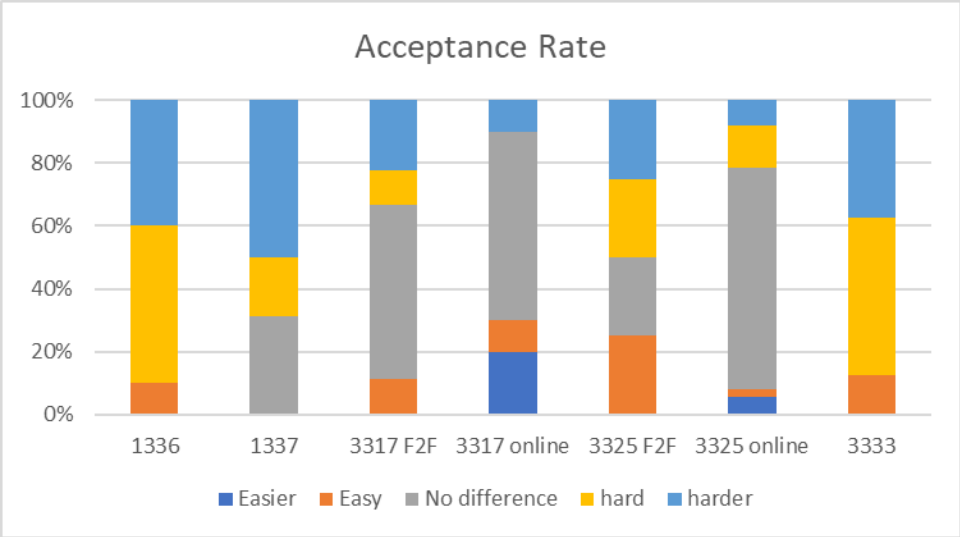

Figure 2 Percent of Students Acceptance Rate

From Figure 2, we observe that from 1336/1337/3333, 90%/68.75%/87.5% students think moving to online is either hard or harder, respectively. However, this number is only 33.33% for COSC 3317 F2F. In addition, 55.56%/60%/70.27% students from 3317 F2F/3317 online/3325 online think moving to online has no difference, we expect that online students will select majority to no difference since they select online option at first, but half of 3317 F2F students think there is no difference as well.

3.3 Learning Content

In survey, we asked when moving the courses from F2F to online, which course content has

- theoretical concepts: the building concepts studied in the class.
- non-programming assignments: all submitted assignments that are not programming related, such as quizzes, discussions activities, etc.
- programming assignments: all submitted programming assignments such as homework and projects.
- course schedule: the schedule including sychnoized classes, due dates for all assignments, discussions, etc.
- programming skills: the programming skills the students needed in the class.
- software usage: the usage of the needed software in the class.
- course materials: all distributed course materials including handouts, class discussion, video/audio presentations, reading materials.
- feedback: the responses from the instructor and the classmates.

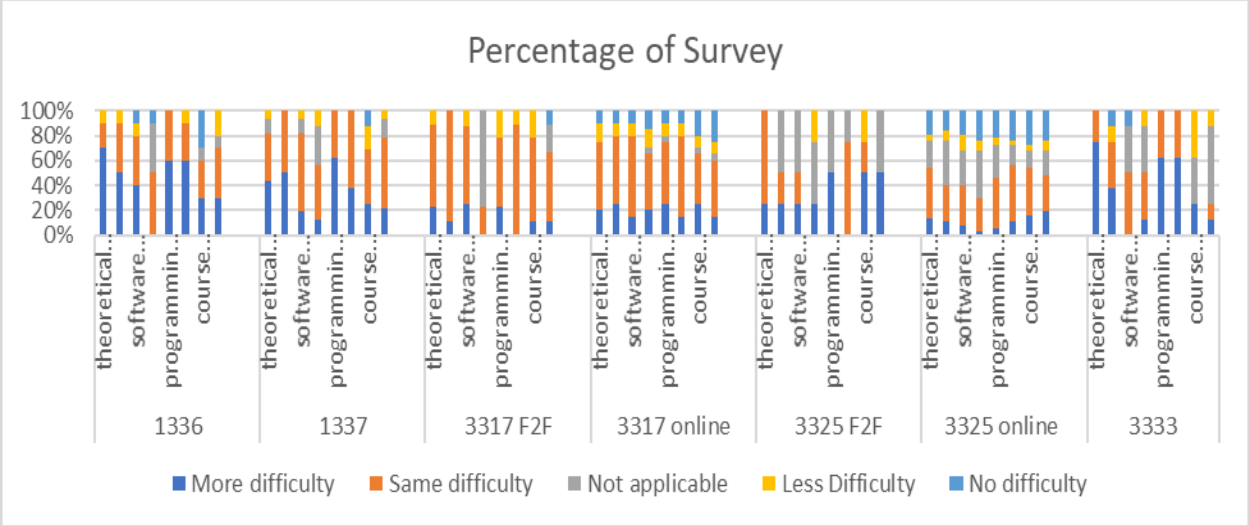

Figure 3 Percent of Students' Survey

The Figure 3 showed the survey results in all areas listed above in percentage.

- theoretical concepts: 1336, 1337, and 3333 all have large percentage students think that the theoretical concepts were more difficult in 70%, 45%, and 75%, respectively. And the percentage plus *Same difficulty* of all three courses are all over 80%. Even the percentage of *More difficulty* plus *Same difficult* for 3317 F2F, 3317 online, and 3325 F2F are all over 80%, but the percentage of all three courses of *more difficulty* is just around 20%. 3325 online has only 50% thought the theoretical concept is either *More difficulty* or *Same difficulty*.
- programming skills: the percentage of programming skills is almost the same as the theoretical concepts. 3325 is exceptional since it has no programming involved in this class.
- software usage: only 40% of 1336, 20% of 1337 and 3317, and 0% of 3333 of students thought the software usage is *More difficulty*. Almost 50% of students thought it is the *Same difficulty*.
- non-programming assignments: In all courses, nearly 50% students thought it is at the *Same difficulty,* only a few students thought it is *More difficulty*. Except 3317 has no non-programming assignments, that is the reason for large percentage of *Not applicable*.
- programming assignments: 1336, 1337, and 3333 have more than 60% selected *More difficulty*, and all students thought either *More difficulty* or *Same difficulty*. Also 3325 F2F has more than 50% selected *More difficulty*. However, it is interesting that 3317 online and 3317 F2F more than 50% thought *Same difficulty*.
- course materials: 1336, 1337, and 3333 have selected *More* difficulty in 60%, 40%, and 60%, respectively, and almost all students thought either *More difficulty* or *Same difficulty*. Other classes the majority of the students thought *Same difficulty*.
- course schedule: the survey feedback for this one is distributed, some thought it is *More difficulty* and some thought it is *Same difficulty* or even *Less difficulty*.
- feedback: the result is almost the same as course schedule.

In summary, what we observed are:

- over 50% of students in COSC 1336, COSC 1337, and COSC 3333 thought it is harder to move from F2F format into online format, especially for theoretical concepts, course materials, programming related assignments, or programming skills. For all other categories, such as non-programming assignments, schedule and feedback, even 10-20% thought it is *More difficulty*, however, the majority students thought it is the *same difficulty* or *not applicable*.

- For COSC 3325 online course, the majority students thought it is the *same difficulty* or *not applicable* for all categories since it is non-programming related.
- For COSC 3317 F2F and COSC 3317 online, even though 10-20% students thought *More difficulty* in all categories, but the majority students thought it is the *same difficulty* or *not applicable*. An interesting point is there are also 10-20% students from COSC 3317 online thought there is *No difficulty* at all.
- For COSC 3325 F2F course, the survey result is not reasonable due to the small number of students.

3.4 Online Resources

In [7], they mentioned that useful online resources would help to engage students in active learning such as online study groups and help them to explore the deep learning in some specific topics such as YouTube videos. We had conducted in survey which online resources they find helpful during the online transition as following (they could select more than one choice):

- APV: Asynchronous pre-recorded videos (such as YouTube, etc)
- APL: Asynchronous pre-recorded lectures by the instructor
- SM: Synchronous meeting using Zoom/MS Teams
- OOH: Online office hours (individual or group)
- OSG: Online study groups
- OSI: Online SI (Supplemental Instruction) sessions
- OT: Online tutoring

Table 1: Percentage of Students' Selecting Resources

	APV	APL	SM	OOH	OSG	OSI	OT
1336	40%	30%	10%	0%	30%	20%	70%
1337	81.25%	50%	12.5%	0%	18.75%	31.25%	12.5%
3317 online	45%	60%	10%	10%	15%	NIL	20%
3317 F2F	0%	25%	75%	25%	25%	NIL	25%
3325 F2F	50%	25%	50%	25%	25%	0%	0%
3325 online	51.4%	42.9%	34.3%	28.6%	8.6%	8.6%	11.4%
3333	62.5%	50%	0%	12.5%	25%	12.5%	12.5%

Generally, there are high percentage on demand on asynchronous pre-recorded videos, asynchronous pre-recorded lectures by the instructor, and synchronous meeting. In contrast, very low demands on online office hours and online tutors.

3.5 Study Habits

We also asked if the students' learning habits have been changed or not, if yes, what kind of changes they have made. Figure 4 shows the percent of students who has changed the learning habits or not. We can see for the original F2F class such as 1336, 1337, 3317F2F, 3333, the rates are all high (>=60%). 3325F2F is 50% since it is not a programming related class.

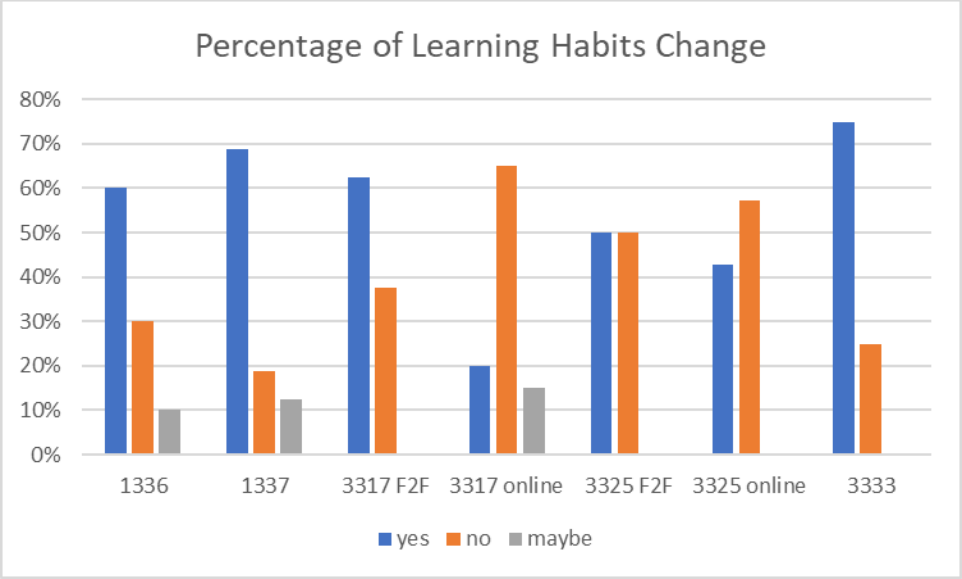

Figure 4 Percent of Students' Learning Habits Change

For the question "What types of changes you have made to your study routines?", there are many different answers, we pick a few answers that are commonly mentioned:

- More difficult in learning at home, lack of energy, home is not a good study environment.
- Learning from online is more difficulty, self-learning is hard, need face interaction.
- Hard to keep all due dates for the assignments of all classes, time prioritization, need to have a digital routine to learn daily.
- I had to study longer, spend more time in learning. Need to check blackboard more than usual and spend more time.

3.5 Self-Assessment and Challenges

In addition, in the survey we asked the students to self-assess their performance in the new learning environment, below, meet, or exceed their expectation. The survey results are shown in Figure 5.

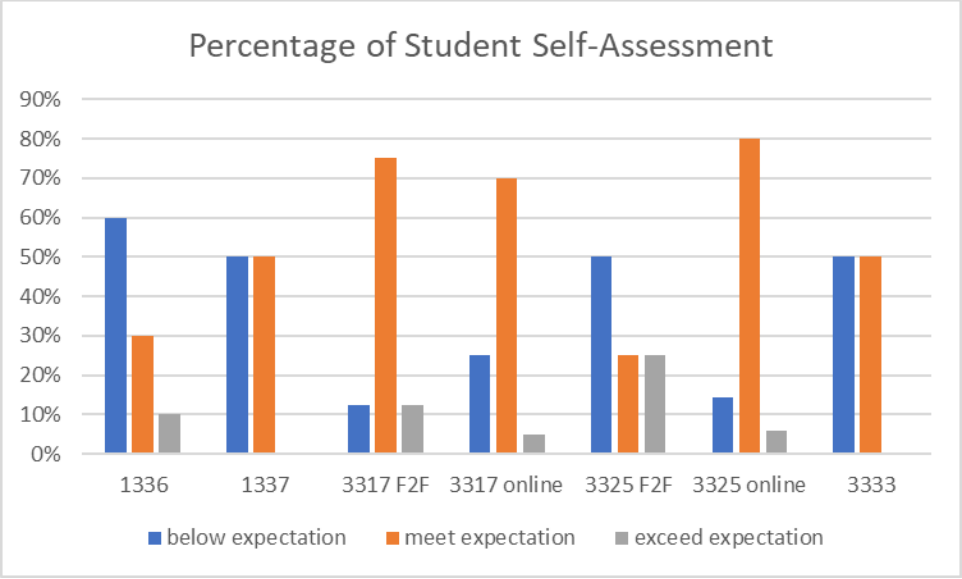

Figure 5 Percent of Students' Self-Assessment

From above figure, we could find for 1336, 1337, 3325 F2F, and 3333, at least 50% of students thought that they are below the expectations. But for 3317 F2F, 3317 online, and 3325 online, most students (more than 70%) thought that they meet the expectations.

At the end of survey, we also asked the question "What is the most challenging aspect of the online transition?" Next, we list those are mentioned more frequently in the answer,

- Lack of the instructor's directly interaction, harder to get help.
- Course materials delivered online is not as easy to understand if compared to F2F.
- Home is NOT a good study environment.
- Self-discipline learning, time management, maintaining schedule, and deal with conflicting deadlines.
- Mental exhaustion and anxiety of COVID-19 crisis.

4. Conclusions

Online instruction is increasing very fast recently at many higher education institutions, for most of the universities including UHV, offering both face-to-face sessions and online sessions to the students. However, COVID-19 has forced nearly all students, including those who initially selected face-to-face sessions to online instruction during pandemic time.

In our study, majority students who initially selected f2f sessions thought moving to online is harder and their grades are below their expectation, especially for the first-year programming courses (COSC 1336, COSC 1337) and some hard programming courses (COSC 3333). Their studying habits have changed because of the home environment, learning style, and time management. However, for the students who initially selected intermediate programming class (COSC 3317) and non-programming class (COSC 3325), most students could accept the online transition and believe that they could meet their expectation. The challenges for the online transitions are instructor's f2f interaction, the way to help, time management, schedule maintain, and study environment.

For the question, will the online learning instruction completely replace f2f instruction? We do not think that will happen, at least not very soon. In Computer Science, especially for the first year's programming classes and some advanced hard abstract courses, we should offer both f2f and online to the students. For the online courses, there are high demands on the resources of asynchronized pre-recorded videos and synchronized meeting tools. In addition, some supplement tools are considered necessary such as course scheduler to help students to deal with assignments confliction and time management from multiple courses.

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