

The Online Teaching Practice of the Tunnel Engineering During the COVID-19 Pandemic

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Abstract: To cope with the constraint of the COVID-19 pandemic, online teaching is widely used in education. However, the adaptation from conventional face-to-face dominated classroom teaching to that of online mode is generally in a swift way. Considering the significant features of the online learning and teaching situation, both instructors and students would be confronted with various challenges. Here is the presentation of the online teaching practice of the Tunnel Engineering during the COVID-19 pandemic. The practice indicates that the major challenges of the instructors are to perform the multiple roles of content expertise and presenter, student work assessor, online teaching procedure facilitator and manager. The students are confronted with the requirements of competence in terms of learner, presenter and respondent. The course design and implementation plan are initially tuned at the beginning of the online teaching to adapt to the new situation. With a new teaching strategy being set up, the online teaching activities have been progressively tailored in corresponding to the feedback from students, peer reviews, the results of formative and summative assessments on the learning and teaching activities. The experience and lesson learned from the Tunnel Engineering online teaching for six classes from the three academic years 2020 to 2022 are presented in terms of course design and implementation plan, assessments, effective interaction and online teaching community.

Keywords: Practice, Challenge and Lesson, Design and Assessment, Online Teaching, Tunnel Engineering, COVID Pandemic

1. Introduction

Thanks to the development of internet and digital technology, online education is developing with time to meet the emerging and life-long learning requirements. This increasing tendency was accelerated by the abruptly suspending of the conventional face-to-face classroom teaching activities due to the COVID-19 pandemic at the beginning of spring semester in 2020. The pandemic impact on the globe formal education is deep and extensive [1]. Online teaching was widely applied in reaction to the lockdown measures due to the COVID-19 pandemic. A challenge for the online teaching is to sustain educational visions and ideals in this new circumstances [2], since the hastily adapted approaches are sometimes bypassing established quality control processes [1]. The explosive growth of online education means the need of guidelines for instructing new and continuing online instructors on how best to teach in online spaces [3], such as training teachers in

digital competences and open pedagogies [1].

However, numerous practices make their first step in a passive way, where there is a quick shift from conventional classroom mode to online teaching to response to the personal activity lockdown in the COVID pandemic [2, 4]. In corresponding to this challenge situation, the course learning and teaching has been tuned in a hurry. To meet the basic principle of student-centered teaching, it is accordingly necessary to improve the online teaching in practice. The roles of the online instructors and their critical competencies for online teaching should be timely well-recognized in practice. For example, it was found that effective online instructors were assuming five different roles [3]: Facilitator, Course designer, Course delivery, Subject matter expert, and Mentor. It is challengeable to effectively play the instructors' roles in practice. The result of online learning and teaching would meet requirements provided that the course has been effectively executed [5].

Similar to conventional face-to-face classroom activity, the

instructors of the online teaching need to consider course design, assessment and evaluation, and facilitation. For example, to be a successful online instructor, we need design the course in a systematic and dynamic process [6], especially with the learner needs and learner interaction under consideration. At the same time, learning and teaching activities should be effectively evaluated with well-designed measures, which may include traditional assessments and used rubrics to assess students, course templates and quality assurance process, such as through surveys, learning analytics, and peer reviews. For example, qualified instructors recommended to use these facilitation strategies, such as timely response and feedback, availability and presence, and periodic communication [6]. And therefore, during online teaching, the performance of instructors needs improvement to meet the online teaching requirements [7]. On the other hand, the faculty attitudes on their competency and preparation for a specified course are important for online teaching [8].

Formal resources at the institutional level would be fully used only effectively in conjunction with online teaching skills [9]. Since the online learning and teaching situation is different from that of conventional face-to-face mode, the faculty are therefore challenged in terms of both course design and plan implementation [10], such as in terms of the skillful usage of digital facilities and online teaching platforms. The instructors would play the roles with multiple competencies in online teaching [3, 11, 12].

Although the online learning during the COVID-19 pandemic would not be ordinary state, multiple ways, such as both online and offline coexisting or hybrid approaches, will be increasingly operational in the future. Practices during the epidemic accelerated the dissemination and consolidation of online learning in higher education [13]. It is meaningful and vital to explore the impact of the learning and teaching practice on the course process quality [10]. Here is the online teaching practice of the course Tunnel Engineering during the COVID-19 pandemic at Chang'an University in China.

2. Adaptation at Beginning

There was no indication for the COVID-19 pandemic at the end of 2019. During the Spring Festival 2020, we simply considered that the pandemic would have been lasting with the similar tendency of the SARS pandemic in 2003. However, at the beginning of the spring semester in 2020, we were confronted with the traveling restraint due to the COVID-19 pandemic. To cope with the emergency situation, almost all of education activities in China hastily shifted from conventional face-to-face classroom to online mode. It was not a planned procedure. The online learning and teaching was adapted in a passive way at that time. To sustain the educational visions and ideals under new circumstances, both students and instructors must consider their adaptation affairs related to the online learning and teaching activities.

2.1. Facilities and Platform Choosing

As the decision of online teaching was informed, both students and teachers must prepare their online facilities within a few days. The basic devices to meet the requirements for an online course include: (a) applicable terminal units, such as internet cable or WiFi, computer with microphone or smartphone, and a camera for a teacher's computer; (b) a network platform for the online teaching.

Thanks to the digital infrastructure development in the recent years, the basic terminal units are generally ready for online teaching. However, the choosing of effective network platform and personal facilities for the online teaching is relatively tough. For example, the available network platform for online teaching was Rain Classroom through administration website at the beginning of the spring semester in 2020. Unfortunately, the platform capacity were too limited to meet the nationwide users' online teaching requirements. Similar situation is the institute workstation to deal with the requirements from about 40,000 online users' terminal units. Indeed, the platform was built as an alternative learning and teaching facility in responding to this digital era tendency. Some of the first-time online classes was not smooth or even partially failed.

To cope with the information exchanging lagging or abrupt off-line in teaching, a teacher ought to change to other platform, such as Tencent meeting, QQ classroom, Ding Talk, Zoom meeting. In general, an optimal online platform would have been approved for a specified course within three class times, provided the course instructor had made good preparation for the course, such as being skillful at using the online teaching platform alternatives and informing the students to be familiar to the proposed platform a few days before the next class time.

On the other hand, the service provider and the administration are expanding the capacity of the existing platform and institute workstation through integrating the existing resources and new facilities. The updated administration online platform, named as Chang'an Course-online (<http://course-online.chd.edu.cn/>), is highly practicable in terms of capacity, convenience and friendly interface.

In institute, the optimal course platform for a course could be various due to the teachers and students' places of logging in the online course platform are different. The practical internet speed between teachers and students' terminal units during the course time is always vital to the platform choosing. On the other hand, the internet features of the students' terminals are various since their homes are in different regions or villages. A favorable platform for our course time was determined through a few course hours. In conjunction with the updating and improvement of network platforms in China, we changed the Zoom meeting into Tencent meeting after five weeks.

In brief, thanks to the effective national internet infrastructure and the available of personal facilities, as well as the popularity of online social networks, such as WeChat

and QQ, it was generally smooth and fast choosing an effective internet platform for the online teaching.

2.2. Adaptation of Course Design and Implementation Plan

Tunnel Engineering is a conventional major subject for the students in the Civil Engineering at Chang'an University [14]. The course design and implementation plan are prepared for the conventional learning and teaching situation, which is presented with a face-to-face activities, such as classroom lecture, discussion, quiz, testing, presentation, grouping work, and a random questioning & answering during a program. Although the application of a digital courseware, such as PPT, video, cartoon and simulation procedure, is common in ordinary lecturing, the traditional chalk handwriting on a blackboard is also indispensable, especially in the logical process presentation of the course key points.

Where the learning and teaching of a course is shifted from the conventional face-to-face classroom dominated activities to nearly full online process, the situation is greatly different from that of the prospective one during the original course design, which generally has one single tradition that fits all. The online teaching requires continuous adaptation and improvement that will strongly depend on local contexts [15]. The prepared course materials and implementation plan need adjusting to adapt the online teaching requirements.

The online teaching community is quite different from the conventional one, special treatment is needed in responding to new learning and teaching situation. Online situations challenge our teaching and learning paradigms. Both learners and instructors need reimagine our experiences. For example, as students are growing in their knowledge and improving in capacity, instructors need to nurture them with well-designed and presented programs. To follow the student-centered principle, the instructors need to know the students' adaptation situation in time, especially at the first stage of the online teaching. For example, effective online learning would be characterized by the thoughtful design and facilitation of the interaction among student, content, instructor and technology [16], and be achieved through reflective practices in learning design, online teaching and the facilitation of online learning [17, 18]. The main requisites include effective course design and implementation plan, favorable learning environments and instructors competence. The main items are as the followings.

(a) Effective course design and implementation plan. To realize the pre-expected learning and teaching outcomes, the course design and implementation plan should provide multiple opportunities for students to interact with each other, with the course materials, and with the instructor. For example, to meet the specific learning and teaching goals, students would have good opportunities for reflection, self-assessment, and peer learning. The learning achievements and teaching effect should be assessed with well-designed specific formative and summative assessing measures, such as in terms of teaching units or topics.

(b) Favorable learning environments. Favorable learning environments could facilitate active learning experiences.

Favorable environments are based on appropriate resources and technologies, which could be used to timely communicate with students, to guide students to construct knowledge, demonstrate knowledge, and interact within the course. For example, the course website could provide current, timely and accessible learning materials, as well as a clear path for learners to engage with the materials toward their own success.

(c) Instructors competence. Online teaching instructors should be able to not only effectively implement online pedagogies, but also to cultivate an active and reciprocal community of students [19]. For example, the designed online learning environment would be favorable to a process involving critical discourse and reflection in an online community of peers. On the other hand, instructors should be skillful at the effective usages of the available facilities, platform, as well as managing communication and various interactions.

3. Practice of the Online Teaching

3.1. Considerations for the Online Teaching

Although student-centered principle is followed in both conventional face-to-face classroom and online teaching, the essential elements for online teaching are partially different from that for conventional mode. In terms of course design and preparation, the main considerations, with additional strengthening items, for the online teaching include: alignment in objectives, evaluation plan, implementation plan, and effective communication and interaction.

3.1.1. Alignment in Objectives

At beginning, set up course outcomes in details, in which specific plan is designed such as in terms of unit or topic objectives. For example, based on the course outcomes, it is needed to develop the specific modules/lessons plan and related objective. To make the students to obtain the necessary information and materials to meet the course outcomes, it is important to timely communicate the course expectations to the students.

Content preparation is a challenge to most of the instructors. If a teacher does not has a deep understanding of the topic/content, the prepared manuscript for the course presentation will be truthful in stating the facts. Indeed, there need constructive speculations when writing, such as with understanding the different knowledge types, such as practical or theoretical, recessive or dominant, declarative or procedural knowledge. On the other hand, course implementation plan should be in details for each of lessons and units, in terms of students' prior knowledge, the task of learning, expectation outcomes by the end of the lesson/ unit.

Based on the course subject system, instructors would identify not only the truly crucial content that students need to learn, but also find a system procedure to guide the students to realize their expectation outcomes. For example, the major components for the system include: (a) the lecture note for the course could sort out the contents that students

can truly understand and master, (b) determining what is more for a teacher to present to students than the text in the note, (c) designing questions or tasks in corresponding to the specific contents to guide students to think the meaning that they are learning, (d) improving approaches based on feedback from students and assessments. The procedure should be helpful to students' learning engagement. For example, students would infer new things based on what they have read and combine their previous knowledge to generate answers, rather than just pairing the questions with what they have read.

Learning is a cognitive process, in which some items are related to intangible things. It is generally beneficial to present the course contents, such as transforming complex concepts into aesthetic and simple graphical forms. A concise and clear illustration not only has great educational significance for readers, but also helps to promote scientists' modeling of engineering processes. For example, if the students can't understand an illustration in 3 seconds, it's too complicated. In an ideal situation, students can have a good understanding of a unit after reading the sub-titles and charts in order.

In practice, the learning experience should be perceived in alignment with related objectives. For example, there need a few specific objectives for each learning experience, with specific and measurable outcome. The effect of the learning and teaching experience is timely checked with well-designed measures, such as questionnaires, quiz, assignments, and communication with students.

3.1.2. Evaluation Plan

The effectiveness of teaching is demonstrated by students' learning of what has been taught. To measure the learning and teaching outcomes is the next step following course design. For example, it is generally useful to use actionable verbs to determine the student's understanding of the content and the effectiveness of the applied teaching methodology for delivering the content. At the beginning of the course, instructors should explain the course expectations in details and provide a rubric. During the course procedure, it is always need to tune the rubric based on the feedback from their effectiveness in assessing students' performance.

For example, the focuses of the evaluation on the learning outcomes should be favorable to guiding students' capacity development, such as through reflection on their learning. The questions in tasks include not only knowing fundamental knowledge of facts, principles and theories, but also demanding analysis, application and problem-solving.

To make the outcomes of a course to meet the specified student achievement, the goal completion and student satisfaction should be timely evaluated with well-designed criteria. For example, instructors need to ensure that the designed course objectives align with specific module objectives, such as in terms of course content, learning activities and assessments aligning with the specific teaching and learning objectives. Therefore, it is important to review the objectives, content, activities, and assessments in the

online environment where clarity of communication is so essential.

3.1.3. Implementation Plan

Of the online teaching course design, instructors need consider the lecturing situation, in which everyone is separated in sense. A well-design implementation plan could determine how to keep the students deeply engaged in the learning and teaching activity. The implementation plan must be in details, which is clear and actionable for a specific learning and teaching item. The involved activities include not only specific content for a learning and teaching unit, but also setting assignments for students and creating favorable learning environment.

1) Assignments with comprehensive features

To create the experience to keep the students truly engaged in learning and teaching procedure, a variety of assignments are always necessary. For example, following the Bloom's Taxonomy, the assignments for a specific topic supporting function surrounding rock disturbance due to tunneling would include:

(a) Assigning textbook readings to remember and understand the principles of in situ stress redistribution in surrounding rocks due to tunneling disturbance;

(b) Using case studies, such as through group activity, to discuss and analyze influence factors on the degree or magnitude of surrounding rock disturbance;

(c) Utilizing quizzes or presentations to help the students evaluate the effectiveness of supporting interventions.

(d) Assigning students an assignment to create a tunneling plan with the key influence factors under consideration.

2) Creating favorable learning environment

Techniques and facilities are necessary but not all for a favorable online learning and teaching environment, which should be with the components of effective communication mode and interaction platforms among learners and instructors.

The basic requirements of the learning environment would provide useful learning materials, techniques and activities, where students could utilize both synchronous and asynchronous lectures and activities, discussion boards, group working approaches. The students could easily manage the facilities to reach every learner and learning style. For example, well-deigned and involved discussion board would not only encourage students to read other students' post or points of view on a specific topic, but also to make thoughtful comments, which is helpful in ushering students being involved in active learning strategies.

Online teaching means there is a distance among learners and instructors. It is vital to the learning and teaching effectiveness to activate students' learning attitude, such as using a variety of active learning strategies to guide them joining into the learning environment. For example, the learning and teaching platform could create learning opportunities where students can work collaboratively on a group work project.

On the other hand, the learning platform could provide

students specific topic related information, such as through exploring multimedia and social media for a variety of learning opportunities to develop their information sampling capacity and to understand the professional practice.

At the beginning of the course, there usually needs a few times to invite the students into the learning environment, such as setting an activity requiring real name participant's response on a specific questionnaire. Where the students get used to the learning environment, some group activities and small group chats will develop and peer-to-peer learning community would appear. In general, the active students would have learning opportunities working collaboratively on a case study or analysis project.

3.1.4. Effective Communication and Interaction

During the COVID-19 pandemic, the conventional face-to-face communication is greatly restricted due to the mobility restriction and institute lockdown. Effective communication and interaction among students and teachers are vital to online teaching success. To follow student-centered principles, the course objectives, such as in terms of faculty and student expectations, should be understood by students. The first step is to provide students clear and consistent messaging on the course objectives, such as guiding students to understand the course structure and optimizing methods of communication. During the online teaching procedure, instructors would timely update the information and course materials, adjust communication approaches, and inform the changes to students.

Besides the basic infrastructure and platform conditions, favorable interaction community is with characteristics of being social, effective learning resources, active presence of the online teacher. For example, a social environment will facilitate polite and friendly interaction. The participants will feel a sense of belonging and social connection, freely open communication but strong group cohesion.

The students join in the interaction community in purpose, such as being cognitive favorable. Therefore, the learning materials and content are most effective when used in support of a relevant problem, and used to guide students through investigation and resolution of the problems. This "practical inquiry" process includes ample opportunity for discussion, collaborative problem-solving, and reflection.

To make the communication and interaction effective, the active presence of the online teacher is critical to the success of the above-mentioned considerations, i.e., alignment in objectives and evaluation plan. When teaching online, it becomes even more imperative to act as a learning guide. This includes providing concise instructions, setting clear expectations, creating a consistent online course site, and modeling effective online behaviors and participation [20]. The role of an online teacher incorporates all three of the considerations [21, 22].

To make the communication clarity, terminology in the course activity need be in alignment. The terminology in practice should be consistency across specific content and activity, such as for every page and unit activity. For example,

to enhance effective online communication and instruction, the title for a specific topic should be same in the course syllabus, schedule, presentation, discussion and assignments.

In practice, the instructor-student interaction is performed off-line or online. The well-used instructor-to-student interactions include: (a) emails, person-to-person WeChat or QQ chat, which need responding within 24 to 48 hours; (b) video or phone conference, which is offered during specified office hours or arranged for a specific topic to be discussed in a small or large group. It is noted that the online feedback from instructors during office hours or at a reserved time is favorable to student's digesting current content or pre-considered questions, respectively.

3.2. Tuning Based on Feedback

The online teaching is a continuous improvement procedure. The learning and teaching situation is changing in terms of students' knowledge and capacity developing. Continuous improvement [23] is necessary to evaluate and adjust course elements based on identifying what is working effectively for student learning. For example, to ensure high-quality and accessible online courses, the course design and implementation plan should be periodically reviewed based on the agreed-upon guidelines.

Of the feedback on the course content and presentation effectiveness, the possible methods could include:

(a) Before the event, discussing with related instructors to determine the course implementation plan and course quality assurance standards;

(b) While the course is running, reviewing stage learning analytics and students' feedback, which is based on periodic surveys and communication with students, especially to know where and when the students are confused on the course;

(c) After the course has ended, reviewing semester learning analytics and having a post-class survey of student learning satisfaction and student rating of teaching.

With the online teaching circumstance, presentation style and students' learning performance under consideration, at the beginning of the online teaching, questionnaires and email investigation were used to adjust teaching time schedule and presentation styles. For example, it is identified that same presentation style, such as speech plus PPT shared, should last no more than 15 minutes. There needs an interval, such as video play, flash, quiz or improvised questioning on a lecturing point. The well-arranged styles would be helpful for lasting students' attention to the course content and reflecting the engineering significance of the knowledge points under discussion.

3.3. Performance

As education is student-centered, the online teaching would be of cognitive, affective and managerial features [24]. The effective learning and teaching activities will help student process information efficiently, interact actively, and keep the activities structured and instrumented. Considering

the students are separated during the pandemic lockdown, it is vital to accommodate individual needs and to encourage student self-directed learning in online teaching [25]. This means that a timely review of the teaching and learning process is necessary and the online teaching should be multiple perspectives to meet the individuation requirements. Both teachers and students play vital roles to make success in online teaching.

3.3.1. Teachers' Roles

Teaching is a dynamic procedure, which can be considered as three stages, i.e., before, during and after the online course delivery activity. Instructors will play multiple roles in this process, such as course design, assessment and evaluation, and management. Following student-centered principle, teachers give service to students. Therefore, competence is required to fill teaching tasks. The domains of the competence for instructors include professional foundations, planning and preparation, instructional methods and strategies, assessment and evaluation, and management [12]. In brief, instructors should play their teaching roles, who have identified competencies to finish specified tasks [26], such as for pedagogical, social, managerial, and technical functions. The five top-rated competencies [12] by online instructors are related to course content, communication with students, and assessment, i.e., working as assessor, subject matter expert, facilitator, manager, content presenter, as the followings.

(a) Assessor of student work: setting requirements or outcomes, such as what are the requirements for each specified points or topic. The evaluation gauges should also be clearly indicated at the beginning of a plan. Assessing student work is the highest-rated competency [6] using a variety of assessments, such as traditional and authentic assessments and rubrics for assessments in their role as an assessor.

(b) Subject matter expert: ensuring accurate course content. It is favorable for an online instructors to be involved in both online course design and delivery. Online instructors as a content expertise would ensure the veracity of the course content and facilitate the delivery of the online course. This is consistent with the findings [27] that content expertise was rated highest in e-instructors' perceptions and practice.

(c) Facilitator: creating a friendly invitation or gesture. The environment created by a welcome message or video is helpful to students being immersed in a community of learning and social presence [28]. Teachers generally make the online course ready 10 minutes ahead of the time schedule. As the students join in the online platform, both course orientation and weekly announcements are helpful facilitation strategies [29]. To make use of the digital resource, it is welcome to play the videos related to tunnel engineering histories, famous case histories, and the flash of tunnel building or structures. The chosen item is related to the specified content of a course time.

(d) Manager: giving clear instructions to learners. In a face-to-face classroom, instructions can be provided instantly

and clarified whereas in an online setting it is important for instructions to be clear ahead of time to avoid confusion. While some students' hesitation to ask for clarification hinders their learning, others might contact the instructor with a number of questions which results in an increased work load for the instructor. When instructions and navigation is unclear it is easy to lose student participation. On the other hand, rubrics including clear instructions are critical to the success of online learners [6, 12].

(e) Subject matter expert: demonstrating with expertise.

Demonstrating content expertise was rated high by online instructors as critical for online teaching, in which the instructors emphasized the importance of creating content for students to achieve mastery [3]. Similar results are from the study on e-instructors' ratings of being content experts [27]. To meet student's capacity development, course content presented by instructors should provide students with constructive knowledge and should not solely be textbook based [30]. This shows the importance of online instructors being content experts and focusing on the design of the content for online delivery.

The optimal faculty behaviors in online education are student-centered and interrelated in producing teaching outcomes [7]. As the course and material structure are based on the students' characteristics and learning needs in course design, student-centered instruction also requires faculty to demonstrate diverse pedagogical and managerial behaviors during course delivery. The effect of the online teaching is assessed to improve teacher's behaviors and student learning.

On the other hand, the presentation of the optimal faculty behaviors in terms of dialogue and structure has the potential to enable teachers to identify performance deficiencies in each construct, and design and develop interventions to improve faculty behaviors and performance outputs [7].

3.3.2. Students' Roles

Learners are the focus of education. There is no achievement if student do not take responsibility for his or her own learning. During the online teaching, the key roles played by students can be considered as: a learner and contributor, respectively.

(a) Autonomous learner. During online teaching, learner autonomy is much more vital in comparison with the conventional learning and teaching situation. To be an autonomous learner, students should have active learning motivation, the skills of facility and platform usages, the ability of managing time and study environment, and the ability to seek assistance. As a successful learner, students would monitor and evaluate their own progress, i.e., have the ability of making effective reflection in learning procedure.

(b) Community and course contributor. The online learning and teaching needs timely assessing, in which students' feedback is indispensable. As mentioned in the above sections, students play positive roles in the adaptation at beginning, platform choosing, presentation style adjusting, as well as the online teaching community building. The feedback both during and after a semester course is important

reference to adjusting or improving the course design and implementation plan, updating the course materials and communication focuses.

3.4. Assessments

Quality standard is of important to online learning and teaching. However, quality standards could not be naturally followed in practice. It is important to evaluate, verify, and communicate online quality to prospective students, such as conducting course quality assessments [10].

The development of online teaching capacity is a dynamic process, which needs thoughtful considerations of what to do before, during, and after the process [31]. For example, in a supportive teaching community, it is helpful using reflective practice of identifying areas of strength and weaknesses [31].

To assess the effectiveness of the online teaching, especially the students' learning achievements, there need posted exercises and practice quizzes available to students weekly [32]. The intensity of the assessing measures should correspond to the density of the topic under consideration.

Both formative and summative assessments are designed and implemented during the online teaching. The practices show that formative assessments are more helpful to the course presentation style tuning and guiding students' learning capacity development, in terms of learner's personal perspective. The summative assessments of 180 students from six classes during the academic year 2020 to 2022 indicate that the online learning can generally meet the assumed learning and teaching objectives.

4. Discussion

To serve the students' learning procedure, it is crucial for instructors' understanding students' knowledge increasing, to improve teaching skills and results. In practice, teachers need to constantly reflect, especially the relationship between the foundation of course content teaching and other specific issues, related to students' learning achievements. Otherwise, it is impossible to effectively present the course knowledge in online teaching. The teaching will lose its direction. In this sense, the task of a teacher is to grasp the learning and teaching direction, and guide students to reach a professional level.

On the other hand, the learning and teaching outcomes are closely related to students' interests and attitudes, prior knowledge, performance and learning objectives. Positive motivation and curiosity are helpful for students to be actively engaged in learning. Favorable online learning and teaching community, as well as timely assessing and feedback, would contribute to realizing assumed course outcomes.

Practice implies experiences and lessons. The experiences learned from the online teaching during the COVID-19 pandemic are discussed in terms of course preparation, management and tuning, and interaction.

4.1. Online Course Preparation

It is one of the misconceptions to prepare an online course same content and implementation plan as face-to-face education [33]. Effective online course preparation should include course design, assessment and evaluation, and facilitation [6], as shown in Figure 1. This framework is related to the online course full life-cycle activities, before, during, and after the online course delivery. With the basic indexes under consideration, the effect of preliminarily prepared course design and implementation plan, as well as the facilitation, will be assessed during the online teaching. The student learning experience or outcomes will dominate the results of the evaluation. The relationship of the basic indexes and the quality of the course preparation are as illustrated as the intersecting domains (Figure 1).

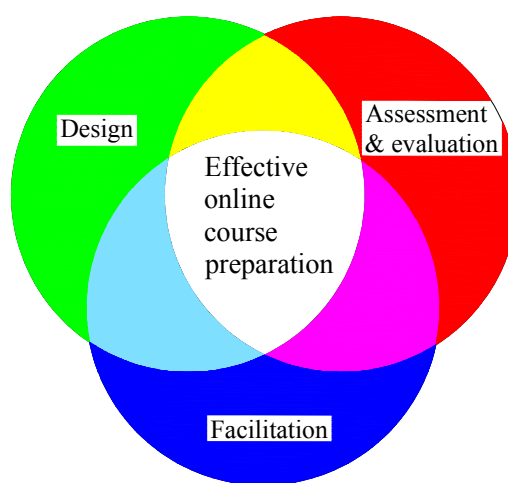


Figure 1. Conceptual framework for effective online courses preparation.

Course design should be developed according instructional logics. The contents are determined according to the analysis on the student characteristics and needs. In conjunction with the features of the subject of the course, the course implementation plan is designed, with specific evaluation criteria under consideration. Of online teaching, the delivery plan should include appropriate instructional methods and tools, presentation skills, interaction with students, as well as instructors' managerial behaviors [7].

Course design has been preliminarily finished before related content teaching. Online teaching is facilitated with prepared instrumentation or platform. As the learning and teaching is in process, the results are systematically evaluated with pre-defined performance indicators. And then, the course design and implementation plan are accordingly revised to support learning objectives.

In the full-life learning and teaching procedure, the quality of the student's learning outcomes are of the ultimate objective. Besides the parameters of design, assessment and evaluation, and facilitation under consideration, effective interaction is vital to create an effective learning community, as shown in Figure 2. In online teaching, the students will play an indispensable role for effective online courses (Figure 2).

Traditional pedagogies and teaching models, such as

mainly based on books and manuals, could not adapt to the new situations. The preparation for the online course should be in details in terms of course content, presentation stages and units, interactions and evaluations. For example,

well-prepared delivery sub-theme should cover the roles of lecturing, evaluation approaches, guidance and motivation to students' performance, and material development in a specific way [33].

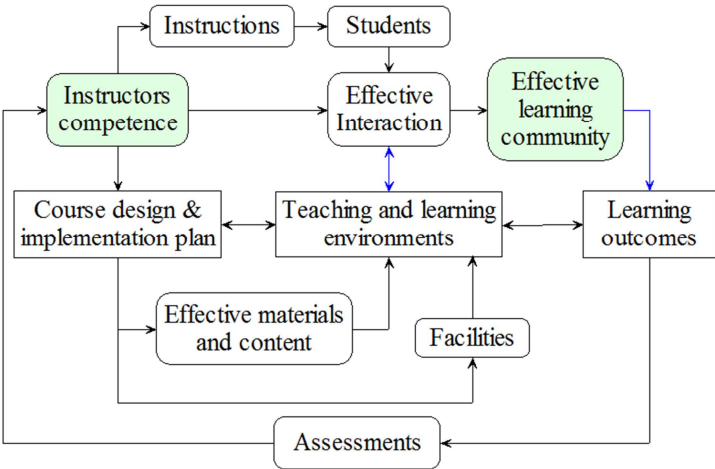


Figure 2. Factors and their relationship in online teaching with student-centered principle under consideration.

The interactions and assessments are also focuses of preparations. For example, the feedback from instructors will include online and offline ways. There are specifically designed exercises and practice quizzes for each learning unit or important topic. For the course subject fundamental topics, integrated problems should be designed with various density components, which correspond to learning stages.

In brief, online course preparation should include not only content choosing, but also implementation and delivery plan

in details, such as the roles of environmental/technical planning and instructional design [33]. The actionable implementation plan, with specific content and presentation styles, are therefore prepared for online learning and teaching practice. The outcomes are timely assessed with the assumed criteria. Based on the feedback and evaluation results, the course design and implementation plan will be tuned in a dynamic way, as shown in Figure 3.

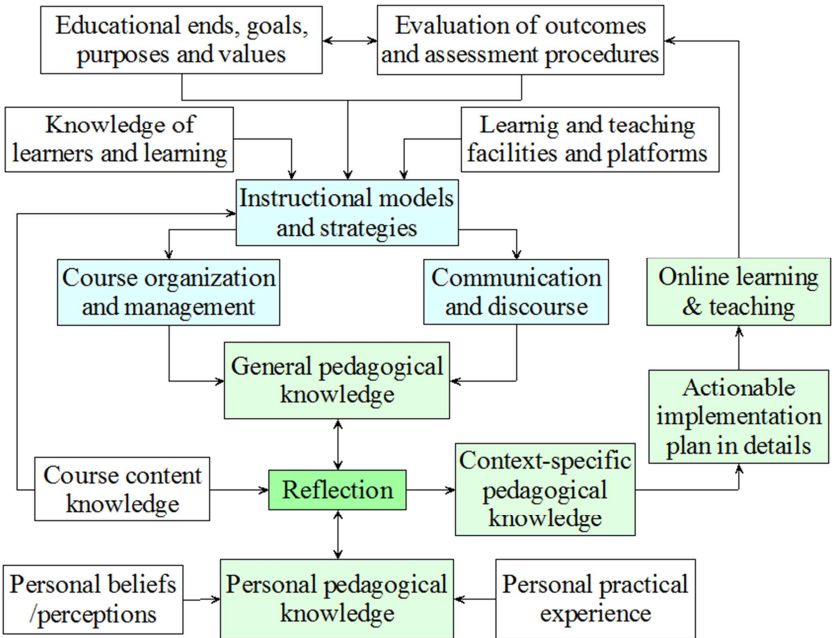


Figure 3. Factors and their relationship to online learning and teaching procedure in terms of course preparation.

4.2. Online Class Management

Effective discussion must have a specific topic, which is

previewed by students following carefully setting tasks and questions. And then students would actively discuss and engage in interactive, social, and experiential learning. It is

similar to Flipped Classroom teaching mode. Its success is based on students' abilities, efforts, and active participation. It is vital to activate students' subjective initiative, such as through process based assessment, students' participation in design, and joint construction between teachers and students. There need more opportunities for students' daily communication through various online and offline platforms to promote teacher-student communication. The commonly used approaches include instant feedback system, virtual teaching and research room, and process based assessment.

We are in a virtual meeting room during online learning and teaching. Although the lecturing is in front of students through live-stream video, the presentation focuses on the course content under discussion. The screen of the student's online facility is mainly occupied by the course presentation, such as PPT text, picture, sketch through a drawing board or code, video and so on. Students hear teacher's voice but could not see all of the activity and mood. It is difficult to bring teacher's body language into full play, in terms of content indication and mood communication. This is not favorable to impress student's brain being engaged in the learning process. In face-to-face in classroom, teachers are guided by their pedagogical abilities when interacting with students [34], such as by gaze, gesture, facial expression and physical actions. Positivity and emotions are important focusing factors in higher education [35].

Learning in an online class is far less interesting than watching movies for entertainment. Continues online classes make people prone to tiredness. How to manage the online teaching, such as in terms of time schedule and teaching units, is vital to keep the students' attention. For example, although multimedia are helpful to learning journey [34], the key cognitive processes in learning, namely selection, organization and integration of information, are linked to learners' eye fixation duration [36]. This implies how to design the course content presentation style and rhythm. The traditional rhythm in teaching should be tuned in terms of time schedule and learning activity. For example, it is generally right that the same style content will not last more than 15 minutes. We need change in performance, presentation style, mode or activity, with an interval of about 10 minutes.

4.3. Effective Interactions

One of the misconceptions in online teaching is to use the same materials and implementation style with face-to-face education [33]. The learning and teaching process would be ineffective if there is lack of effective interaction among students and the instructors.

The subject of learning is students. Effective learning is closely related to student introspection and reflection on the available information and learning materials. Instructors could not observe and follow the students' internal learning processes [37] and the learning progress, knowledge and competencies are built by the learner itself [38]. The teachers have the responsibility of guiding the students how to acquire course knowledge language, providing learning platform and materials. However, instructors cannot prove a causal

connection between learning offers and effective learning processes [37]. The practical role for instructors to play is try to strengthen the learning and teaching relationship, and the effectiveness in students' knowledge accumulation and capacity development.

The impression separated ordinary information in brain readily disappears unless it is consolidated with additional stimulation. For example, we could present a lecturing in in terms of text and voice, in conjunction with picture, sketch or video, to strengthen the learner's impression. In general, learners can pay more attention and hold it for longer period of time to visuals [37]. On the other hand, it is to make a reflection during learning, such as through learning autonomously and using self-assessment. The feedback from instructor's during office hours and by emails are identified as effective student-teacher interaction [32].

It is always helpful providing motivation in online teaching in terms of instructors and students perceptions [32]. For example, students would response actively to teachers' instructs, if they are encouraged such as receiving positive responses from their instructors or partners in a group work or discussion. Course-based learning community involved by students and teachers on social media can provide social, technical, and pedagogical support for learning designs [1].

4.4. Tuning Timely

As the above-mentioned, it is vital to adjust course implementation plan, especially at the beginning stage of the online teaching in terms of the facilities and platform choosing, adaption of presentation style and communication. There needs quickly shifting from traditional face-to-face classroom mode to online learning and teaching. In brief, it is necessary to tune the existing course design and implementation plan to adapt to the online teaching.

At the beginning, the online teaching was to meet an urgent need. Both teachers and students need to get used to the learning and teaching environments. Teachers made a hasty preparation for the online teaching. Since it was not well-designed and improvement needed during application in practice, especially with the features of online teaching under consideration. The course design and implementation plan should be timely tuned in responding to the results of assessments, as shown in Figures 2 and 3. The improvement would be before, during and after a semester in a dynamic way.

On the other hand, students play indispensable roles in an effective online teaching process, especially in terms friendly and effective online learning community building. The feedback from students would stimulate adaptation of the existing course implementation plan in a specific way.

4.5. Implication for the Future

Although the online teaching is mainly based on traditional learning and teaching mode at the beginning, the well-developed digital infrastructures provided preconditions for the swift adaptation from face-to-face classroom to fully

online mode. This transition are also related to the favorable policies, regulations and norms for student and faculty online communication, access to online resources, as well as the platforms from government, institutes, free-shared internet and enterprise resources. In general, the online teaching could be rapidly progressing in improving, such as through performance assessment, monitoring and quality assurance [37]. The practice experience is helpful to the future standard of online learning.

The online teaching practice implies great potential of making change in education under this digital era. We need try something new which is not be well-recognized by educators. On the other hand, it is right following student-centered principle in any teaching activity. Therefore, we should accept the increasing risk to low satisfaction in new mode. It is important to build a nurturing and positively communicating culture among the involvers. For example, considering a teaching mode is generally led by instructor, it is necessary to build a trusting environment where faculty have no increasing risk for the trying not being well-received by students [32].

5. Conclusion and Recommendation

Based on the online teaching practice of the course Tunnel Engineering during the COVID-19 pandemic at Chang'an University in China, the following conclusions can be drawn:

(a) The online teaching is challengeable to both instructors and students during the COVID-19 pandemic. Thanks to the nation-wide digital infrastructures, social internet platforms, institute and personal facilities, the hasty adaptation from traditional face-to-face classroom teaching to online mode is quick and effective.

(b) The major challenges of the teachers are to perform the multiple roles of content expertise and presenter, student work assessor, online teaching procedure facilitator and manager.

(c) To adapt to the online teaching environment, the course design and implementation plan should be delineated with specific content and presentation styles and be timely tuned in responding to the assessment of teaching outcomes and students' feedback.

(d) Friendly and effective course interaction community is vital to the effectiveness of the online teaching, in which students play multiple roles of learner, presenter and respondent.

(e) The online teaching practice implies great potential of making change in education under this digital era.

Considering the well-built digital social infrastructures and the availability of personal digital facilities, it is beneficial to take advantage of the experiences obtained from the online learning and teaching by both the nation-wide instructors and students, respectively. The following research items are recommended for the high education conventional major course teaching in the post-pandemic era.

(a) What are the favourable presentation styles for conventional professional course learning and teaching in

this digital era?

(b) How to make use of the online communication platforms and networks to optimize the extracurricular interaction mode between students and instructors to improve students' learning effectiveness.

(c) What are the additional basic performance indicators needed to guide both instructors and students to effectively adapt to the teaching and learning challenges when internet resources are increasingly blended in education?

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