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Research Paper

Engaging first-year engineering students in hybrid/blended teaching and learning activities

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Abstract. Prompted by social distancing regulations during the COVID-19 pandemic, this study engaged first-year engineering students in hybrid/blended teaching and learning activities at The Hong Kong Polytechnic University. By adopting hybrid/blended learning approaches we aimed to enhance students' engagement and accomplish the intended learning outcomes in a flexible yet interactive learning environment. Basic concepts of Civil Engineering and Sustainable Development were introduced in the physical/digital classroom, where lectures were augmented by real-world examples. Interactive online discussion on crucial environmental and engineering issues was facilitated by course instructors and tutors with relevant expertise. Student-directed activities were emphasized to create an appropriate environment for students' constructive and connective learning. Students' perceptions regarding hybrid/blended teaching and learning approaches applied in this course were evaluated qualitatively and their feedback was collected through an institutional questionnaire survey. Survey results indicated a high satisfaction of the participating students regarding the course design, learning experiences, available resources, teaching arrangements, etc. Notably, students highly appreciated the encouraging and flexible approach of course instructors/tutors who stimulated their interest and motivation in self-directed learning and helped them to realize valuable learning experiences. Students' positive perceptions in this course suggested that hybrid/blended learning approaches can be a fruitful strategy in higher education with potential integration into future curriculum design.

Keywords: Higher education, hybrid/blended teaching pedagogy, face-to-face instruction, distance learning, digital classroom, COVID-19.

INTRODUCTION

The unpredictable global crisis during the COVID-19 pandemic challenges our society in different aspects. In particular, a significant disruption in teaching and learning activities is prevalent around the world and people have to comply with the essential social distancing regulations. Face-to-face lectures, interactions, and learning activities are restricted for a considerable period due to pandemic control, which unavoidably compromises educational advancement worldwide. To resume teaching and enhance students' learning, educational institutes have adopted online and distance education that provides a realistic solution for teaching and learning activities through digital platforms when face-to-face interactions are restricted. Distance learning approaches may facilitate continuity in education and foster us to adopt flexible learning approaches in view of challenging situations.

Web-based distance learning was gaining momentum around the globe in the last few decades, and due to the COVID-19 pandemic, it has become an integral part of higher education. However, implementing online and

distance learning exclusively might affect students' learning experiences due to decreases in interactions between teachers and students, and among peers to some extent. Lacking sufficient interactions might adversely influence students' motivation and engagement during the learning process, especially for first-year students who are yet to adapt to the learning environment at the university level (Lorenzo-Lledó *et al.*, 2021; Potra *et al*., 2021). Under this circumstance, impactful learning experiences might not be realized as expected, which could be critical for the prospective careers of students. Therefore, a hybrid/blended teaching and learning approach combining both distance learning and face-to-face instructions with relevant learning activities might be a potential strategy to engage students in their studies and make their learning process effective for achieving meaningful learning experiences (Li *et al*., 2021).

Overview of hybrid/blended teaching and learning approaches

Hybrid/blended teaching and learning activities refer to a mixed approach that combines conventional face-to-face instructions and web-based distance learning. "Hybrid learning" and "blended learning" are often used interchangeably (Koohang and Durante, 2003). Blended learning was defined by Garrison and Kanuka (2004) as the "thoughtful integration of classroom face-to-face learning experiences with online learning experiences". Online education is highly attractive in terms of flexibility and control regarding time, location, and work-life balance. Moreover, it can accommodate a large number of students. Nevertheless, remote learning has shortcomings owing to limited student-teacher interactions and lack of support for practical skill development. By contrast, in traditional classroom settings, it would be challenging to accommodate the growing number of students every year in various disciplines. The hybrid/blended instructional model merges traditional classroom settings and on-site activities that require the physical presence of the teachers and students with remote learning through digital platforms in order to extract the best of both methods (Nielsen, 2008; Singh *et al*., 2021).

In a hybrid/blended learning environment, the role of course instructors/teachers would require considerable skills shift between online and in-person instructions/activities. In the online classroom, instructors may deliver the course lectures, provide students with verifiable learning resources, and facilitate online group discussions, etc. In comparison, during face-to-face activities, instructors would devote considerable effort to enhancing students' engagement and practical skills through nurturing student-teacher interactions and peer-to-peer communication. Therefore, the blending of two different learning environments creates unique challenges for the course instructors in designing and accomplishing meaningful learning activities (Hung and Chou, 2015). Facilitating a hybrid/blended learning environment can be particularly challenging in the case of designing a student-centric learning environment and strategies instead of a traditional teacher-driven one, which needs to maintain the right balance of teacher and student control over the learning process (Kallick, 2017). Designing interactive online learning activities is essential for implementing hybrid/blended learning successfully while in-person learning activities should be planned carefully to achieve maximum benefits regarding students' engagements and practical experiences. Furthermore, a problem-based learning environment could be incorporated to encourage students to develop problem-solving and critical thinking skills to cope with complex situations in the real world.

Potential benefits of hybrid/blended learning

Hybrid/blended learning is a holistic pedagogical approach that integrates online instruction and in-person learning to make the best of both environments. It could be highly beneficial in enhancing students' understanding and retention of the course contents, which is usually the topmost priority for both the course instructor and the students. "Hybrid courses allow for flexibility and choice in pedagogical strategies that work best in face-to-face and online environments. For example, the face-to-face environment allows for more spontaneity and immediate feedback, while online allows for more reflection, critical thinking, recollection, and conceptualization" (Skibba and Ndon, 2006). Instead of exclusive distance learning, hybrid/blended learning could offer students ample opportunities to obtain hands-on experiences through 'learning by doing' activities. It can incorporate diverse learning theories and pedagogical strategies that include active learning, collaboration, and meaningful connection, which could be conducive to realizing the intended learning outcomes.

Study scope

In this study, hybrid/blended teaching and learning approaches were applied to engage first-year engineering students at The Hong Kong Polytechnic University. It was an introductory course that offered a theoretical foundation and applied perspectives in the field of Civil Engineering and Sustainable Development. This course combined online lectures and seminars with supervised field trips (Figure 1) that involved face-to-face interactions in groups complying with the existing COVID-19 regulations, and it did not compromise the necessary aspects of face-to-face

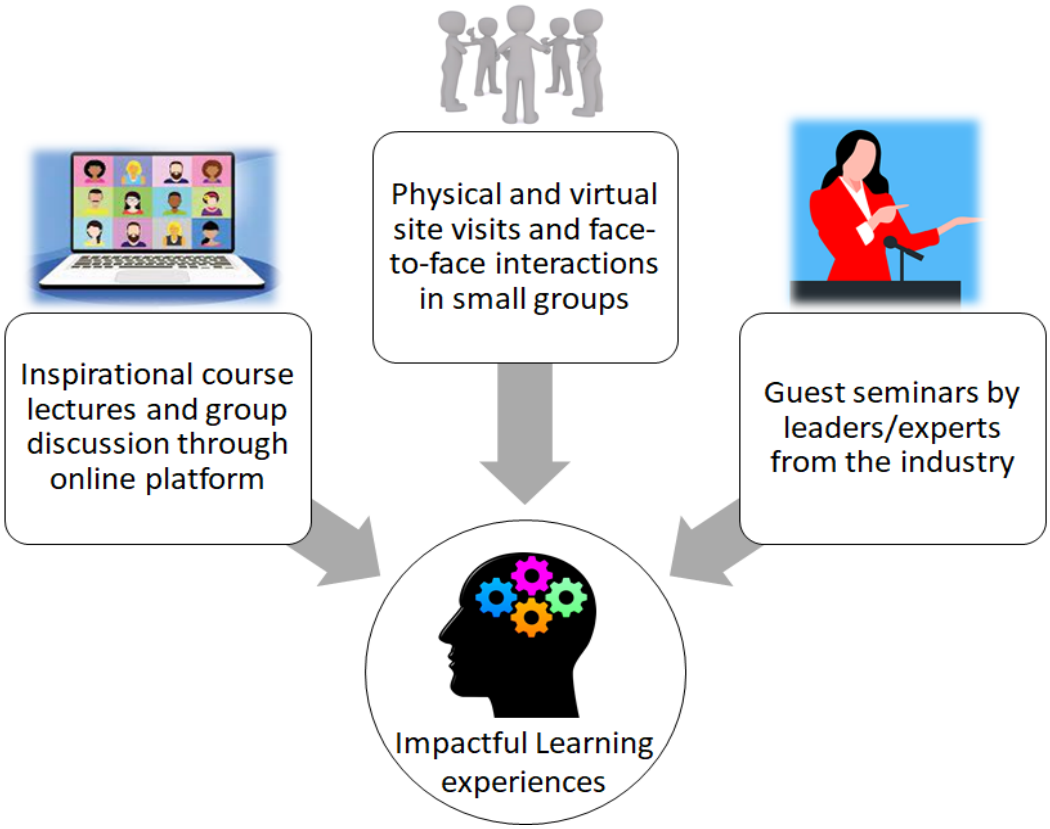

Figure 1. Hybrid teaching and learning approaches adopted in this study.

instruction/activities required for knowledge building and essential skill development during the course.

The objectives of the hybrid/blended approach were to engage first-year engineering students with:

(i) diverse cultural backgrounds, who may not be familiar with Hong Kong, and its unique settings of environment and infrastructure;
(ii) different academic backgrounds, who may not be familiar with various disciplines of Civil Engineering and what to expect in the 4-year curriculum during the study period;
(iii) different needs and strengths in learning, *e.g.*, face-to-face compared to online learning; lecture delivery compared to self-paced knowledge search; classroom learning compared to field activities.

METHODOLOGY

Implementation of hybrid/blended teaching pedagogy

The hybrid/blended teaching and learning activities were designed and implemented for a first-year undergraduate engineering course, "CSE1000: Introduction of Civil Engineering and Sustainable Development". In total, 162 first-year university students attended this course in the semester of this study. At the beginning of the course, the contents, hybrid approaches, expected learning outcomes, and evaluation criteria were well explained to the students for their better understanding and preparation. During weeks 1 to 6, interactive and inspirational lectures were delivered through the online platform by three different instructors who had proven teaching excellence and considerable academic expertise in their respective fields. These lectures introduced different engineering and environmental concepts to first-year engineering students through a student-centric learning environment. The online class also facilitated interactive group discussions and provided them with additional ideas about the study environment and expected opportunities during their four-year undergraduate study. During this period, three different assignments were designed by the instructors to arouse students' interest in diverse engineering and environmental issues, with the hope to trigger their self-motivated learning behavior, which could help them develop problem-solving and critical thinking skills. Moreover, guest lectures by the leaders and experts from the industry were organized during weeks 7 to 8 to enhance students' understanding of the practical development of Civil

Engineering and Sustainable Development. During weeks 9 to 13, physical site visits including virtual technical tours in (i) Plover Cove Reservoir and Lung Mei Beach, (ii) High Island Reservoir and UNESCO Global Geopark, and (iii) the university campus with architectural/structural features were arranged to provide the students with exposure to what they have learned during online lectures. Supervised technical tours and face-to-face interactions were organized in small groups considering the existing pandemic situation. Technical tours focused on the development of students' appreciation of the unique natural/built environment and geological features in Hong Kong, and how engineering technologies/solutions could be applied for environmental and structural enhancement. The site visits were supplemented by an online platform (Microsoft Teams) for live communication, video illustration, verbal explanation, and interactive activities during the site visits. Relevant videos from the government and industry were shared to enhance students' understanding of the history and rationale for the infrastructure development of the target sites. Further details regarding hybrid/blended learning activities and the augmentation of students' learning ability through the designed approach will be discussed in the next section.

Students' feedback and learning experiences

Students' perception, acceptability, learning experiences, and adaptation to the hybrid/blended teaching and learning approaches were evaluated qualitatively during the online lessons and face-to-face learning activities. In addition, students' feedback was collected through an institutional questionnaire survey (online) focusing on the following points: (i) learning experience of the subject, (ii) achievement of learning objectives/outcomes, (iii) learning facilities and teaching arrangements, and (iv) teaching of the staff members. Students were asked to rate their feedback in response to the specified questions on a scale of 1 to 5, where 5 = Strongly agree, 4 = Agree, 3 = No strong view, 2 = Disagree, and 1 = Strongly disagree. A mean score was calculated for each question included in the student feedback questionnaire, reflecting the overall feedback of the students on a particular category.

RESULTS AND DISCUSSION

Teaching and learning activities in the digital classroom

The online lectures, learning materials, assignments, and face-to-face activities (technical field trips) were carefully designed to accommodate the diverse needs of the students and promote impactful learning experiences. In the digital classroom, three-course instructors with different expertise introduced the basic and core concepts of Civil and Environmental Engineering through inspirational lectures and facilitated student-driven online group discussions. Moreover, assignments on the selected topics were conducted by students as a core part of their assessment in this course. The pedagogical instructions and learning objectives incorporated the principles of various learning theories simultaneously, *e.g.*, constructivism and connectivism (Ertmer and Newby, 2013; Siemens, 2017), to enhance students' engagement toward self-directed learning and to develop their problem-solving skills and critical thinking. Constructive learning implies that the learning process is specific to students' personal learning environment and they can construct knowledge based on their past experiences. "The principle of constructivism positions students as active knowledge seekers and co-creators who organise new relevant experiences into personal mental representations or schemata with the help of prior knowledge" (Yew and Goh, 2016). The subject assessment particularly focused on the evaluation of students' enhancement regarding knowledge building and skill transfer, *e.g.*, whether they could construct knowledge based on previous experiences, connect new ideas and information, and apply what is learned to solve new problems in different circumstances similar to real workplace situations.

The inclusion of real-world problems complemented theoretical learning, which made the course informative and engaging for students. For instance, basic concepts of structural engineering and fire safety engineering were introduced at the beginning of this course through the online classroom. Motivational lectures with real-world examples were delivered to trigger students' interest in relevant topics (Figure 2). One such topic was modular integrated construction (MiC), an innovative method used for off-site prefabrication and assembly of structural components and subsequent on-site installation. MiC could significantly reduce the duration of and manpower for construction processes, which could be highly productive and efficient for structural development. For instance, at the beginning of the COVID-19 pandemic when China suffered from space unavailability in healthcare facilities, MiC was used to construct two specialty field hospitals for quarantine and treatment of patients with confirmed infections, which required just over a week to complete the whole construction process. Case studies on MiC applications in different parts of the world were discussed during online classes. Subsequently, students were required to conduct an assignment to analyze the given case studies and explain the functions, prospects, and constraints of MiC and fire protection measures that should be implemented, respectively. As observed, students were positively benefitted from motivational lectures and intrigued to learn more about

Figure 2. Snapshots of online lectures and assignment on structural and fire engineering.

relevant issues on emerging technologies. Analyzing case studies helped to improve their understanding through active engagement and self-directed learning.

Further, this course introduced the concepts of environmental engineering and sustainable development in the digital classroom. Crucial and emerging issues such as environmental pollution, climate change, carbon neutrality, waste management, biodiversity, etc., were discussed by demonstrating relevant case studies and the latest policy drivers. The interactive discussion was conducted through the online platform regarding the current standing on local and global concerns and engineering applications for combating environmental problems. A focal point of discussion was about promoting sustainable development that should make the best way out for the environment and society through integrating environmental protection, economic growth, and societal advancement. During the remote learning period, special emphasis was placed on student-centric pedagogical approaches, where students were allowed to have control over their learning process while the teacher acts as a facilitator. Constructive and connective learning theories were applied actively for promoting students' self-directed learning behaviour to explore further contemporary environmental issues that were discussed in the online classroom (Figure 3).

A problem-based assignment was conducted as a part of the summative assessment in the course. In the online classroom students were introduced to three different environmental policies adopted in Hong Kong (Figure 3), *i.e.*, (i) Clean Air Plan 2035; (ii) Waste Blueprint 2035; and (iii) Climate Action Plan 2030+. Consequently, they were asked to form a team of two and shoot a 10-min video presentation where they should evaluate one of the above three local policy documents and compared it with overseas practices. Students created informative and interesting videos (Figure 4) that demonstrated their original understanding and higher-order thinking about different environmental policies as well as the ability to critically compare different practices in various municipalities. This problem-based assessment stimulated their thoughts beyond the online lectures and triggered their intrinsic curiosity to explore relevant information, through which the students could enrich and

Figure 3. Snapshots of online lectures and assignment on environmental engineering (EPD, 2021).

deepen their professional knowledge. A significant increase in students' enthusiasm and self-directed learning ability was obvious and evident after conducting the video assignment, as they could feel a strong sense of purpose and their constructive and connective learning could be intrigued through the problem-solving tasks.

Later in the course, students were introduced to the concepts of geotechnical and hydraulic engineering by depicting the relevant history of construction and discussing case studies of major geotechnical and hydraulic engineering projects in Hong Kong and other parts of the world (Figure 5). One such case study was about the 200-year construction history of the tower of Pisa in Italy, which is a classic example of foundation failure, inclined considerably due to an unstable foundation. Another case study discussed in the online classroom was Big Ben in London and its response during the construction of the nearby Jubilee line extension. Moreover, students learned about slope upgrading works that reduced landslide risks in Hong Kong. Another illustration of local hydraulic engineering application was the construction of a gigantic underground stormwater storage tank, with a capacity of 60,000 m^3, beneath the existing Happy Valley Recreational Ground, which temporarily stores excessive stormwater during heavy rains before discharging to the downstream drainage system. This is a perfect example of a sustainable urban drainage system demonstrating an innovative design that mitigates flood risks as well as facilitates water reuse. These state-of-the-art examples of geotechnical and hydraulic engineering applications attracted considerable attention from the students and prompted discussion on the frontier of engineering applications. Furthermore, students worked on a relevant assignment where they should choose one of the case studies discussed in the online classroom or any other infrastructure project with significant elements of geotechnical and/or hydraulic engineering, and outline the following points in 500 to 1,000 words: (i) background of the project, (ii) significance of the project, and (iii) lessons learned from the case study. Students explored more on these issues from different sources such as relevant websites, books, journals, etc., and expressed their

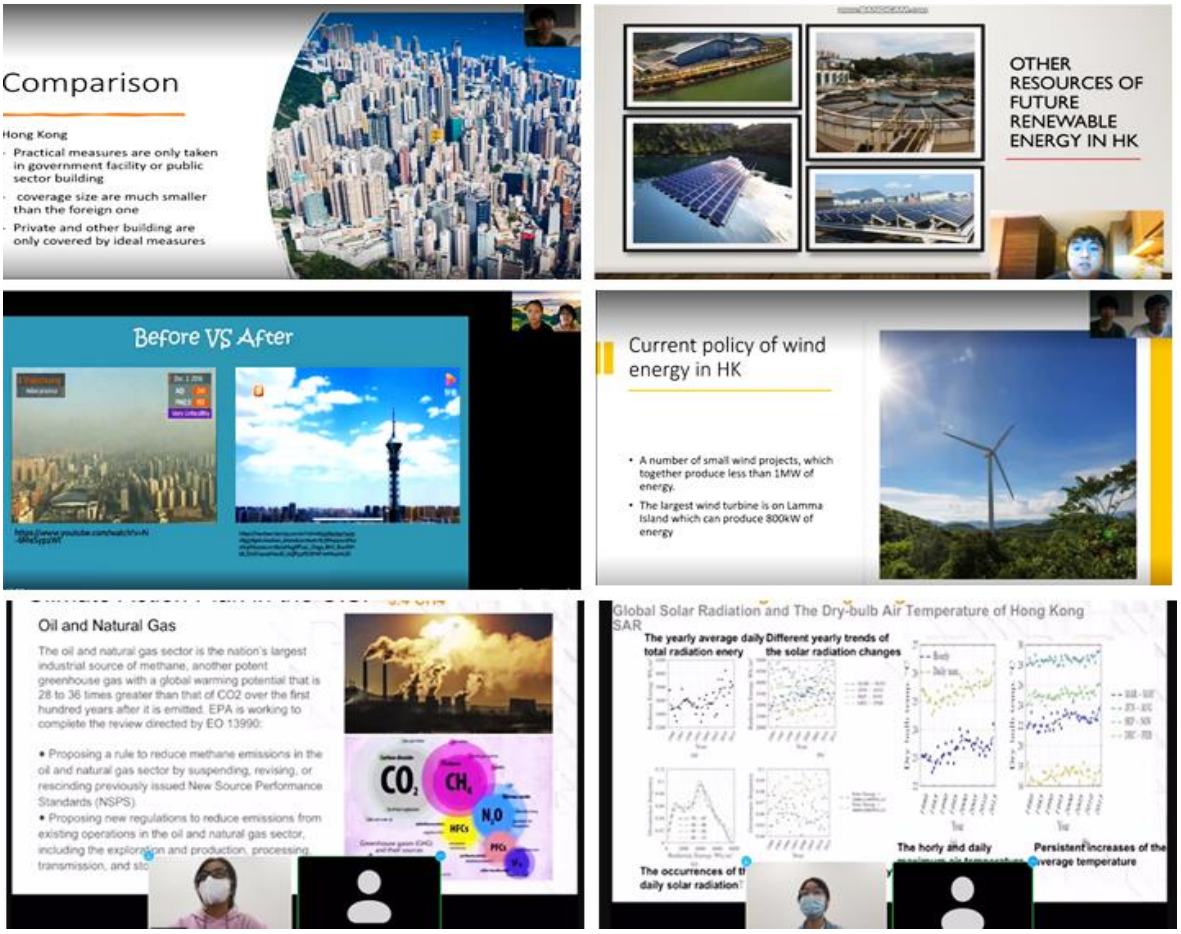

Figure 4. Snapshots of students sharing their video presentation assignments on environmental engineering topics during the course.

thoughts and analysis that improved their critical thinking ability.

Apart from the online lectures delivered by course instructors, several guest seminars were organized in which the local experts and leaders from the industry and different institutions shared their experiences regarding real-life designs and applications, discussed environmental and engineering innovations, and encouraged the students to be engaged in learning about regional and global issues. Knowledge sharing by the experts captivated students and helped inspire their interest in relevant topics. Students could get ideas and insights about complex and ill-structured scenarios in the real world and learn how to better prepare and equip themselves for future careers.

Face-to-face learning activities through technical tours

Compared to exclusive online/distance learning, hybrid/blended learning was highly beneficial to augment active learning, collaboration, and meaningful interactions between teachers and students and among students themselves. Supervised technical tours and field trips organized in this course provided ample opportunities for interactive face-to-face discussion and field observation that enhanced students' practical experiences and genuine interests. Facilitated by course instructors and tutors, the students observed in person and learned about engineering applications and unique geological features of Hong Kong, where they could relate their learning from the digital classroom to actual scenarios. To ensure effective learning experiences, students were divided into multiple groups of 30-60 persons per group including students, teachers, and tutors.

The first technical tour was organized at Plover Cove Reservoir and Lung Mei Beach (Figure 6). Plover Cove Reservoir is renowned for its magnificent dam, which is the largest water storage facility inside Plover Cove Country Park in Hong Kong. It is the longest dam in Hong Kong and the greatest structure of its kind, measuring 2 km in length

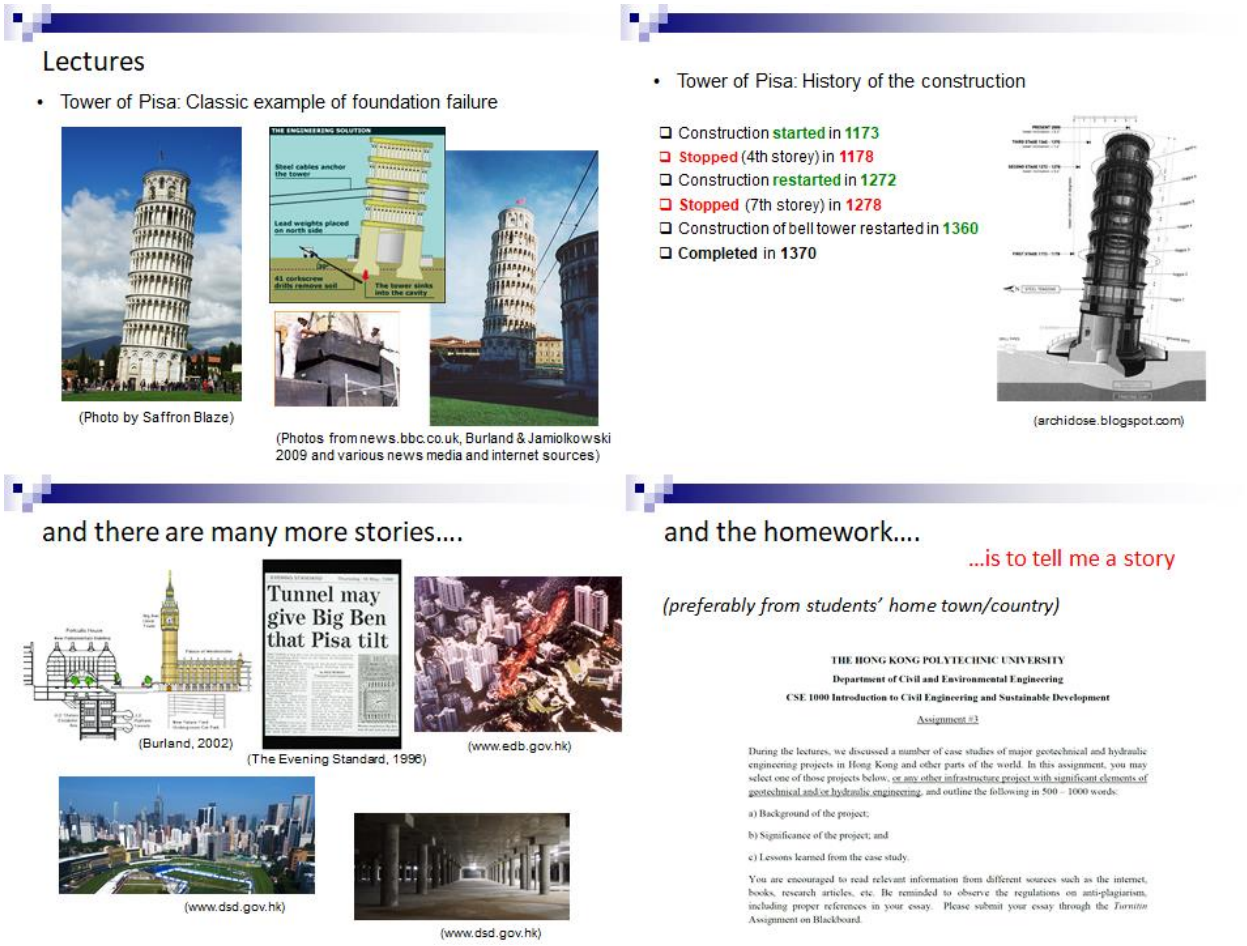

Figure 5. Snapshots of online lectures and assignment on geotechnical and hydraulic engineering.

and constructed over 24 hectares of land. Lung Mei Beach is the first man-made beach in Hong Kong, which was constructed by adopting the principle of "Conservation before Construction". The beach and surrounding facilities were prudently designed and constructed to provide excellent services for visitors while preventing pollution and protecting the local environment and ecosystem at the same time. A detailed ecological survey was conducted before construction and mitigation measures were implemented for the affected marine organisms to minimize the impact on marine ecology. Observing this practical model during the field trip helped students to understand the contribution of engineering applications to the betterment of the community and the environment. Notably, the site visits were concurrently supplemented by additional information and relevant videos together with live communication and explanation that were shared on the online platform (Microsoft Teams) during the trips, which further boosted students' overall learning experiences.

The second technical tour was arranged in the High Island Reservoir East Dam and UNESCO Global Geopark (Figure 7), located in Sai Kung East Country Park, Hong Kong, which is famous for its scenic beauty and has been a popular attraction among local and international tourists. During the construction of the reservoir, earth materials were extracted from the cliffs around the East Dam, and the excavation work revealed globally rare acidic volcanic hexagonal rock columns that were formed about 140 million years ago as a result of a massive volcanic eruption. The main focus of this field activity was to expose the students to special geological features in the UNESCO Global Geopark and elucidate the historical and cultural context of the dam construction, which was a good opportunity for first-year engineering students, particularly non-local students who came to Hong Kong from different countries and diverse cultural background to know about the unique geology and development in Hong Kong. Furthermore, students learned the importance of considering distinct geological features for the future planning and development of infrastructure, which enriched their engineering knowledge and holistic thinking.

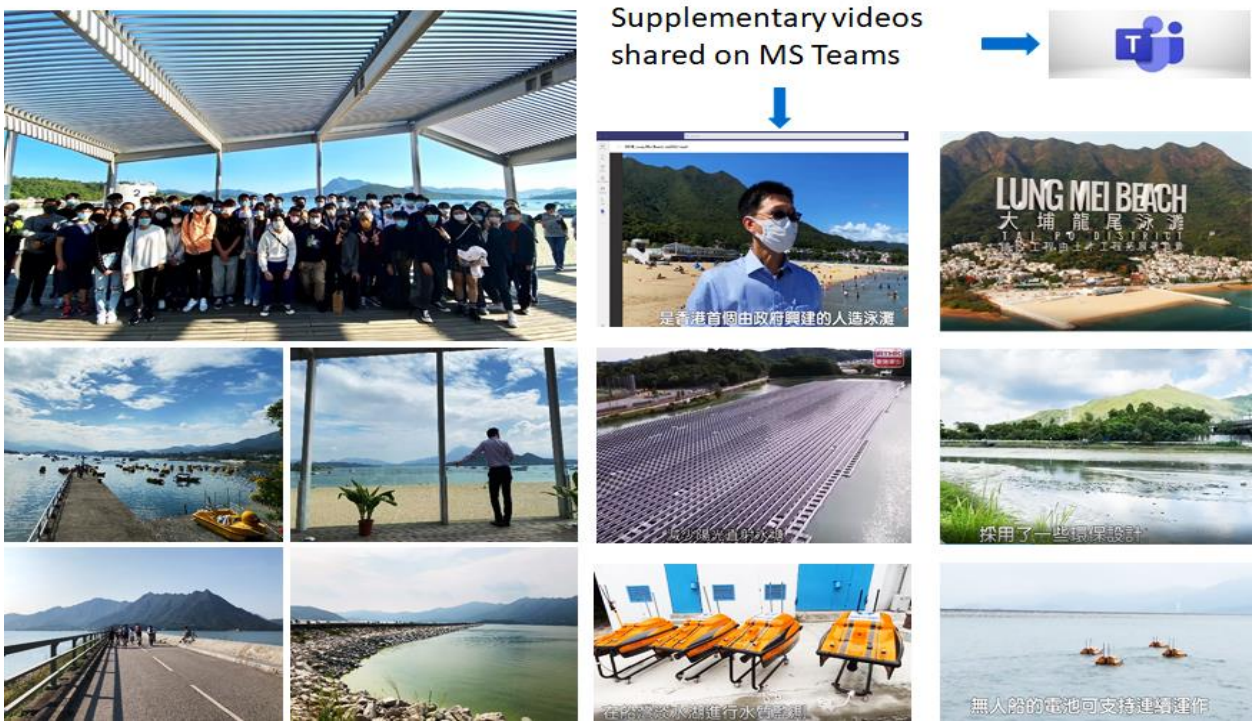

Figure 6. Technical tour in Plover Cove Reservoir and Lung Mei Beach demonstrating engineering applications adopting the principle of "Conservation before Construction".

Students highly appreciated the organization of such technical tours as they could attain some valuable experiences on the special geological features in Hong Kong. For instance, a non-local student commented that "I have always been impressed by skyscrapers in HK, but never knew the natural environment is so beautiful".

Later, an on-campus site visit was arranged at The Hong Kong Polytechnic University featuring the state-of-the-art architectural designs of buildings and structures (Figure 8). Through face-to-face interactions with the course instructor, students learned about the building materials, structural planning, design, and diverse aspects of structures including technical, economic, environmental, aesthetic, and social aspects. Most importantly, they learned about how to ensure the strength, safety, and resilience features of the structures that should be maintained to execute their intended functions in the long term. The technical tour was very helpful for students to reflect on their learning in the digital classroom and stimulate students' thoughts for future planning and construction of safe and efficient structures.

Students' feedback and learning experiences regarding the hybrid/blended teaching pedagogy

The institutional questionnaire survey reflected the students' feedback regarding the hybrid/blended teaching and learning approaches implemented in this course. The mean scores for different feedback categories ranged approximately from 3.9 to 4.2, which is promising and indicated effective implementation and students' recognition of the hybrid pedagogical approach. The majority of the students agreed that they had a clear understanding of what was expected to learn from this subject (mean score 4.1) and recognized that the teaching and learning activities (*e.g.*, lectures, discussion, case studies, assignments, presentation projects, site visits, etc.) helped them to achieve the intended learning outcomes (mean score 4.1). The course assessments required the students to demonstrate their knowledge, skills, and understanding of the subject (mean score 4.1), which reflected students' improvement in the constructive learning environment.

Most of the students (85%) acknowledged that the workload for this subject has been appropriate relative to the intended learning outcomes, suggesting that the design of course contents, continuous assessment, and learning activities were suitable to accommodate the diverse needs and abilities of the students with different academic and socio-cultural backgrounds. The contents and design of this course fostered them to develop a better understanding of the basic concepts in the field and various study options under the broad discipline (mean

Figure 7. Technical tour arranged in High Island Reservoir and UNESCO Global Geopark featuring unique geology in Hong Kong and history of the dam construction.

score 4.1). The learning activities aroused their interest in studying relevant environmental and engineering issues around the world. Nevertheless, some students might need additional guidance and mentoring for improving their active engagement and self-directed learning behaviour (mean score 3.9).

The students appreciated the learning facilities and systems provided by the university, which were adequate to support their study in this subject. Their feedback was satisfactory regarding the teaching arrangements for the subject, which provided them with appropriate learning experiences and adequate opportunities to interact with course instructors (mean score 4.1). Notably, the students were highly satisfied with the course instructors' organization and delivery of the course contents under the current setting (mean score 4.2). Timely feedback and after-class help provided by the teachers were very useful to enhance their learning experiences in the hybrid/blended teaching approaches. Moreover, the students valued the indispensable role of teachers in stimulating their learning interests in diverse issues and creating an impactful learning environment. Some interesting and useful remarks from the students are quoted below.

For instance, one student commented, "I learned different knowledge in Civil Engineering, which helped me to understand more on relevant topics." Another student commented, "The introduction of environmental protection

Figure 8. Technical tour conducted on the university campus with architectural features providing an opportunity to learn about important aspects of structural engineering.

practices during online lectures stimulated my interest in learning more about Environmental Engineering." The students highly appreciated the course instructors for their flexible attitudes and excellent lecture delivery and communication skills while maintaining a comfortable and constructive atmosphere that encouraged students to perform well and enrich their learning experiences. Communication and synergistic collaboration among students, instructors, and professionals positively influenced the students' intrinsic motivation and knowledge-building in this study. These observations are in line with the findings reported in previous studies on hybrid/blended learning (Arbaugh, 2014; Kintu *et al.*, 2017).

When asked about the "most useful aspects" of the hybrid/blended teaching and learning activities, one student replied that "site visit was the most useful part for my learning, (where) I learned more deeply about different aspects of Civil Engineering". Another student commented that "the explanation and questions given by the teacher were thought-provoking, which helped me a lot in my learning". Considering students' reflections and positive feedback on this course, it can be perceived that the hybrid/blended teaching approaches and learning activities implemented were successful in nurturing student-teacher interactions and promoting impactful learning experiences through combining distance learning and face-to-face instructions/activities. This is promising and potentially inspires future designs of foundation courses as well as academic curricula in higher education institutes.

Implications of hybrid/blended learning for prospective course design

The COVID-19 pandemic has taken its toll on our education system, however, it has also created new

opportunities (and necessities) for learning through diverse and innovative methods. Hybrid/blended teaching and learning approaches can be flexible and applicable in higher education without compromising the essential aspects of face-to-face interactions and in-person learning activities. The hybrid/blended teaching approaches can facilitate student-teacher interactions while taking advantage of online learning simultaneously, which can incorporate unlimited learning resources, self-directed learning attitude, and inventive pedagogies. However, the course should be designed carefully considering the course contents, online lectures, interactive group discussion, in-person learning activities, and assessment methods, etc.

Flexibility and interactions are two distinguishable features of hybrid/blended learning, which should be promoted and balanced to foster knowledge-building by the students (Müller and Wulf, 2022). In this regard, our current experiences with hybrid/blended teaching and learning can serve as a useful reference for future course design taking into account the issues discussed above. Particular focus should be placed on developing a connected, deep, and personalized learning environment that can accommodate students' unique learning needs, instead of a disconnected and generalized system for all. A deeply connected and personalized learning environment will nourish students' self-directed learning ability and promote their life-long learning behaviour (Tsang and Tsui, 2017). Designing more student-centric learning activities by incorporating constructive and connective learning theories can effectively bring about the anticipated learning outcomes across different disciplines, which is highly desirable and important for the sustainable development of the higher education system.

CONCLUSIONS

Hybrid/blended learning is increasingly becoming an essential approach during the pandemic situations. The overall evaluation of this study indicated that the students positively perceived hybrid/blended teaching and learning activities, which can be promising for future planning and implementation of such course/curriculum design. To leverage the merits of hybrid/blended learning, the attributes of students should be nurtured carefully by promoting interactions, collaboration, self-directed learning, etc., which would enhance students' learning ability and experiences in the new setting. A higher extent of motivation and interest was witnessed among the students, which could be attributed to the flexible yet effective learning in the digital classroom together with face-to-face activities arranged through technical tours that provided excellent opportunities for students to observe a real-life demonstration of engineering applications. Designing appropriate contents and learning activities as well as awakening students' genuine interest in self-directed learning is essential for the successful implementation of hybrid/blended pedagogic approaches in this study. When designed appropriately, hybrid/blended courses can be highly conducive to enhancing students' learning experiences and realizing desirable graduate attributes and intended learning outcomes in higher education.

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