

Article

Investigating Undergraduate Student Experiences of NEE Courses in Guangdong, China during the COVID-19 Pandemic from 2020 to 2021

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Abstract: New Engineering Education (NEE) has become increasingly important in higher education in China. The COVID-19 pandemic has forced higher education institutions to adopt online and hybrid modes of instruction globally, with Massive Open Online Courses (MOOCs) becoming a primary educational tool. In this paper, we explore the impacts of online/hybrid modes on NEE courses in the context of the COVID-19 pandemic. We hypothesized that the rapid transition to online/hybrid modes may have negatively affected students due to insufficient preparation by teachers. This hypothesis was tested through an investigation involving 787 students conducted in 2020 and 2021. The results indicated that, while most students considered online/hybrid modes a helpful tool for their studies, 28.69–36.74% of participants reported significant issues. Through one-to-one interviews with negative/neutral attitude students, we found that insufficient and burdensome communication/interaction with classmates and teachers was the main contributor to these issues. We conclude by proposing a conceptual path to address the issues raised in the study, as well as offering the obtained results as a critical reference for educational researchers seeking to improve the quality of online/hybrid courses and contribute to the field of education.

Keywords: online/hybrid education; investigation; new engineering education; MOOC



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1. Introduction

The Ministry of Education of the People's Republic of China (MOE) introduced New Engineering Education (NEE) in 2017 [1,2]. NEE focuses on big data, cloud computing, artificial intelligence (AI), blockchain, virtual reality (VR), and other related technologies [3–5]. In particular, the integration of various fields is a defining feature of NEE [6]. NEE courses are required to continue to update their content with the advancement of engineering technologies; however, due to time constraints, the traditional on-site educational mode may be limited in its ability to provide comprehensive coverage of this dynamic and rapidly expanding field. To address this challenge, it is imperative to explore the use of online resources to supplement student learning experiences and facilitate access to frontier knowledge.

Massive Open Online Courses (MOOCs) leverage information technology to offer a hybrid approach to education that combines both online and on-site components [7–9]. MOOCs involve the provision of online courses to help students to learn professional content under a flexible schedule [7]. This mode of education enables students to access a wealth of online resources while providing opportunities for in-person interactions with instructors and peers, helping to better answer their questions and facilitating deeper learning [10,11]. Additionally, online education platforms have the potential to benefit students in developing countries by breaking down geographical barriers and promoting inclusive and equitable access to quality education, which is in line with the United Nations

Sustainable Development Goals (SDGs) [12]. In short, flexibility and affordability are the key features of MOOCs. As a discipline at the forefront of science and technology, NEE has excellent potential to harness the benefits of MOOC-based education and further promote learning through information technology [13].

Before the outbreak of the COVID-19 pandemic, the MOE promoted the use of online platforms, such as iLab-x (<https://www.ilab-x.com/>, accessed on 8 February 2023), in order to increase the availability of high-quality NEE course resources [14]. Through these platforms, students in remote areas can now access and benefit from high-quality educational content [14]. However, online and hybrid education adoption in higher education was mainly limited to small-scale pilot initiatives in most universities before 2020 [15].

The COVID-19 pandemic completely changed the global education mode, forcing most universities to entirely use online or hybrid education [16–18], and most academic staff and students prepared to face online/hybrid education for the first time [19]. Javier has stated that students cannot receive suitable social support for online education in developing countries [20]. Furthermore, Colette has stated concerns regarding inefficient guidance to support home-based learning, which may limit the effectiveness of online/hybrid education [21]. Considering the above research, we assume that there were various challenges and issues related to NEE in China during 2020 and 2021.

The research presented in this paper details a long-term investigation analyzing the study experience in online/hybrid NEE courses in the context of the COVID-19 pandemic (2020 and 2021). The proposed research scope covers a specific region in China (i.e., Guangdong/Zhejiang/Jiangsu). The contributions of this study are as follows:

1. We collected undergraduate student feedback on online/hybrid NEE courses during the COVID-19 pandemic in order to conduct a user investigation with a large number of participants.
2. We obtained user feedback through questionnaires and one-to-one interviews with negative feedback participants. We described the overall quality performance and evaluated potential issues.
3. We analyzed user data and MOOC features in order to propose a conceptual path to enhance the online/hybrid NEE course study experience.

2. Related Work

We first aimed to design a suitable experimental flow to test our hypothesis. Due to the highly numerous universities in China, we narrowed the research scope to specific regions and universities. Here, we detail relevant MOOC resources and analyze their features. Additionally, we briefly discuss the design of a proper experimental flow.

2.1. Research Scope

Guangdong is home to 67 universities and continues to maintain its position as China's most economically powerful province [22,23]. Compared to other developing provinces, Guangdong's graduate students are more closely connected to the job market. In 2016, the Guangdong government introduced the concept of Application-Oriented Undergraduate Universities (AOUUs) in response to the current educational landscape [24], which aims to speed up the integration of professional training [23,24]. The AOOU strategies can help drive industrial transformation and upgrade in Guangdong, revitalizing and developing Guangdong's east, west, and north regions [25–27]. Furthermore, NEE courses are closely connected to industry. Educating suitable new engineering experts to support the industrial transformation has become a significant challenge for AOOUUs [28]. Considering the above background, we decided to investigate AOOU NEE course students in Guangdong as participants and review the overall online/hybrid education performance of NEE courses at AOOUUs during the COVID-19 period.

2.2. Online/Hybrid NEE Courses in AOUIs (Guangdong)

We investigated the online/hybrid NEE courses at AOUIs in Guangdong. The investigation included various AOUI MOOCs, such as those of Guangdong University of Finance, Guangzhou Nanfang College, and Guangdong Polytechnic Normal University [29].

NEE courses, which involve subjects such as VR, data analysis, and other advanced technology courses, typically include project-based learning to assess student effectiveness without requiring traditional exams [30]. According to our investigation of NEE courses in the Guangdong area, 63.50% of NEE courses use experimental project reports for the final assessment. Thus, project-based learning is the usual phenomenon in NEE.

Additionally, the successful completion of a final project often requires the integration of various disciplines. For example, the development of a VR project requires not only coding proficiency but also a thorough understanding of user interface design. Similarly, an AI project should be accompanied by practical web design skills to build a functional online AI platform. Therefore, students should aim to acquire additional professional skills beyond the conventional classroom curriculum. To facilitate this learning, teachers are responsible for guiding students in exploring related disciplines, which may raise questions requiring communication with the teacher.

Considering the above, we may conclude that NEE courses have the following features: project-based, extension study, and project tutoring.

2.3. Design Concept

The COVID-19 pandemic has greatly impacted society and led to an increase in online/hybrid education. Thus, it is necessary to understand the transformation trend of online/hybrid education during this time. Joel has found that a single investigation may not accurately reflect a transformation trend [31]. Compared to a one-time investigation, a long-term tracking approach allows for the collection of data over an extended period, providing a comprehensive and nuanced understanding of the impact of the research subject on society [32]. Thus, we conducted a survey in each year of the study period (i.e., 2020 and 2021), which helped us to clearly identify the remaining weaknesses and challenges related to online/hybrid education.

Through this study, we aimed to identify both the advantages and disadvantages of online/hybrid NEE through a survey. To avoid potential biases and inaccuracies in the collected data, it is necessary to classify participants by their different attitudes. In this context, a branching questionnaire is considered to yield valuable data for the study [33]. Figure 1 illustrates the conceptual flow of the branching questionnaire. The questionnaire comprises two to four fundamental questions related to the overall performance of online/hybrid courses. If the participants return a positive response to all the basic questions, they will be categorized as positive participants. Conversely, they will be classified as a negative or neutral participant. Positive participants were asked to provide insight into the advantages, while the negative/neutral participants underwent one-to-one interviews to gather more in-depth information on the weaknesses.

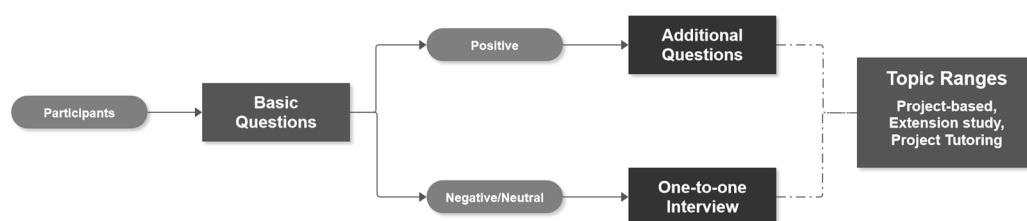


Figure 1. Branching Questionnaire Concept Flow.

We designed the branching questions and interviews based on previous research on the features of NEE courses. For example, the overall perception of team cooperation in project-based assessments, the acquisition of knowledge through extension studies, and the quality of online communication with tutors were considered.

3. Experiment

3.1. Participants

For this study, 787 undergraduate students from AOUUs in Guangdong were recruited as participants. The investigation was conducted in 2020 and 2021. Table 1 provides the demographic information of the participants from various groups.

Table 1. Demographic information of the participants.

	Group A	Group B
Number of Participants	474	313
Average Age	21.36 (2020)	21.08 (2021)
Gender (Male:Female)	235:229	165:148
Background	Undergraduate Students at Guangzhou Nanfang College	Undergraduate Students at Guangzhou Nanfang College and Guangdong University of Finance
Major	Digital Media Technology	Digital Media Technology and Computer Science
Online Study Period	March–May 2020	May–June 2021
On-site Study Period	June–July 2020	March–May 2021 and July 2021

In response to the COVID-19 guidelines issued by the Department of Education of Guangdong Province, higher education institutes in Guangdong suspended in-person teaching at the start of the spring semester of 2020, and they consequently adopted various online educational platforms [34]. In our investigation, we found that only Guangzhou Nanfang College, a member of the AOUUs, allowed its 2017 and 2018 grade students to return to campus for in-person teaching at the end of the spring semester (June 2020) [35]. As a result, the 2017/2018 grade undergraduate students at Guangzhou Nanfang College underwent a hybrid education experience, consisting of online teaching in the first half of the semester and in-person teaching in the second half. Thus, we invited all the 2017/2018/2019 grade undergraduate students studying digital media technology (493 students in total) to participate. We received 474 valid participant feedback responses (96.14%) from this group (denoted as Group A), with which we evaluated their hybrid education performance.

At the end of May 2021, the rapid spread of COVID-19 (Delta Variant) in Guangdong forced many universities to switch to online study [36]. On-site teaching resumed at the beginning of July 2021, after the COVID-19 Delta Variant was under control [37]. Students who suffered from the 2021 online study experience were categorized as Group B. Group B consisted of 313 participants who provided valid feedback, including 161 undergraduate students at Guangzhou Nanfang College (78.15% students from 2018 grade Digital Media Technology Major) and 152 additional students from the 2018 grade undergraduate students (77.55% students in Computer Science Major) at Guangdong University of Finance. Group B was significantly different from Group A, as the participants in Group B had experienced online study twice (in 2020 and 2021) and suddenly received updates in 2021, while Group A followed a smooth transition plan in 2020.

3.2. Experimental Flow

The purpose of the study was to examine the quality of hybrid/online NEE during the COVID-19 period (i.e., from 2020 to 2021), as depicted in Figure 2.

The participants in both groups experienced hybrid/online education during the 2020 semester. Group A was surveyed in July 2020 using a questionnaire about their learning experience. The participants with negative or neutral attitudes toward hybrid/online education were selected for individual interviews to discuss their perspectives. These interviews lasted for a month due to the high number of participants. Group A was not included in the 2021 semester experiment.

Compared with Group A, Group B did not undergo a feedback survey in 2020. They continued with hybrid education during the 2021 semester and completed an online questionnaire in July 2021. The questionnaire for Group B included additional comparison

questions in order to examine the differences between hybrid/online NEE in 2020 and 2021. The participants with a negative/neutral attitude also participated in one-on-one interviews in August 2021. The results of the study were finally collected and analyzed in 2022.

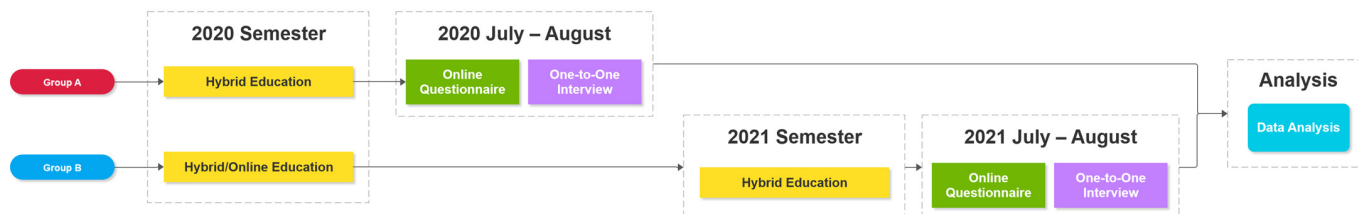


Figure 2. User Investigation Experimental Flow.

3.3. Questionnaire and Interview

The questionnaire form included two fundamental questions asking for overall feedback from the students. Group B were provided with additional questions covering the comparison and future view, as they had more extended online/hybrid study experience (i.e., 2 years). We made each question essential to answer in order to ensure that there was no unfinished feedback. If a student selected positive feedback, they were brought to a branching question asking about the advantages of hybrid/online courses. The team marked the negative/neutral participants and arranged for them to have a one-to-one interview in the next month. Table 2 provides the details of the questionnaire.

Table 2. Details of questionnaire form.

Question Topic	Question Type	Question Detail
Basic Question	Single choice	• Course quality evaluation.
	Single choice	• Acquired knowledge from the online/hybrid courses.
Additional Question in Group B	Single choice	• Do online/hybrid courses have better performance than traditional courses?
	Single choice	• Do you want more online/hybrid courses in the future?
Branching Question (Positive Participants)	Single choice	• Select the advantage of online/hybrid courses.

In the interview, the participants were asked to explain the reasons underlying their negative or neutral feedback on online/hybrid courses. We used a semi-structured interview approach, as this format allows for open discussion and provides ample time for participants to provide in-depth and nuanced responses [38]. This method enabled the research team to better understand the reasons behind the negative or neutral feedback [38]. During the interview, the research team engaged with the participants to explore the limitations and challenges of hybrid/online NEE courses, covering areas such as learning progress in project-based assessments, study questions, and communication. The research team documented their perceived shortcomings and guided the participants to identify the most significant issues.

We then carried out a content analysis to classify and analyze the data collected from the semi-structured interviews. The data were systematically summarized from the participant responses. Based on the interview data, the research team could draw insights and conclusions regarding the disadvantages of online/hybrid NEE courses.

3.4. Ethical Approval

This study complied with all relevant guidelines and regulations. The protocol for this study was reviewed and approved by Guangdong University of Finance, Faculty of Computing, Center of Experimental Teaching.

4. Experimental Results

We successfully collected data from the questionnaire and interviews, and we compared the selection distribution of the different groups through two basic questions. The p -value for question one was 0.1225, while that for the second question was 0.0672. The data indicated that, while there was no significant difference between the two years, there were still some minor differences. Thus, discussing the details of the data on the overall performance of hybrid/online courses during the COVID-19 period is still necessary. The detailed data from 2020 and 2021 are presented in the following sections.

4.1. Data Result (2020)

Table 3 displays the overall view of hybrid/online courses among the Group A participants based on the two basic questions on the questionnaire form. The data indicated that 75.32% of participants had a positive attitude toward the course quality, 17.93% had neutral opinions, and 6.75% had negative views. According to the second question, 71.94% of participants had a positive opinion about the learning knowledge gained through the hybrid/online study, 19.62% had neutral opinions, and 8.44% had negative comments. These results suggest that most participants had a positive attitude toward hybrid/online courses and believed that they can successfully deliver knowledge. However, 24.68–28.06% of participants still had a neutral or negative attitude, necessitating further analysis of the advantages and disadvantages of hybrid/online NEE courses.

Table 3. Distribution of responses to basic questions (Group A).

		Number of People	Percentage
Course quality evaluation	Positive	357	75.32%
	Neutral	85	17.93%
	Negative	32	6.75%
Acquired knowledge from the online/hybrid courses	Positive	341	71.94%
	Neutral	93	19.62%
	Negative	40	8.44%

We selected the participants who selected the positive option for both questions. These positive participants ($N = 338$) were asked about the advantages of online/hybrid NEE. To obtain the maximum number of opinions from participants, they could either select a specific option or type in any comments in the text panel. The detailed options were as follows: online resources and offline tutoring can help to understand knowledge more deeply, independent learning schedule, and an interesting interaction mode between teachers and students.

Table 4 lists the primary reasons why the positive group believed that online/hybrid NEE was better for them. The results show that 54.43% of the participants believed that the mix of online resources and offline tutoring is the primary reason for understanding professional knowledge thoroughly, while 36.09% of the participants believed that the hybrid course is conducive to a flexible arrangement of study time. In the additional option, 5.62% of the participants highlighted that they could watch replay videos from the course. We combined the schedule and replay groups (41.71%), as watching videos should be considered part of the flexible arrangement of a learning schedule. Additionally, 1.77% of the participants selected the interesting interaction mode, while 2.07% indicated the teacher's teaching quality.

Table 4. Details of online/hybrid education advantages (Group A).

		Number of People	Percentage
Advantages of online/blended education	Online resources and offline tutoring	184	54.43%
	Independent learning schedule	122	36.09%
	Interesting interaction mode	6	1.77%
	Better education quality from teacher	7	2.07%
	Can watch the replay video of the course	19	5.62%

According to the views of the participants, the flexibility to arrange the learning time and the combination of online resources and offline tutoring are the main advantages of online/hybrid NEE courses. However, there are a small number of people who preferred blended teaching with better teacher–student interactions. The new mode of online teacher–student interaction is a significant feature of online/hybrid learning; however, students did not seem to agree with this. Hence, the discrepancy between theory and the current state of online/hybrid NEE should be analyzed.

All the negative/neutral participants agreed to join in the interviews. Table 5 presents the results of the interviews with the negative/neutral participants (N = 136). Noting that the considered courses usually require students to complete projects in small groups, the results indicated that 58.82% of participants believed that lacking communication with team members is the most significant issue in online/hybrid education. Additionally, 23.52% of the students felt that the course needs a teacher Q&A session. In comparison, only 1.77% believed that the new model of teacher–student interaction is an advantage of the online/hybrid course, as indicated in the branching questionnaire. As such, optimizing smooth teacher–student/student–student interactions and providing sufficient online Q&A tutoring interaction is an important issue in online/hybrid education. Furthermore, 17.64% of the students stated that the course content lacks a clear connection between online and on-site study.

Table 5. Details of online/hybrid education disadvantages (Group A).

		Number of People	Percentage
Disadvantages of online/blended education	Insufficient communication with team members	80	58.82%
	Lacks teacher Q&A session	32	23.52%
	Not well connected between online and offline	24	17.64%

4.2. Data Result (2021)

In order to better track the effectiveness of online/hybrid education, a second survey was conducted in 2021, with the aim of using comparative measurement to analyze whether online/hybrid education had improved. In July 2021, an investigation was started in Group B (N = 313).

Table 6 displays that 81.15–83.38% of the students positively confirmed the course quality and knowledge acquisition, while 12.1–12.78% held neutral opinions and 4.47–6.07% returned negative comments. Compared to 2020, the percentage of negative/neutral opinions decreased. Therefore, online/hybrid education can be improved in terms of quality with more time for preparation.

Table 6. Distribution of responses to basic questions (Group B).

		Number of People	Percentage
Course quality evaluation	Positive	254	81.15%
	Neutral	40	12.78%
	Negative	19	6.07%
Acquired knowledge from the online/hybrid courses	Positive	261	83.38%
	Neutral	38	12.14%
	Negative	14	4.47%

We asked the Group B participants an additional question, given their two years of experience with online/hybrid learning. Table 7 reveals that, while 81.15–83.38% of participants had a positive view of blended courses, only 66.13% of participants agreed that they are better than traditional classes. Additionally, only 72.52% of students preferred online/hybrid courses over traditional ones. Although 10.67–14.50% acknowledged the positive impact of online/hybrid NEE, they did not believe that it surpasses traditional teaching.

Table 7. Distribution of responses to additional question (Group B).

		Number of People	Percentage
Online/hybrid courses are better than traditional learning	Positive	207	66.13%
	Neutral	62	19.80%
	Negative	44	14.05%
Hope to have more online/hybrid courses	Positive	227	72.52%
	Neutral	58	18.53%
	Negative	28	8.94%

We chose the participants who selected the positive option for all four questions. The positive participants (N = 198) received a question about the advantages of online/blended education. Table 8 lists the primary reasons why the positive group believed that online/hybrid NEE is better for them.

Table 8. Details of online/hybrid education advantages (Group B).

		Number of People	Percentage
Advantages of online/blended education	Online resources and offline tutoring	85	42.93%
	Independent learning schedule	95	47.98%
	Interesting interaction mode	5	2.52%
	Better education quality from teacher	9	4.54%
	Can watch the replay video of the course	4	1.27%

The table indicates that 42.93% of participants believed that the combination of online resources and offline tutoring is the main reason for a thorough understanding of professional knowledge, while 49.25% of participants (including 1.67% who selected the option for watching replay videos) believed that the hybrid course allows for a flexible arrangement of study time. Additionally, 2.52% of participants chose the option for an interesting interaction mode, while 4.54% selected the option for a teacher's teaching quality. Although the percentage of participants who chose the interaction mode had increased from 2.07% to 4.54%, the number remained low. Thus, the need to analyze the discrepancy between online/hybrid education theory and practice was reinforced.

All the negative/neutral participants in Group B also agreed to join in the interviews. Table 9 displays the results of the interviews with the negative or neutral participants (N = 115). The results indicate that 50.43% of participants believed that insufficient communication with team members is the most significant problem in online/hybrid education. In addition, 16.52% of the students thought that the course needs a Q&A session, while 7.83% reflected that, even though a Q&A session may exist, the online platform restricts the ability to present questions to teachers. Thus, optimizing teacher–student/student–student interaction and providing sufficient online tutoring interaction through Q&A sessions remains a crucial issue in online/hybrid education. Additionally, 10.43% of the students reported that the course content needs to be better connected between the online and in-person components, and 14.78% strongly believed that the online course lacks methods to restrict student behavior.

Table 9. Details of online/hybrid education disadvantages (Group B).

		Number of People	Percentage
Disadvantages of online/blended education	Insufficient communication with team members	58	50.43%
	Lacks teacher Q&A session	19	16.52%
	Hard to represent question to teacher	9	7.83%
	The class has no restriction	17	14.78%
	Not well connected between online and offline	12	10.43%

4.3. Data Analysis

According to the investigation, it is significant that most participants (students) had positive attitudes toward online/hybrid education regarding acquiring professional knowledge from related NEE courses. We determined two primary reasons why the undergraduates preferred online/hybrid courses: the self-arranged study schedule and the combination of online resources and on-site tutoring. However, there were also many negative opinions on online/hybrid education. We could conclude through the communicated aspects that the primary weakness was insufficient and burdensome communication/interaction with teammates (classmates) and teachers. Communication is the key element in providing a smooth experience and leading students to efficiently absorb professional knowledge [39]. Considering the above data, it is necessary to reconsider how to enhance the study experience in online/hybrid education. Thus, we propose the following paths, which may serve to narrow the gap between theory and reality.

Content Arrangement in Online/Hybrid Courses: It is necessary to divide online and on-site teaching content while designing course schedules. Online content should be at the front-end of the industry, while on-site tutoring should focus on answering questions from students. In this way, the student can clearly learn the knowledge through on-site study and broaden their horizons through online education.

Building Abundant Online Resources: One of the most significant advantages of online/hybrid education is that students can play back the course content on online platforms. Suppose that a teacher does not build a knowledge library with abundant resources and, instead, simply hosts live classes through Zoom or another meeting software. In this case, the study mode is no different from traditional teaching. Therefore, online/hybrid courses should include abundant teaching resources on the online platform, such as weekly coursework and various resources such as course video recordings, course practice case videos, and so on. Consequently, students can independently arrange a time to use the resources for practical retrospective study after class.

Convenient Online Communication Mode: Although the course arranges on-site tutoring, the online platform should also have relevant communication modes in order to help the teacher to answer urgent questions from students. As such, course designers should consider using an efficient online tutoring platform. The platform should not merely provide simple text communication, but should also contain a professional online experimental section for students. Teachers can provide visual feedback on questions and even remotely control the students' computers to solve their issues in real time.

Comprehensive Project Coordination Guidance: NEE courses are different from traditional courses, which are typically biased toward theory. By contrast, NEE courses include a lot of experimental or practical content. Therefore, the course assessment usually takes project development as the assessment basis. However, many students do not have rich teamwork experience in online communication. Online teamwork of the sheep-herding style can easily cause communication barriers, and teammates may not contribute equally. Therefore, online communication poses a key challenge for students. Therefore, teachers must formulate appropriate project development content based on individual skills and the sizes of teams. In addition, it is also necessary to teach related project management knowledge such that students can gain experience in team management in related fields through their coursework. The course should not merely teach professional skills, but also guide the student on how to communicate in their career.

In summary, a successful online/hybrid NEE course should include more than just traditional teaching content. More importantly, teachers need to consider a broader range of aspects for online/hybrid education, including content arrangement, abundant online resources, online/on-site tutoring mode, and guiding students in efficient teamwork. A successful online/hybrid NEE course should not merely allow students to learn the knowledge of the course, but also guide them to understand the professional frontier and foster their teamwork communication ability. This will inevitably help them to lay a solid practical foundation for their future careers.

5. Conclusions

The global shift to online and hybrid education during the COVID-19 pandemic has forced the widespread adoption of MOOCs as the primary mode of education delivery. In this study, we focused on NEE courses in the Guangdong area with the aim of investigating the impact of the sudden transition to online/hybrid education. Through a survey of 787 participants and follow-up one-to-one interviews with those who reported negative experiences, we gathered both positive and negative feedback from students. The results demonstrated that, while most students found the online/hybrid courses beneficial, approximately 28.69–36.74% of participants reported significant issues with the mode of delivery. The main challenges were found to be related to insufficient and burdensome communication/interactions with classmates and teachers. This finding has been supported by prior research findings stating that the large scale of hybrid/online education can lead to several negative impacts [20,21]. Based on our findings, we proposed a conceptual path and suggestions for improving the online/hybrid NEE course experience. The key factors for enhancing the quality of online/hybrid NEE include the proper arrangement of course content, the provision of sufficient online resources, a balanced combination of online and in-person tutoring, and the promotion of practical teamwork skills. This conclusion is consistent with prior research findings regarding the future outlook of online education [13]. We believe a successful online/hybrid NEE course can overcome these existing issues. This study contributes to ongoing efforts to improve the quality of online/hybrid NEE and provides valuable data for educational researchers.

6. Limitations and Future Work

Although we conducted large-scale user investigations and pointed out the major challenges associated with online/hybrid education, we were not able to fully put forward a detailed resolution. Furthermore, the experiment merely covered the student aspect. As such, it is necessary to consider issuing a similar survey among teachers. Additionally, the questionnaires were too short, especially that given to Group A. Therefore, future work should consider gathering feedback from teachers/educators to gain a more well-rounded understanding of the challenges posed by online/hybrid education. To improve online/hybrid NEE, future research should continue to delve into this topic and design more comprehensive questionnaires to better reflect teaching quality. We believe that such research will inform and assist educators globally.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by Center of Experimental Teaching, Guangdong University of Finance (Project No. 20TJ1005, Approval Date: 30 November 2020).

Informed Consent Statement: Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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