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Qualitative impact assessment of COVID-19 on the pedagogical, technological and social experiences of higher education students in Taiwan

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Abstract

COVID-19 has imposed a rippling effect on educational institutions globally, substantially impacting nearly 1.6 billion learners in more than 190 countries. Recognizing Taiwan as an atypicality during this crisis for suffering from a relatively moderate mortality/morbidity compared with the rest of the world, the present paper qualitatively explores the pedagogical, technological and social impact of COVID-19 on higher education students in Taiwan. Employing the focus group discussion methodology, we recruited a cohort of 23 students, comprising of 15 local and 8 international students. Findings show diverse pedagogical experiences in students' instructional modalities. Trending by either discipline of study, students from Science, Technology, Engineering and Mathematics disciplines expressed a greater preference for face-to-face instruction compared to their humanities counterparts. Distance learners reported a decrease in study efficacy and a lack of sense of belongingness to their university. All students demonstrated a high sense of perceived safety and reported minimal changes in their socializing norms during the pandemic. In terms of career planning, local students expressed minimal concerns about potential changes in their careers, versus international students who expressed high degrees of uncertainty, fear and pessimism in the same regard.

Abbreviations

CDC   Centers for Disease Control
CECC   Central Epidemic Command Center

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COVID-19   Coronavirus-19 or SARS-COV-2- Coronavirus 19
FGD   focus group discussion
HEI   higher education institution
IHG   International Humanities Group
ISG   International STEM Group
LSG   Local STEM Group
LHG   Local Humanities Group
LMG   Local Mixed Group
MOE   Ministry of Education
NCKU   National Cheng Kung University
QR   quick response
RQ   research question
STEM   science, technology, engineering and mathematics

1 Introduction

The outbreak of the Coronavirus 19 (COVID-19) pandemic has created a destabilizing effect on institutions globally. It has arguably been the most significant culprit of social disquiet in history (Balkhair, 2020; United Nations, 2020), causing critical repercussions on education systems (Ali, 2020; Anwar & Adnan, 2020; Aristovnik, 2020b; Chaturvedi et al., 2021; Marinoni et al., 2020; Tadesse & Muluye, 2020; World Bank, 2020). According to the United Nations, nearly 1.6 billion learners in more than 190 countries have been affected by this crisis (United Nations, 2020). In particular, higher educational institutions (HEIs) have been tremendously challenged in their efforts to facilitate learning while adhering to stringent public health measures (Cheng et al., 2020; Coman et al., 2020; Dennon, 2021; Ferraro et al., 2020; Kuhfeld et al., 2020; United Nations, 2020). Some responsive measures to this crisis included temporary closure of schools and a shift to digital learning (Cheng et al., 2020; Coman et al., 2020; Dennon, 2021; Ferraro et al., 2020; Kuhfeld et al., 2020; United Nations, 2020). This marked disruption has crippled educational productivity (Ali, 2020; Anwar & Adnan, 2020; Aristovnik, 2020b; Engelbrecht, 2005; Marinoni et al., 2020) while imposing major socioeconomic and academic changes on students pursuing higher education (Ali, 2020; Anwar & Adnan, 2020; Aristovnik, 2020b; Engelbrecht, 2005; Marinoni et al., 2020).

On December 31, 2019, the first official cases of COVID-19 were reported in Wuhan, China (World Health Organization, 2020). The virus rapidly spread across the Asian pacific, reaching Taiwan on January 21, 2020 (Chiang, 2020). In response, Taiwan's Center for Disease Control (CDC) swiftly implemented a robust pandemic prevention plan, using big data analytics to accurately track and detect suspicious and confirmed cases (Duff-Brown, 2020; Wang et al., 2020). Other implemented public health measures included: quick response (QR) code scanning, issuance of travel bans, and requisitions on surgical masks (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a, 2020b).

The suspension of transit air flights imposed by the Central Epidemic Command Center (CECC) (Taiwan Center for Disease Control, 2020a, 2020b) posed unusual

challenges for HEIs (Cheng et al., 2020). As of December 2019, Taiwan's college student population was over 1,200,000, inclusive of 130,000 international students (Ministry of Education, 2021; Statista, 2019). During this period, students ventured to travel abroad for the Lunar New Year holidays, leaving many stranded overseas due to border lockdowns (Cheng et al., 2020; Taiwan Center for Disease Control, 2020b). To accommodate the delayed return of overseas students, HEIs jointly delayed the opening of spring semester, citing time allocation for the completion of two weeks of self-quarantine (Cheng et al., 2020; Taiwan Center for Disease Control, 2020b; Yang, 2020).

In an attempt to curtail the lingering uncertainty induced by the pandemic, Taiwan's Ministry of Education (MOE) delineated strict guidelines to facilitate the safe reopening of HEIs (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a). Decreed were measures on general hygiene conduct, ventilation and sanitization practices, principles for quarantine or suspected cases, and distance learning conduct (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a). MOE's safety guidelines provided for the establishment of a task force at each university that was responsible for the implementation and amendment of COVID-19 containment measures (Cheng et al., 2020). These efforts ensured a crisis-resilient contingency plan, aimed to withstand any sudden surge in incidence rates (Cheng et al., 2020).

As one of the largest universities in Taiwan and latter Asia (National Cheng Kung University, 2020; World University Rankings, 2020), the National Cheng Kung University (NCKU) organized a COVID-19 Task Force that prepared swiftly to secure the safety of their student (around 23,000) and staff (around 2000) population (World University Rankings, 2020). Sanitizer dispensers were installed at various locations on campuses to promote personal hygiene practices (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a). Teaching assistants were required to check and record students' temperature and maintain fixed seating arrangements (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a). Within the classroom, students were encouraged to maintain a safe distance of 1.5 m indoors and wear masks (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a). Though instructors were encouraged to adopt online learning methodologies, such practices were not mandated (Taiwan Center for Disease Control, 2020a). This non-uniformity in class modality resulted in diverging pedagogical experiences for students.

Thus far, literature consortiums have sparingly assessed the holistic impact of COVID-19 on student life. More specifically, Taiwan's student experience is globally unprecedented, being one of the few countries that have maintained normalcy during this crisis (British Broadcasting Corporation, 2020b; Cheng et al., 2020). During this time, most countries were deleteriously impacted (British Broadcasting Corporation, 2020a), citing immense strain on their public health surveillance systems to effectively contain outbreaks locally and nationally (Al-Hazmi et al., 2018; Aristovnik, 2020b; Morgan et al., 2021).

Our research therefore aims to understand the pedagogical, technological and sociological impacts of COVID-19 on student life through the experiences of NCKU's local and international undergraduate students. We intend to focus only on spring semester, 2019 (February 2020 to July 2020) since this was the peak adoption

period of Taiwan's stringent local containment guidelines (Cheng et al., 2020; Taiwan Center for Disease Control, 2020a).

We anticipate that the findings of this study could better assist educators in gauging student adaptability to develop appropriate instructional modalities, thereby improving student efficacy.

In order to comprehensively explore the impact of COVID-19 on the experiences of Taiwan's student cohort, the following research questions were addressed:

1. Did COVID-19 affect the instructional modality of students' practicum courses? If yes, how did students perceive these changes?
2. How did students respond to containment measures implemented by the government and the school against COVID-19?
3. How has COVID-19 impacted students' social, and how have students perceived these changes?
4. Has COVID-19 affected students' career planning, and how has this been perceived by students?
5. Is there a distinction between local students' and international students' COVID-19 experiences while studying in Taiwan?

2 Methodology

2.1 Focus group interview

Students who have been enrolled at NCKU since the spring of 2019 were invited to online focus group interviews. The benefit of the focus group method over other individual interviews methods is it creates an environment for group dialogue since one individual's experience might be echoed by another or stimulate further discussion. Through the group discussion, students were able to share their collective learning experiences during the pandemic. Moreover, the online format has the advantages of efficiency, no geographical limitations, and more honest and open responses.

2.2 Participants

Data were collected from a sample of local and international undergraduate students. Each group contained a Science, Technology, Engineering and Mathematics (STEM) and a humanities strata, and one mixed stratum (STEM and humanities) was included in the local cohort only. Consequently, there were five groups of participants: Local STEM Group (LSG), Local Humanities Group (LHG), International STEM Group (ISG), International Humanities Group (IHG), and Local Mixed Group (LMG). Therefore, a total of 15 local students and 10 international students

were sampled for this study. We anticipated that this selection was sufficient to comprehensively capture student experiences during the initial pandemic.

2.3 Interview questions

A triangulated framework of objectives (Fig. 1) was obtained from the World Universities Network (WUN) "University Students in the Time of Corona (COVID-19)" research team, from which an interview protocol was subsequently prepared. Under this ambit, all researchers (from NCKU's research team) were asked to formulate structured research questions in accordance with the specified objectives. Research assistants then consolidated the interview questions, and the resulting guideline was proofed and officialized by the research team. The official interview guideline is annexed in the Appendix Fig. 2.

In accordance with the interview protocol, the study employed a focus group discussion (FGD), using semi-structured interviews. All interviews were held remotely via Cisco WebEx, each lasting approximately 60 to 90 min. Three interviews were conducted in Mandarin Chinese for Taiwanese students, and two interviews were conducted in English for international students.

Prior to implementation, approval was obtained by the Review Ethics Committee from the NCKU (NCKU HREC-E-109-443-2). Informed consent was obtained from all research participants prior to the interview.
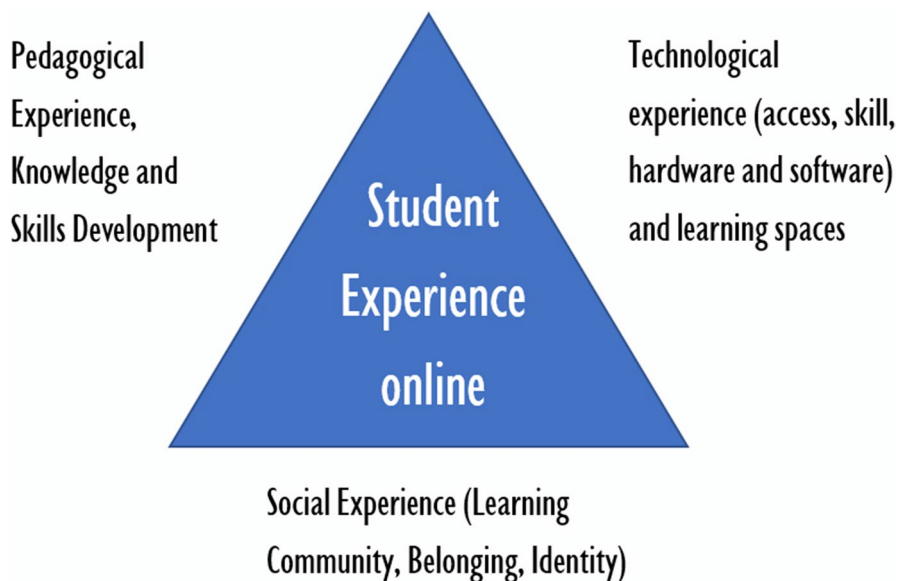

Fig. 1 World Universities Network (WUN) Theoretical Framework

2.4 Procedure

Interviews were recorded and manually transcribed by research assistants. The researchers then undertook an intense immersion process which involved repetitive rereading of the transcripts to gain familiarity with the content. This strategy of persistent observation improves the trustworthiness of the research by providing in-depth focus on the characteristics of a situation relevant to the phenomena being studied (Korstjens & Moser, 2018). We performed this strategy consistently throughout analyzation to maintain data credibility.

Transcripts were then imported into NVivo 11 (QSR International) for data analysis. Informed by an examination of participant responses, we employed a descriptive open coding method. Descriptive coding is a first cycling elemental coding method that uses a word or a short phrase to summarize data of similar topics (Onwuegbuzie, Frels, & Hwang, 2016).

After thorough revision of the initial codes, the recoding process was conducted by reviewing existing codes and eliminating, lumping or splitting codes where necessary. At this phase, simultaneous coding which is the process of applying multiple codes to the same text (Onwuegbuzie et al., 2016) was also employed. Simultaneous coding was chosen, not due to perceived ambiguity in data analysis, but rather, to capture the complex, multifaceted nature of participant responses.

For the second coding cycle, pattern coding was employed to further consolidate the data set. This method is a means of finding patterns or relationships among previously generated codes, and grouping them by similarities (Onwuegbuzie et al., 2016). We thus developed meta-codes and subsequently generated major themes relating to the triangulated framework of objectives described above. As to pedagogical experience, emerging subthemes were on students' experienced teaching modality (remote, in-class, or hybrid), overall interaction with faculty and peers, preferred teaching modality, and overall perception of their learning experience during the pandemic. Resulting subthemes on technological experience were instructor's preparedness, structure of online classes, and students' attitude toward remote learning. Lastly, resulting subthemes for students' social experience were belongingness, safety, social containment measures, interaction with friends, and career planning. Screenshots of this process are annexed in the Appendix Fig. 2.

It is noteworthy to mention that at each stage of the coding cycle, results were analyzed and further scrutinized by various members of the research team in an effort to improve the trustworthiness of our findings. Cohen's Kappa coefficients (k) were all above 0.90 indicating a high measure of reliability (McHugh, 2012).

3 Results

3.1 Final study cohort

As one international student withdrew during the interview, the participant retention rate was 96%. The final study cohort included 15 local students and 9 international students were sampled for this study, including 15 females (62.5%) and 9 males

(37.5%). In the local sample, 13 students (73%) were identified as Taiwanese, and 2 (27%) were from Hong Kong. It must be noted that Hong Kongese are included in the local cohort as they are not eligible for international studentship under the Nationality Act, and Articles 2 and 3 of the *MOE's Regulations Regarding International Students Undertaking Studies in Taiwan* (Laws & Regulations Database of The Republic of China, 2021; Ministry of Education, 2012).

Nationalities of international participants included Belizeans (25%), Jordanian (12.5%), South African (12.5%), St. Lucian (12.5%), Mongolian (12.5%), Eswatini (12.5%), Ghanaian (12.5%), and Indonesian (12.5%) (Table 1).

Table 1 Socio-demographic information of survey respondents

Socio-demographic Characteristics	Number (%)
Age	
20	4 (16.7)
21	9 (37.5)
22	8 (33.3)
23	1 (4.2)
24	2 (8.3)
Sex	
Female	15 (62.5)
Male	9 (37.5)
Nationality	
Taiwanese	13 (54.2)
Hong Kongese	2 (8.3)
Belizean	2 (8.3)
Jordanian	1 (4.2)
South African	1 (4.2)
St. Lucian	1 (4.2)
Mongolian	1 (4.2)
Eswatini	1 (4.2)
Ghanaian	1 (4.2)
Indonesian	1 (4.2)
Year of Study	
Freshman	1 (4.2)
Sophomore	2 (8.3)
Junior	8 (33.3)
Senior	12 (50)
Super Senior	1 (4.2)
FGD Discipline Classification	
Local STEM Group (LSG)	5 (20.8)
Local Humanities Group (LHG)	5 (20.8)
International STEM Group (ISG)	5 (20.8)
International Humanities Group (IHG)	4 (16.7)
Local Mixed Group (LMG)	5 (20.8)

FGD: focus group discussion; STEM: Science, Technology, Engineering and Mathematics

3.2 Thematic results

The themes were coded in alignment with the aims of this research as it relates to the pedagogical, technological and social experiences of local and international students during the COVID-19 pandemic. All resulting themes are presented in response to the proposed RQs, with the exception of RQ 5, which is addressd in the Discussion.

RQ 1: Did COVID-19 affect the instructional modality of students' practicum courses? If yes, how did students perceive this changes?

3.3 Theme 1: COVID-19 pedagogical experience

Balancing access to a sensible learning modality for students amidst the COVID-19 pandemic resulted in heterogeneous academic experiences for NCKU students. Instructors' decision to pivot to remote learning was mostly at the instructor's personal discretion. Some instructors maintained the traditional face to face method while others shifted to remote learning or employed a hybrid of the two. Some students reported insignificant changes in their academic experiences, as one interviewee expressed:

"Actually, in my department, we weren't actually affected if I would put it that way because most of our classes were as like…we do go in person...to meet the professor to be in class." [ISG]

Other students were adversely impacted in significant ways. Some were discontented with the flexible modalities, and expressed skepticism about its containment effectivity. One student stated:

"We only had two classes which were online. Which I found...sorry to be blunt...which I found pointless, reason being, why would you have classes from 9 a.m. to 12 p.m. and then you'd come to class in the afternoon, sitting side by side in close proximity to each other. I found that...very...pointless." [ISG]

3.4 Subtheme 1–1: Remote learning experience

Students expressed varying sentiments toward remote learning. An observed trend was an overall negative sentiment expressed by the STEM groups and a moderately positive sentiment expressed by the humanities groups. This disparity was most evident among the international groups. Students who responded positively to remote learning reported that convenience and flexibility were two major factors in their experience. One student expressed:

"I think online courses are a good choice, because I think it's quite efficient. It saves you the time of going out and going into the classroom." [LHG]

Regaining access to pre-recorded videos was also reported as an advantage of remote learning. Some students related that this modality feature was especially convenient during examination periods because it afforded easy accessibility to course material. One student expressed:

> *"I think the online version is pretty good. There are somethings that can be replayed, and then when you take the midterm and final exams you can watch Moodle and also re-watch those videos to deepen your understanding."* [LSG]

Other students who were dissatisfied with remote learning reported internet connectivity issues, delayed feedback, and audio lagging as three major impediments. These communication lags interrupted class flow and made students less inclined to participate in online discourses. A student explained:

> *"As opposed to being online, you're just listening to like a professor speaking. And it would be hard to say like professor and then you would have to type can you explain this and by the time he sees that it's like half an hour later then he disrupts the whole class by going all the way back."* [ISG]

The overall consensus was that there was a direct correlation between the nature of the courses and the preferred instructional modality. Theoretical courses were found to be adequately suitable for e-learning modalities, whereas practical courses required a face-to-face/traditional modality. One likely explanation is the technical nature of practical courses which requires hands-on training. Contrarily, the curriculum design for theoretical courses can be suitably supported through remote learning. One student encapsulated this concept by saying:

> *"I'd say it depends on the nature of the classes. Because there are some classes that I take and I usually end up teaching myself anyways, like, through reading a textbook and doing my own research because the lectures in my department are in Chinese, um, but we have our textbooks in English, so, um, if it were of course where it's mostly reading material, then I think online is fine despite the little technical difficulties on occasions. Uh, for other courses that are more, like numerical, like statistics or these kinds of classes, I would not be able to learn much online. I would need to be there in person."* [IHG]

3.5 Subtheme 1–2: Student efficacy

Student efficacy refers to student's innate belief about her/his will for academic success. This study observed a decrease in student efficacy due to remote learning. Students who reported low levels of self-efficacy in their study behaviors attributed the causation to remote learning. Inadequate software support and poor connectivity issues were prevailing factors that interrupted student concentration and subsequently discouraged academic motivation.

Instructor preparedness was a salient concern within this category. Among these were factors of unfamiliarity with e-learning software, limited technical knowledge, improper webcam configuration, and lack of grade transparency. Some instructors

were described as "technologically unsavvy," and there were considerable doubts about their familiarity with the e-learning platform. One student described her experiences with online classes saying:

"I get so distracted when it's online, I don't, and like I can't see the teacher's face I don't know why it's distracting me so much, but like I can't pay attention to what they're saying a lot. And, also just because there are so many disruptions in an online setting with like, lagging or the microphone's not working, the teacher isn't that tech savvy. So then like it really takes away and it really makes me not want to pay attention anymore." [IHG]

Another student shared similar experiences with his remote classes:

"…they had an entire equation and they're explaining but the professor is on the left side of the black board, whereas the computer webcam was placed in the middle and is pointing towards like the top and so like you're not seeing anything." [ISG]

Uncertainty related to grading standards and requirements were also issues experienced by students in the classroom. Some instructors did not clarify grading requirements regarding participation and attendance scores for online classes. This might result in unstandardized grading that was not individually reflective of student performance. One student expressed this problem saying:

"So, it affected the grading because you couldn't grade participation, so he just gave everyone the ten percent. And it affected their exam marks because um, the average was higher." [LSG]

RQ 2: How did students respond to containment measures implemented by the government and the school against COVID-19?

Students demonstrated a high sense of perceived safety during the pandemic. There was an overall positive reception toward Taiwanese government's containment strategies. During this period, the government mandated various hygiene measures such as social distancing, mask-wearing, and temperature checks. All students expressed great confidence in the government due to its success in effectively controlling the spread of the virus. One international student stated:

"So, like the biggest advantage for me is like being here in Taiwan, actually [chuckles] because it's the safest place for me to be right now. And we actually...You can like, you know you're here as an observer looking what a country that actually knows how to handle it has learned from previous mistakes how to handle such, um, such pandemics. And they did such an awesome job, and you can go back to your country and you can attest to how great they responded…." [ISG]

However, some students expressed slight annoyance with the various containment policies implemented within the university. On-campus, other implemented hygiene practices were QR code scanning and temperature checks before entering each classroom, single checkpoint building entries, and fixed and distanced seating positions

in the classroom. Some students found great inconvenience in adopting to these containment measures. One student explained:

"For me, I think the one thing that I would always forget to do was the school tracking thing…so like signing into the…like logging into the QR codes and signing and remembering to do it for every building, every classroom that I entered into. And I feel like I found myself like having to um, do things ahead of time, so like, just to allow myself enough time to log in and get into my class and settling in…." [IHG]

In terms of friendships and socializing, students were minimally affected. They all related still being afforded the social freedom to gather with friends in public spaces, while adhering to containment policies. One student shared:

"We weren't really affected in any way. We still had it like a regular get-together, like studying together was the same. Um, talk to each other maybe we were just wearing masks...." [LSG]

RQ 3: How has COVID-19 impacted students' social life, and how have students perceived these changes?

3.6 Theme 3: Belongingness

Concerns about student's sense of association, herein referred to as "belongingness," were repeatedly expressed by students who participated in remote learning. Many reported a decreased sense of belongingness to their university. Students stated that relationships with professors and classmates became increasingly estranged. This is likely attributable to the limitations of remote technologies in facilitating interpersonal interactions in the classroom. A senior student wrote:

"I think I would say that I felt less connected. And it was a matter of like I said before, not being able to meet up with my professors in person in situations." [IHG]

Another student expressed:

"I think the change to online is actually, um, the relationship with your peers is reduced…just disappeared, um, because it means that you don't have to go to class together, and because my own courses are…quite a lot of the time, it would be group discussions. Therefore, in such courses, I feel that the relationship with my peers changed and significantly reduced. And when group discussions are changed to online, it is not as effective as actual face-to-face discussion." [LHG]

These sentiments largely exuded the incapacity of instructors to devise creative instructional strategies to create meaningful relationships in the online classroom. Some students suggested that instructors should use appropriate mechanisms to boost presence, and improve student-instructor rapport.

RQ 4: Has COVID-19 affected students' career planning, and how has this been perceived by students?

3.7 Theme 4: Career planning

There was a stark discrepancy between local students' and international students' responses to career planning. Local students expressed minimal concerns about the impact of COVID-19 on their career planning. In contrast to that, international students expressed great uncertainty about their future and expressed sentiments of fear, anxiousness and pessimism. Some students explained their intentions of furthering their academic studies in a different country, but the onset of COVID-19 halted this possibility. A senior student explained:

> *"…initially I was planning to leave Taiwan as soon as I graduate and further my education, uh, elsewhere maybe Canada or the UK, but now, that just seems like a bad idea [chuckles] so, currently Taiwan seems like the safest place in the world to be, during this pandemic, and so, that is definitely affecting my future plans…."* [IHG]

Many expressed considerable doubts about returning to their home countries postgraduation due to anticipated difficulties in finding jobs. The inception of COVID-19 has exacerbated the economic challenges in their countries. One student shared feelings of anxiety when discussing her future plans:

> *"…it's like as if wasn't already anxious about like my future and like getting a job after graduating, now it's like even more, because how am I supposed to get a job like where am I supposed to go? Do I stay in Taiwan? Do I go back? Do I go to a different country? Is it all even still possible now? So, its... its affected it quite a lot a lot."* [IHG]

Other students have tentatively considered alternative options such as teaching English in Taiwan:

> *"Now, coming back to our plans, yes it's being affected and I would say I would stay in Taiwan and teach English, which is a way of accumulating money for foreigners like ourselves so I would say I would remain in Taiwan for a small time interval after graduation in order to see my next way forward."* [ISG]

4 Discussion

Since its earth ravaging appearance in late 2019, the COVID-19 has imposed considerable consequences on student lives. In particular, HEIs have been tremendously burdened in their quest to facilitate learning amidst containment protocols. Recognizing students at the forefront of this global catastrophe, this research aimed to holistically assess the impact of COVID-19 on their pedagogical, technological and

social lives. We herein employ a comparative analysis of our findings in relation to current literature on this global discourse.

In terms of their pedagogical experience, some students reported significant changes in their academic lives, while others reported minimal changes. An explanation for such a discrepancy is the administrative autonomy of the university's task force enacted through Taiwan's government. Within each university, the task force was responsible for delineating general on-campus guidelines. NCKU's task force did not mandate a standardized modal class guideline (Taiwan Center for Disease Control, 2020a). Therefore, the decision to adopt the most suitable instructional modality was mostly at the discretion of the instructor.

This finding mostly contrasts other reported student accounts of experienced instructional modality (Aristovnik, 2020a; Coman et al., 2020; Kedraka & Kaltsidis, 2020; Schleicher, 2020; Son et al., 2020). During the initial pandemic outbreak, most universities outside Taiwan reported a complete shift to remote learning (Aristovnik, 2020a; Aristovnik et al., 2020; Bergdahl & Nouri, 2021; Dennon, 2021; Kedraka & Kaltsidis, 2020; Marinoni et al., 2020). The hybrid approach was only later introduced as COVID-19 cases stabilized or declined (Potra et al., 2021; WeWork and Brightspot Strategy, 2021). One main reason for such a discrepancy is attributed to the reported COVID-19 incidence rates for the respective period.

Attempts to curtail the severity of the infection rate prompted many countries to institute restrictive public health interventions. By April 1, 2020, over one hundred countries had plunged into a full or partial lockdown (Aristovnik et al., 2020; British Broadcasting Corporation, 2020a). However, Taiwan remained an anomaly as one of the few countries that instituted only national recommendation measures (British Broadcasting Corporation, 2020a; Cheng et al., 2020; Duff-Brown, 2020; Taiwan Center for Disease Control, 2020a). For many countries, the high rates of infection made it unfeasible to even support hybrid instruction (Aristovnik et al., 2020; Kedraka & Kaltsidis, 2020; Owusu-Fordjour et al., 2020; Potra et al., 2021; WeWork and Brightspot Strategy, 2021). This finding was further corroborated by a study in Greece, where all Greece universities suspended teaching activities from March 11, 2020, forcing the implementation of online education (Kedraka & Kaltsidis, 2020). During this period, Greece was experiencing a surge in COVID-19 cases, prompting authorities to implement a strict lockdown (GardaWorld, 2020). Similar remote learning policies were also implemented in high COVID-19 risk countries such as Spain, Italy, France, Ghana and India (Centers for Disease Control and Prevention, 2021; GardaWorld, 2020; Owusu-Fordjour et al., 2020).

Contrarily, Taiwan's leniency in utilized instructional modality was due to the low risk of community transmission (Taiwan Center for Disease Control, 2020a). A similar trend was observed in Sweden, also a country with remarkably low COVID-19 infection rate (Bergdahl & Nouri, 2021). Though remote learning was employed at the secondary and tertiary levels, relaxed interventions were employed at the primary school level, and it was at the teacher's discretion to find pragmatic solutions for their respective situations (Bergdahl & Nouri, 2021). It can therefore be reasoned that there is a strong correlation between students' experienced instructional modality and the current rate of infection per territory.

Students who reported significant changes in their pedagogical experiences cited the shift to remote learning as a primary cause. Our findings showed a stark variance in students' receptivity toward remote learning, trending by discipline. Humanities students mostly responded positively to this shift, reporting convenience and flexibility as two major significant benefits. The said students were afforded the convenience of accessing courses in their personal space, with the facility to revisit the uploaded materials when necessary. Some students reported that this state of affairs significantly improved their understanding of targeted academic concepts and assisted them in their exam preparation. Alternatively, it was observed that STEM students expressed mostly negative sentiments toward remote learning. Instructor unpreparedness was a salient issue of concern. There were reports of instructors being technologically unsavvy, unable to operate the e-learning software which disrupted the flow of classes, thus impeding student learning experience. Instructors' improper positioning of the computer webcam was another issue. Students explained that it was difficult to thoroughly grasp concepts because they were unable to see the instructor's board. Other notable mentions were of internet connectivity issues such as lagging, buffering, and delayed feedback. Students related that these issues deterred their participation in online discussions, and in some instances, decreased student efficacy.

There were also considerable doubts about grading transparency. Students reported that instructors did not clarify grading requirements for online courses. The credibility of participation and attendance scores were questioned, with assertions made that such measures were not genuinely indicative of student performance.

Though our findings are consistent with other literature (Aristovnik et al., 2020; Owusu-Fordjour et al., 2020; Pokhrel & Chhetri, 2021; Son et al., 2020), its implications only partially represent factors of students' overall response to remote learning. There was an observed global discrepancy in terms of attributable factors in response to remote learning, trending by the Human Development Index. Students from developing countries such as Bhutan, Ghana, Pakistan, and India responded negatively, citing a commonly reported issue of limited or no access to technological resources to support online learning (Aristovnik et al., 2020; Bordoloi et al., 2021; Pokhrel & Chhetri, 2021; Schleicher, 2020; Tadesse & Muluye, 2020). Internet connectivity was most reported with low speeds and data bundles that were relatively costly to maintain (Pokhrel & Chhetri, 2021; Schleicher, 2020). Conversely, students from developed nations expressed concerns on the uncertainty of their future studies, and a fear of remote confinement (Aristovnik et al., 2020; Kedraka & Kaltsidis, 2020; WeWork and Brightspot Strategy, 2021).

Within this component, students also expressed concerns about the issue of delivering laboratory courses and transparency in grading conduct (Kedraka & Kaltsidis, 2020; Schleicher, 2020). In congruence with our findings, in a study which investigated factors affecting e-learning amongst Biology majors at the University of Thrace, 53.3% found convenience in remote learning, while 61.3% were dissatisfied with their instructors' digital weaknesses (Kedraka & Kaltsidis, 2020). This was further corroborated by a study in the United States which reported that fully online students were half less likely to be satisfied compared to hybrid students (WeWork

and Brightspot Strategy, 2021). Evidently, distance learning has unique peculiarities that makes it distinguishable from traditional learning (Kedraka & Kaltsidis, 2020). Despite differing accounts from students of varied national economic backgrounds, most studies reported a greater preference for face-to-face teaching (Aristovnik et al., 2020; Kedraka & Kaltsidis, 2020; Owusu-Fordjour et al., 2020; Pokhrel & Chhetri, 2021; Potra et al., 2021; Yu, 2021).

On-campus procedures changed drastically to accommodate the new normal. NCKU's task force ratified classroom procedures such as signing in via NCKU online temperature tracking system, distanced seating positions, and mask wearing. Though some students responded indifferently to these practices, others reported feelings of frustration and overwhelm. One participant described these various procedures as "tedious" and "time-consuming."

Overall, all students reported great levels of satisfaction with the Taiwanese government in effectively controlling the spread of the virus, nationally. Locals and internationals perceived Taiwan as a safe living space to peacefully share. Most international students expressed how grateful they were to have experienced such an unprecedented crisis in Taiwan, and some expressed how contented their families were about their perceived safety. Globally, there was an observed trend of sociodemographic factors impacting students' satisfaction with the role of social institutions during the COVID-19 pandemic (Aristovnik et al., 2020). A study investigated university students' satisfaction about government's, university's and hospital's pandemic response measures and found that Oceana students reported higher levels of satisfaction with their institutions compared to their South American (Chile and Ecuador) and African (Ghana, Nigeria and Egypt) counterparts (Aristovnik et al., 2020). Interestingly, a study showed that students in the United States reported significantly less satisfaction (2.6 out of 5.0) with their government's response, compared to their New Zealand counterparts (4.6 out of 5.0) (WeWork and Brightspot Strategy, 2021).

The prevailing consensus exudes a strong relationship between levels of trust in governments among the youth and satisfaction with the performance of these institutions (Aristovnik et al., 2020; Eichengreen et al., 2021). In fact, Eichengreen et al. argues that pandemics exposes the vulnerabilities of especially weak governments and their capacity to institute effective healthcare responses (Eichengreen et al., 2021). This inadvertently leads to a loss of political trust and can have a long-lasting detrimental impact on individuals, especially in their "impressionable years" (ages 18 to 25 years) (Eichengreen et al., 2021). This explanation likely addresses the gap of diverging satisfaction levels in response to government pandemic measures. Taiwan's trust and confidence value in their government was 33, significantly higher than the world median of 68 (The World Bank Group, 2017). Employing this concept, to assess our findings, we can conclude that NCKU students' astounding positive response to government measures is accurately reflective of their current sociopolitical climate (i.e. confidence in public health systems and the government's rapid and effective policy interventions).

Social belongingness to student's university was also explored in this study. There was an observed discrepancy among students according to their experienced instructional modality. Remote learners mentioned feelings of "isolation" and "lack of

connectedness" more often than traditional learners. Some students explained that the online learning platform unsatisfactorily replicated the interpersonal connection with their instructors, resulting in a decreased sense of comradeship with the class. Feelings of isolation due to lack of face-to-face instruction was also a commonly reported issue amongst Romanian students (Potra et al., 2021). Similarly, students in the United States reported that the switch to remote instruction decreased their sense of belongingness and involvement in the classroom (WeWork and Brightspot Strategy, 2021). Interestingly, Hew et al. (2020) contrasted these findings by curtailing the said effects through the implementation of a customized remote learning system, aimed to replicate traditional instruction. This was achieved through the use of a dual-monitor display function that enabled professor-student engagement, thus encouraging student-centered learning (Hew et al., 2020).

It is therefore logical to conclude that inadequate remote learning systems can be detrimental to student learning. This is evidenced in our study, and in the works of the aforementioned literatures, showing decreased student belongingness, and peer and faculty interaction, which can negatively impact student efficacy (Aristovnik et al., 2020; Chaturvedi et al., 2021; WeWork and Brightspot Strategy, 2021). However, if remote learning systems are executed properly, it can be a viable substitute to traditional learning, thus encouraging effective and interactive student-centered learning (Heilporn et al., 2021; Hew et al., 2020).

As to the impact of COVID-19 on students' social life, most participants reported minimal changes in their friendships or recreation activities. No significant changes were reported to their socializing norms, except in instances where they were required to adhere to general containment protocols. This inadvertently led to the adoption of hygienic behaviors (i.e., mask-wearing, social distancing, etc.). This finding is likely attributed to Taiwan's low COVID-19 incidence rate, resulting in relaxed COVID-19 restrictions. These were commonly increased practices amongst students globally (Aristovnik et al., 2020; Kedraka & Kaltsidis, 2020; Noreen et al., 2020). Aristovnik et al. reported a 79.9% increase in mask-wearing, hand-washing, and avoiding crowds and hand shaking, and the trend was also observed in medical students (Noreen et al., 2020). In the study by Aristovnik et al., New Zealand students reported the lowest use of face masks in their daily routine (Aristovnik et al., 2020), and this might be due to the fact that the use of face masks was not an integral feature of New Zealand's COVID-19 elimination strategy (Baker et al., 2020). Some of these (i.e., avoiding crowds and hand-shaking) were not reported practices amongst our participants as they reported minimal changes in their socializing norms.

We also investigated whether or not COVID-19 has impacted students' intended career goals. Our local students reported no significant changes. Contrastingly, all international students expressed uncertainty about their future career plans. Mentions were of concern, pessimism, uncertainty, anxiousness and fear. Some expressed fear of returning to their home countries due to alarmingly high unemployment rates and exacerbated economic challenges imposed by this global pandemic. Others who had ambitions of furthering their education abroad became doubtful that the economic realities of the receiving countries could afford them the opportunity they intended to seek. A global survey observed the weekly shift in student responses

over the progression of the pandemic (QS, 2020). As the weeks progressed, many students reported that COVID-19 had changed their plans to study abroad, deferred entry, or their intended country of future study (QS, 2020). Kedraka and Kaltsidis also reported from their sample an overwhelming majority of Greek students were unsure about their future studies and expressed fear about whether they could abruptly continue their studies (Kedraka & Kaltsidis, 2020). Similarly, other studies showed African and South American students were most concerned about their professional career, future education, and financial circumstances (Aristovnik et al., 2020). Financial insecurity was also another commonly reported factor as many students had lost their jobs during the pandemic and were uncertain about their capacity to continue funding their studies. However, New Zealand and Asian students expressed the least concern in these categories (Aristovnik et al., 2020).

A survey in the United States reported students experienced a 15% decrease in confidence about career certainty and were concerned that remote learning inadequately sufficed the cultivation of their practical skills, which would become detrimental to their career development (WeWork and Brightspot Strategy, 2021).

A plausible explanation for the observed discrepancy in the expressed experiences between locals and internationals in our study is the long-term effects of COVID-19 on the global economy. Taiwan is among the few countries globally expecting a growth in gross domestic product (GPD) in 2021 (4.64%) (Ministry of Foreign Affairs Republic of China (Taiwan), 2021). Similarly, New Zealand, a country relatively mildly impacted by the COVID-19 pandemic (Baker et al., 2020; Jones, 2020) is anticipating a 4.5% GDP growth in 2021 (Focus Economics, 2020). It is therefore inferable that local students are confident in their nation's safety net of job opportunities and economic security. It is also noteworthy to mention that while all international students expressed considerable uncertainty about future career endeavors, many opted for Taiwan as a contingency destination. In contrast to findings in another study (Aristovnik et al., 2020), financial insecurity during their stay in Taiwan was not a reported issue among international students. This is likely attributable to the lucrative English teaching industry that is a commonly utilized means of financial support for foreigners in Taiwan (see student responses to career planning in the results section) (Chen & Cheng, 2010; Luo, 2007; Ministry of Education, 2018). Therefore, we can logically conclude that the source of international students' career uncertainty is impelled by their personal ambition to scout opportunities elsewhere, due to a lack of confidence in the economic reality of their countries.

5 Conclusion

This study aimed to qualitatively assess the impact of COVID-19 on students' pedagogical, technological and social lives. Since its appearance in 2019, COVID-19 has imposed unprecedented socioeconomic challenges on social institutions globally. HEI's have been particularly burdened in their attempt to facilitate learning, while adhering to social containment measures. Taiwan is one of the few countries that

have managed to maintain social normalcy during this crisis. Therefore, we focused on local and international undergraduate students enrolled at the NCKU.

Our findings revealed that students' pedagogical experiences during the initial pandemic varied vastly. Some students experienced remote learning, traditional face-to-face learning or a hybrid of the two. Remote learners from the humanities disciplines were mostly receptive to online instructional modality, citing convenience and flexibility as two primary benefits. In contrast, STEM students mostly responded negatively to remote learning, citing internet connectivity issues, lagging and buffering, improper webcam positioning as some of the major impediments.

We also found that social life was minimally affected. Students were still able to socialize with classmates and friends, while adhering to general containment protocols of mask wearing and social distancing. In terms of career planning, local students reported no changes in their intended career goals, whereas international students expressed great uncertainty about their future.

6 Limitations and implications of study

Several limitations underlie our research. Firstly, FGD was conducted as our methodological tool, and each FGD group consisted of four to six participants. Due to this small sample size, it is reasonable to assume that the responses may not be able to reflect proportionally the distributions of the whole student body. This is a limitation that generally exists in qualitative studies with small sample sizes. Therefore, we did not emphasize the quantitative aspects of the results. Secondly, this research was conducted a semester post Taiwan's implementation of strict preventative strategies. Some students might have provided an inaccurate recollection of the event and as a result, understated or exaggerated their COVID-19 student experience. This is a limitation of all retrospective studies, but its impacts on the study results are generally minimized to the lag between the event and the study. In this case, the lag was only several months, and the participants were young college student volunteers from a prestigious university in Taiwan, who are generally expected to have good memory recollection, and a serious attitude in participating in a scientific study. Thirdly, our sample population only consisted of NCKU students. Albeit the necessary sample size for data saturation within the respective population was reached (Clarke & Braun, 2013), caution must be taken when generalizing these results to other populations.

Notwithstanding the above limitations, the findings offer a critical and comprehensive insight of Taiwan's university experience through the lens of local and foreign students. It also exposes possible fragmentations of Taiwan's education system (unpreparedness for remote learning) and offers valuable lessons (effective containment strategies and its positive impact on student psyche) that the global community should especially take heed of. We anticipate that these findings can better assist social and academic educators in understanding student experiences, thereby gauging appropriate interventional techniques to improve student efficacy.
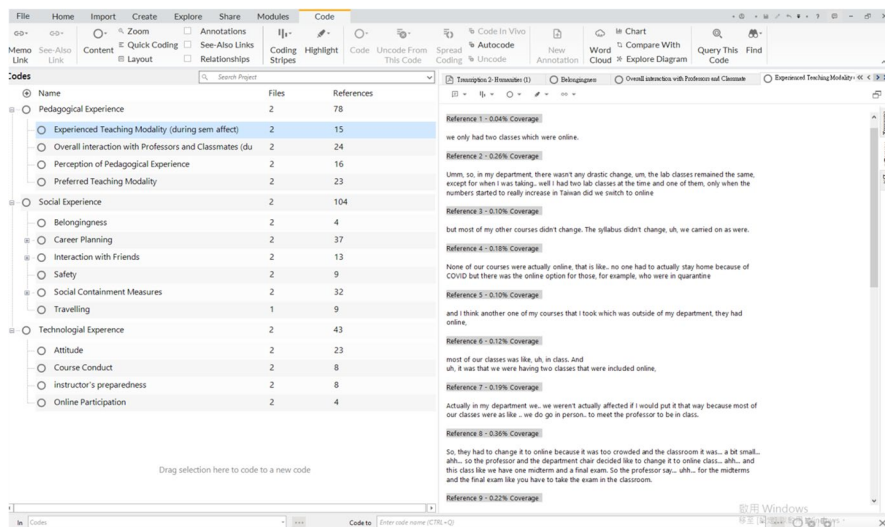
Appendix

Fig. 2 Sample screenshot showing emerging sub-codes for pedagogical experience from Nvivo qualitative data analysis s software

Interview Guideline:

Balancing access to sensible learning modality for students against public health protections.

General Questions:

1. Can you begin by introducing yourself? (name, major, year of study, and country of origin)
2. How are your studies going?
3. Reflecting on the initial 'strict' lockdown phase in February/March, What was your initial response to this situation?

Because of COVID-19, were your practicum courses affected? For example, the courses were suspended, change to an on-line format, change of grading policy, changes of lab experiment? Please specify in which way.

a. Is there special arrangement from the school authorities to cope with this difficult situation?
b. What kind of balance was there in your timetable where you are required to be in classes (virtually or not)?
c. How did you find this change to the way your classes were delivered?
d. Were these responses up to your expectations?

1. 4. Did you have the right 'set up' e.g. hardware/software/bandwidth/internet speed required to manage your online learning, and the right **learning space** e.g. desk/ quiet space – **If not how did you manage to overcome these challenges?**

a. In terms of the technological aspects of online learning what have been your experiences using the technology?

b. In terms of the technological aspects of online learning what have been your experiences using the technology?

c. Did you feel prepared and that you had the skills required to manage the technology?

d. Did you feel you had the support from your teacher/s to manage the technology?

e. Please share how these changes might have affect your learning?

2. Because of COVID-19, was your campus life affected. Please specify in which way. Was your interaction with classmates and teachers affected? Are these changes affecting your expectations for college learning and life?

   a. What about the interactions with others on your course?
   b. Do you feel more connected, less connected, or just as connected with your peers?
   c. Do you feel more connected, less connected, or just as connected with the university? (with your teachers?)
   d. Do you feel part of a **community**?
   e. How about pre-existing friendships – do you feel these have been impacted?
   f. How have you managed physical/social distancing?

   6-1. If NCKU has to close its campus due to the pandemic with only on-line teaching available, what do you think will be the (most) valuable facilities or services that you cannot use, such as the fitness/recreation center/ Libraries/ Student activity center or dorm/dining hall/ student clubs activity/ campus recruiting events?

3. 7. NCKU has asked students to report the COVID-19 health survey and scan QR code while entering any campus building for contact tracing. Please share your thoughts about these regulations and your observations.

4. 8. In your opinion, what is the most preferred teaching modality: full on-line, hybrid, with a mix of some on-line or some in-person. Why?

a. Do you find it easier to learn in a more virtual learning environment?

b. Is there any course that you think you cannot learn from on-line format? Why?

5. 9. Do you plan to study abroad? (check all apply)

c. Degree program

d. Practicum

    e.   Exchange program
    f.   None (skip the next question)

    Because of COVID-19, is your study and career planning affected? Please specify in which way. (Cancellation of plans, postponement of dates, change of destination, etc.)

    a.   Is there any advice or aid from your school or family?

6.   b. What were the biggest challenges you had to deal with?
7.   c. Looking back, had you felt prepared for this 'new' approach to studying?
8.   d. How have things changed from 'then' to 'now'? And what lockdown practices do you think would be useful to keep in NCKU's normal educational system?

    11. And finally, on reflection of the whole experience – of how the COVID-19 crisis has impacted on your university and student experience would you be able to identify any positives that have come out of the experience?

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors declare that they have no competing interests.

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