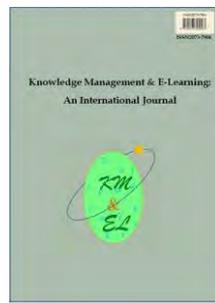

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in teacher education: A case study from Hong Kong**

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Zoom supported emergency remote teaching and learning in teacher education: A case study from Hong Kong

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Abstract: The shift from face-to-face teaching to emergency remote teaching has become the new normal due to the pandemic in 2020. However, little research has been conducted in Hong Kong to investigate pre-service teachers' perceptions of the immediate adoption and delivery of online face-to-face teaching. In response to this call, the present research conducted a questionnaire survey with 48 pre-service teachers at a Hong Kong university to examine their perceptions of Zoom as a viable alternative to the suspended traditional face-to-face delivery mode of instruction. It also discussed key factors that lead to better online learning outcomes. The results showed that the participants had overall positive perceptions of Zoom-supported synchronous online education. The Zoom feature that most students considered useful was screen sharing on computers. Zoom-supported synchronous online learning benefited students by helping them to attend class meetings remotely, study course materials and content, communicate and collaborate with their instructors and classmates, and develop a sense of community and social presence. Four main factors may influence learners' perceptions of synchronous online learning: the quality of online communication and collaboration, learning efficiency, learner autonomy and the usability of technology.

Keywords: Zoom; Synchronous online learning; Synchronous online teaching; Engagement; Emergency remote teaching

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1. Introduction

The 2019-2020 academic year in Hong Kong witnessed an unprecedented increase in the need for synchronous (i.e., real-time) supported online teaching and learning. Recent events such as the civil unrest from November 2019 to January 2020 triggered by the now-suspended 2019 Hong Kong Extradition Bill and the global spread of COVID-19 since February 2020 have forced educators to abandon traditional face-to-face lessons. Accordingly, they have moved rapidly to delivering emergency remote teaching and learning entirely online using synchronous meeting tools such as Zoom (Moorhouse, 2020). Emergency remote teaching is defined as “*a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances [that] involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated*” (Hodges et al., 2020). Thus, the course (e.g., materials, activities, assignments, assessments, platform) is not purposefully designed for synchronous delivery (Onyema et al., 2020). This new and unique teaching and learning environment has significantly altered the way higher education students engage and learn. Prior to the disruption caused by COVID-19, in Hong Kong, most university courses incorporated some asynchronous online learning (e.g., blogs, wikis, forums) (Cheng & Chau, 2014). However, the enforced pure and instantaneous online-only mode of emergency remote teaching and learning using video-conferencing software such as Zoom is new. Although previous studies of higher education students' perceptions of online learning took place prior to the COVID-19 pandemic (Dumford & Miller, 2018; Lee, 2017), few studies have explored the immediate adoption and delivery of emergency remote teaching and learning in lieu of face-to-face teaching.

Therefore, the aim of this study is to explicate Hong Kong university students' perceptions and experience with Zoom-supported synchronous online education to determine the key factors that lead to better online learning outcomes. As such, the study makes a significant contribution by presenting a comprehensive picture of the usefulness and impact of Zoom-supported synchronous online instruction from learners' perspectives. It may also provide educators with pedagogical implications and strategies

to engage learners in emergency online teaching as preparation for the possible suspension of face-to-face classes in the future.

2. Literature review

In Hong Kong and elsewhere, the incorporation of synchronous and asynchronous teaching and learning is increasingly becoming normal in higher education (Broadbent, 2017; Sing & Thurman, 2019). The rapid demand for higher education institutions to offer online courses is continuing (Moradimokhles & Hwang, 2020), as institutions believe that this method of instruction will be critical to the future of education (Garcia et al., 2019). However, the difference is that emergency remote teaching is being implemented rapidly as a crisis response, and thus the courses are not purposely designed for online teaching and learning (Hodges et al., 2020; Vlachopoulos, 2020). In the necessitated migration to emergency remote teaching and learning, higher education institutions have utilised existing learning management systems (e.g., Blackboard, Moodle, Canvas) to incorporate videoconferencing software (e.g., Zoom, Microsoft Teams, Collaborate Ultra) (Adedoyin & Soykan, 2020) to maintain the academic calendar. With this in mind, it is vital to explore how students experience emergency remote teaching as a replacement for traditional face-to-face classroom delivery.

The literature showed students' mixed perceptions of emergency remote teaching and learning at the tertiary levels. Under the rapid transformation of learning and teaching mode, some students held positive attitudes to and satisfaction (Law, 2021), perceiving high efficiency and low anxiety in remote teaching and learning (Alqabbani et al., 2021), while others demonstrated overall negative perceptions of online knowledge delivery and a strong preference to the traditional face-to-face approach (Aguilera-Hermida, 2020; Bayrak, 2022; Zagkos et al., 2022). Researchers have identified several factors and features that might have influenced university learners' perceptions of emergency remote teaching and learning during the pandemic. Zagkos et al. (2022) found the negative impacts of poor quality of pedagogical relationships, unequal digital equipment, and unsatisfactory technological infrastructure on students' attitudes towards remote online learning. Aguilera-Hermida (2020) focused on learner factors and argued that students' engagement in the new teaching and learning mode heavily depended on their original attitude to online learning, motivation and self-efficacy, and competence in using technology. Hussein et al. (2020) found that most students perceived the merits of online learning in saving their time and money on transportation, reducing their risk of the pandemic to their health, and increasing the convenience of study, while the reduced focus on learning, heavy workload, and the lack of group- and team-work might have negatively influenced students' perceptions of this new learning approach.

There are several advantages of online learning over traditional face-to-face and blended education. They include no space and time barriers, so learners have the flexibility and accessibility to study anytime and anywhere (Lee, 2017), connecting virtually (Healey, 2016) without being physically present in the classroom (van Doorn & van Doorn, 2014). Technology also brings advantages to the learning process that might not otherwise be available by promoting practices, delivering instructional content, facilitating interactions and restructuring teaching approaches (Zhang & Zou, 2022b). The migration to emergency remote teaching and learning exposed socioeconomic inequalities due to students' differential access to computers, broadband Internet and quiet places to study (Adedoyin & Soykan, 2020; Alvarez, 2020; Bozkurt et al., 2020; Weldon et al., 2021). Additionally, studies have reported students feeling isolated and the learning mode making it increasingly challenging to foster closeness and a sense of

belonging (Kohnke & Moorhouse, 2021). Therefore, it is becoming increasingly important, due to the emergency transition to online teaching at higher education institutions around the world, to identify which aspects of online instruction and technology foster closeness and facilitate better online teaching and learning experiences. This is particularly true since higher education institutions face increasing pressure to maintain their enrolment levels and because today's consumer-like students have higher expectations even when enrolling in a single course (Lee, 2017).

Generally, studies prior to the COVID-19 pandemic investigating real-time videoconferencing have used Skype (Kato et al., 2016; Terhune, 2016). Along with the findings of recent studies, they have established that higher education instructors may not be fully prepared to teach online in real time, as it requires new digital competencies (Starkey, 2020; Huber & Helm, 2020). Specifically, instructors need institutional support in both technology skills and digital pedagogy (Naylor & Nyanjom, 2020) for teachers to adapt face-to-face activities to a purely online format without losing valuable content knowledge and interaction (Shuey, 2002). As many higher education instructors were not prepared for emergency remote teaching and learning (Moorhouse & Kohnke, 2021a; Moorhouse & Kohnke, 2021b) and lacked professional development opportunities (Rapanta, 2020), teachers ended up relying heavily on multiple-choice quizzes and exams in the online classroom (Wijekumar et al., 2006). Research also demonstrates that online students have a higher dropout rate than face-to-face students (Levy, 2007). This could be because this form of learning involves more self-regulated learning (Schwam et al, 2021) and because engagement in online courses remains mixed (Kahn et al., 2017). A shift to online study requires adjustments to teaching and learning practices for both teachers and students to make it a pedagogically interactive and collaborative experience (Stahl et al., 2006).

Previous studies have found that the quality of online learning depends on the quality of interactions during the teaching-learning processes (e.g., instructor-student, student-peer and student-content interactions) (Weiser et al., 2018). Specifically, teacher immediacy increases learning satisfaction, and it can involve verbal and/or nonverbal behaviours that reduce the perceived distance (Limperos et al., 2015). In the online classroom, this can be achieved by utilising video, chat, polls and breakout rooms to support a variety of online learning activities (Bai et al., 2019; Kohnke & Moorhouse, 2022a). Having a social presence and feeling a sense of community and togetherness have been linked with increased satisfaction with the course and better learning outcomes (Richardson & Swan, 2003; Swan & Shih, 2005).

Perhaps the most difficult challenge facing learners in online learning is participation through rich interaction (Livny & Yair, 2014). Considering that interaction promotes language acquisition and learner autonomy (Long, 1996; Pavlenko & Lantolf, 2000; Vygotsky, 1978), several researchers have focused on the interactive affordances videoconferencing technology offers and how these can help teachers to promote student interaction. They can do so by being positive and active in the online classroom (McBrien et al., 2009; Rassaei, 2017), delivering continuous constructive feedback (Banna et al., 2015), encouraging discussion (Weiser et al., 2018) and utilising pedagogical strategies, including student response systems (e.g., Mentimeter, GoSoapBox, Kahoot!) and tools that encourage interaction (Chen et al., 2015; Kohnke, 2021; Kohnke & Moorhouse, 2022b; Moorhouse & Kohnke, 2020; Tomczyk et al., 2022).

The existing literature proposes various frameworks for investigating and promoting interaction in online learning. For example, Holmberg's (2005) comment, "*distance education works*" highlights that teachers need to develop positive relationships

with students. If they do, this can foster a sense of belonging and community and promote interaction. Moreover, Moore's (1983) framework for transactional distance put forward the notions that the distance between teacher and student should be pedagogical and not geographical, and that dialogue can be promoted by valued interactions. Another relevant framework is Kearney et al.'s (2012), which is grounded in a sociocultural perspective in which the authors propose personalisation, authenticity and collaboration as the three main concepts of positive student experience and interaction in online learning.

In terms of language learning, synchronous learning presents multiple, effective collaborative opportunities for learners to interact (Rassaei, 2017; Reinders & White, 2016). Edelbring et al. (2020) divided their participants into three groups: face-to-face instruction, asynchronous support in the classroom, and synchronous online learning. The results showed that the participants in the face-to-face and synchronous learning groups were similar to each other in emotion, cognition and overall group effectiveness, and they performed significantly better than the asynchronous learning group. Similarly, Shintani and Aubrey (2016) reported that synchronous learning significantly outperformed asynchronous learning in writing performance among second language learners. This suggests that online synchronous meeting tools such as Zoom play a pivotal role in reducing the perceived gap between online and face-to-face learning.

To conduct effective and interactive synchronous online learning, Peachey (2017) proposed four main technology-enhanced teaching strategies: (a) managing the class, (b) setting up group and pair work, (c) using text chat and (d) using an interactive whiteboard. Synchronous meeting tools such as Zoom can be particularly effective to support these four strategies as an online delivery mechanism. Zoom (<https://zoom.us>) is a videoconferencing software program. Designed for online conferencing and webinars, Zoom features include one-on-one meetings, a chat box, group video conferencing, meeting recording and transcribing, screen sharing, co-annotating, document sharing, whiteboard, breakout rooms, etc. – which conceivably offer support for a wide variety of synchronous online learning activities (Bai et al., 2019; Kohnke & Moorhouse, 2022a). Scanga et al. (2018) provided empirical evidence supporting the effectiveness of Zoom-supported synchronous online learning. They also reported that students who took a Zoom-supported synchronous online training course on Burundian culture achieved significant progress in their cultural knowledge and understanding of Burundian life. Darr et al. (2019) found no perceived difference between Zoom-supported and in-person communications. Most of their participants agreed that the proposed learning approach helped them to develop problem-solving skills, as well as self-awareness and responsibility for self-learning. These findings are especially important in the context of this study, as instruction was moved online immediately with little, if any preparation. Hence, it is important to investigate students' perceptions of Zoom as a viable alternative to the suspended traditional face-to-face delivery mode of instruction further.

3. Research gap and research questions

Although previous research has made valuable contributions to Zoom-supported synchronous online learning and teaching, we identified several limitations. First, despite the rich contribution on this topic, relevant studies based on the cases from Hong Kong remain sparse. Previous studies have revealed large differences among learners' perceptions of remote online learning during the pandemic according to their different demographic and social backgrounds. For example, most students in UAE disregarded digital equipment and technological infrastructure as a crucial factor influencing their

perceptions and efficiency of remote study (Hussein et al., 2020), while this factor was highly valued in the case of Greece (Zagkos et al., 2022). Hence, it appears inappropriate to generalise the results of relevant studies across demographics, yielding the necessity to investigate the cases from Hong Kong. Second, most studies investigated Zoom as part of a blended learning approach (e.g., Scanga et al., 2018; Singh et al., 2021). It was conceivably inappropriate to generalise these results to the purely Zoom-supported emergency remote instruction that was implemented throughout the 2019-2020 academic year. Third, to our best knowledge, there has been no previous study focusing on English for academic purposes (EAP) pre-service teachers' perceptions of authentic Zoom-supported synchronous online education. However, learners' perceptions have an essential influence on the effectiveness of both online learning (Song et al., 2004) and language education (Williams et al., 2004), so the effectiveness of Zoom-supported emergency remote learning and instruction is conceivably under the influence of learners now. Thus, it is valuable to investigate students' perceptions of this state-of-the-art learning approach use Zoom with higher efficiency in higher education in the future. Hence, we posed the following research questions:

RQ1: What features of Zoom did students consider useful in emergency remote learning?

RQ2: How did students benefit from Zoom-supported emergency remote learning?

4. Method

4.1. Setting and participants

The participants in the present study were 48 Master of Education students (36 female and 12 male) who were enrolled at an English-medium university in Hong Kong in the Spring of 2020. All of them were originally from mainland China but were attending the course – Professional Practice for EAP Teachers in China – in person in Hong Kong. After the suspension of face-to-face classes was announced in February 2020, the participants returned to mainland China and began participating in synchronous online learning. All of the participants were experienced with using modern technology as part of their learning and considered the use of technology to be increasingly important in education.

In the present study, the students used the videoconferencing software Zoom to attend real-time classroom instruction. Zoom-supported synchronous online teaching was offered every Thursday from 18:30 to 21:30. According to university regulations, it was compulsory to participate in all 13 sessions. The primary content of the course was EAP practice in China. Most of the students were Chinese learners of English who were not familiar with Zoom and had previously not used its various features extensively. The intuitive interface of Zoom and its high compatibility with different devices and operating systems (Bai et al., 2019; Kay & Pasarica, 2019) makes it a suitable tool to facilitate learning activities. It renders instruction and communication highly accessible for both experienced and inexperienced users (Kohnke & Moorhouse, 2022a). In EAP classes, Zoom can promote equal participation, improve language production and reduce anxiety (Kohnke & Zou, 2021).

4.2. Procedure

The participants' perceptions of Zoom and Zoom-supported synchronous online learning were collected through a questionnaire, which consisted of two parts. One part of it was structured and based on the Technology Acceptance Model (TAM) proposed by Davis (1989), an instrument that is often cited to measure and predict people's or organisations' perceptions of new technology (Al-Emran et al., 2018). Researchers have frequently applied the TAM in educational contexts and reported its overall usefulness (e.g., Alfadda & Mahdi, 2021; Edmunds et al., 2012). The questionnaire included a total of 23 items, covering three dimensions that corresponded to the three key constructs in the TAM model: Attitudes Towards Using Technology, Usage of a Technology and Perceived Usefulness. There were six items concerning attitudes towards Zoom (e.g., "Zoom was easy to use"), nine concerning its perceived impact (e.g., "Zoom allowed me to attend class meetings remotely") and eight concerning the perceived usefulness of its various features (e.g., "The whiteboard on Zoom was useful"). A 5-point Likert-type scale was employed for the multiple-choice questions, with response options ranging from 1 (low) to 5 (high). Chen et al. (2022) also applied this structured questionnaire to investigate learner attitude and motivation and identified its overall high reliability and validity.

The other part of this questionnaire was unstructured, including three open-ended questions concerning the participants' favourite features of Zoom and additional comments and opinions about the software and how it supports synchronous online learning. A mock questionnaire was conducted before the primary experiment with three students who had similar backgrounds to the participants. The mock survey demonstrated the reliability and validity of the questionnaire in collecting data to address our research questions. The questionnaire is presented in Appendix I.

The questionnaire was issued at the end of the semester after the participants had experienced Zoom-supported emergency remote teaching and learning for three months. Thus, their reported attitudes toward using Zoom for synchronous online learning, its perceived impact, the usefulness of its features and their favourite features were the result of their longitudinal experience. These longitudinal survey results – which differ from short-term study results, which are likely influenced by initial feelings of freshness or anxiety caused by unfamiliarity – indicate views that had stabilised after three months of fluctuation. Moreover, the participants engaged in the questionnaire anonymously and were encouraged to answer the open-response questions in Chinese, their first language, so they could feel free to express themselves.

Descriptive analyses were conducted on the structured part of the questionnaire, describing the numbers and percentages of the participants reporting different opinions and perceptions of Zoom-supported synchronous online learning. The authors conducted independent data analyses and then compared their results. The results showed satisfactory inter-rater reliability (Pearson's $r = 0.98$), with minor differences resolved via discussion.

The authors worked together to translate the answers from the unstructured part of the survey into English. Then, we analysed the answers independently. The participants' main opinions were abstracted from their answers and grouped according to the Zoom features they mentioned. The frequency with which different Zoom features were mentioned in the survey was also calculated, along with representative quotations. The authors compared the results of their independent analyses. Satisfactory inter-rater reliability was reached (Pearson's $r = 0.93$), with differences resolved via discussion.

5. Results

In this section, we present the results of this study of participants' overall attitudes to Zoom-supported synchronous online learning, the perceived impact of Zoom, the discerned usefulness of various Zoom features and participants' preferred Zoom features.

In the course, the instructor took advantage of several built-in interactive features of Zoom to engage students. The single- and multiple-choice poll function was employed in each class to obtain information about students' understanding and attention during lessons and adjust the presentation of content accordingly. Furthermore, students were encouraged to ask questions, comment and react to class content using non-verbal, built-in emojis; this allowed them to communicate without interrupting the speaker. For example, students were encouraged to 'raise their hand' using the hand emoji if they had a question. Alternatively, they could write questions in the chat box. Moreover, if students were unsure about a particular slide in a presentation, they could annotate it directly to indicate the content they wanted to be explained. As online teaching may reduce the number of visible non-verbal cues, these functions were employed to enforce turn-taking, check for understanding and allow students to seek clarification or ask questions.

In each class, the instructor shared the discussion prompts verbally and using the chat feature, informed students how many minutes they had for each prompt and assigned them randomly to breakout groups. This was intended to ensure all students had the opportunity to work together over the course. Discussion questions were often related to the application of concepts to increase dynamic interaction and allow students to express themselves. Groups were kept small (3-4 students) to increase participation and guarantee that students were not restricted by screen size. Students were asked to nominate representatives who could report back to the whole class after the breakout rooms were closed. Interactive activities were incorporated into each class to encourage communication and create an environment conducive to online learning.

The aim was to embrace the interactive features of Zoom and encourage students to participate actively in their learning. By incorporating features such as polls, emojis, the chat box and breakout rooms, the instructor encouraged students to do more thinking, writing and interacting with peers with the aim of improving their engagement and learning. It was hoped that this would replicate face-to-face education. In previous face-to-face courses, the instructor incorporated student response systems (polls, word clouds) to check students' understanding, as well as Padlet and Lino to allow students to share their answers to discussion questions.

5.1. Overall attitudes to Zoom-supported synchronous online learning

The participants held overall positive attitudes toward Zoom for synchronous online learning. As Fig. 1 illustrates, 24 participants agreed and 17 strongly agreed that Zoom was beneficial to their overall learning in the course. Sixteen agreed and 24 strongly agreed that Zoom supported them in self-expression and idea-voicing in new and creative ways. Twenty-three agreed and 18 strongly agreed that Zoom was easy to use. Eighteen agreed and 18 strongly agreed that Zoom was useful for their learning. Fifteen agreed and 19 strongly agreed that they had enjoyed using Zoom in their course(s). Eighteen agreed and 20 strongly agreed that they would recommend the use of Zoom in other classes.

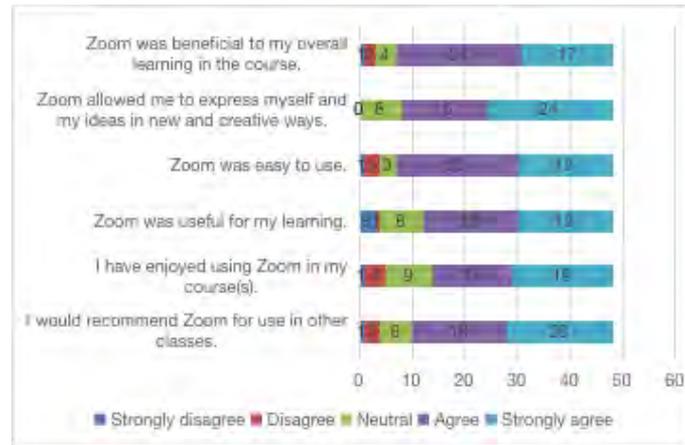


Fig. 1. Attitudes towards Zoom

Despite these overall positive attitudes, between three and nine participants held neutral opinions on each statement. Also, six participants disagreed or strongly disagreed about the overall benefit of Zoom in their course. Eight participants disagreed that Zoom helped them to express themselves and their ideas in new and creative ways. Three participants disagreed or strongly disagreed on the ease of using Zoom. One participant strongly disagreed about the usefulness of Zoom. Three participants disagreed or strongly disagreed that they enjoyed using Zoom in their course(s). Three participants disagreed or strongly disagreed that they would recommend using Zoom.

5.2. Perceived impact of Zoom

The perceived impact of Zoom was generally positive, as Fig. 2 shows. The most-acknowledged impact was that Zoom allowed students to attend class meetings remotely (agreed by 18 and strongly agreed by 26), followed by Zoom helped students to communicate with their instructors (agreed by 31 and strongly agreed by 12). Zoom also aided them in communicating with their classmates (agreed by 32 and strongly agreed by seven) and enhanced a sense of community and social presence in the course (agreed by 22 and strongly agreed by 15). Zoom helped students to make efficient use of their time in the course (agreed by 21 and strongly agreed by 16) and supported students' collaboration with their classmates (agreed by 28 and strongly agreed by eight). Zoom was useful in their learning of the course materials and content (agreed by 23 and strongly agreed by 13) and helped students to control their own learning in the course (agreed by 22 and strongly agreed by 13). Finally, Zoom was helpful in their study for quizzes/exams (agreed by 21 and strongly agreed by 11).

5.3. Perceived usefulness of Zoom

The perceived usefulness of the eight main features of Zoom varied but was overall positive, as Fig. 3 shows. The feature most participants considered useful was screen sharing (very useful to 26 participants, moderately useful to 17), followed by group messaging including chat (very useful to 28, moderately useful to 12). Next came the recording of video and shared content (very useful to 27, moderately useful to 12) and collaboration with co-annotations (very useful to 19, moderately useful to 17). Then came Mac and mobile device compatibility (very useful to 20, moderately useful to 15) and

document sharing (very useful to 20, moderately useful to 11). Finally, whiteboard (very useful to 14, moderately useful to 15) and screen sharing on mobile devices (iPhone/iPad) (very useful to 15, moderately useful to 6).

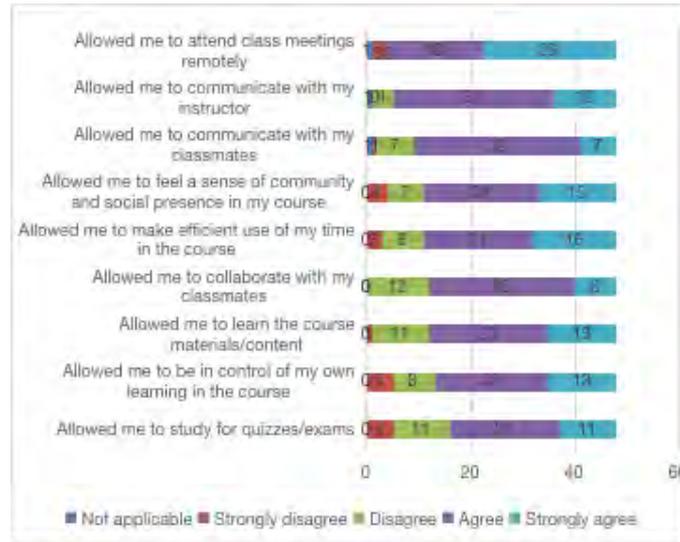


Fig. 2. Perceived impact of zoom

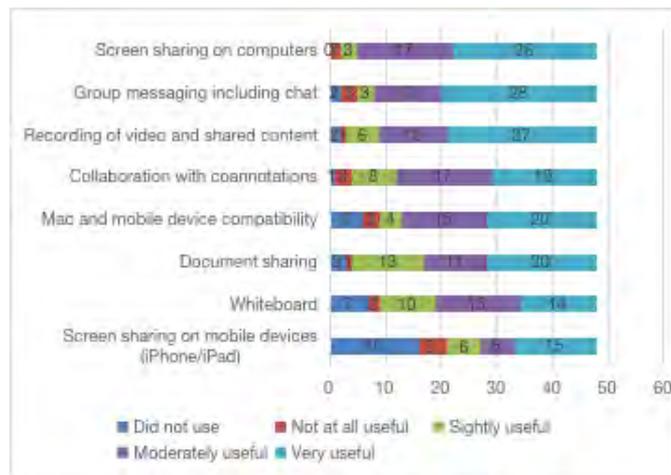


Fig. 3. Perceived usefulness of various features of Zoom

However, some participants did not perceive certain Zoom features as useful. For example, 14 participants regarded document sharing as slightly useful or not at all useful; 12 rejected the usefulness of whiteboard; 11 found screen sharing on mobile devices not useful or only slightly useful; and 11 regarded the collaboration with co-annotations as not useful or only slightly useful. Other features received relatively low usage. Screen sharing on mobile devices was the least used feature because up to 16 participants admitted that they never used it. Mac and mobile device compatibility and whiteboard were also irrelevant to six and seven participants, respectively.

5.4. Favourite Zoom feature

Based on the 16 participants' answers to the question about their favourite features, we summarised the six most favoured features among the students of Zoom-supported synchronous online learning, as Fig. 4 shows. The most frequently mentioned feature was the chatbox (25 participants), followed by the cloud-based system (20 participants). Then came breakout rooms (15 participants), video conferencing (seven participants), meeting recording (five participants) and screen sharing (three participants). The total is more than 48 because some participants mentioned more than one favourite feature.

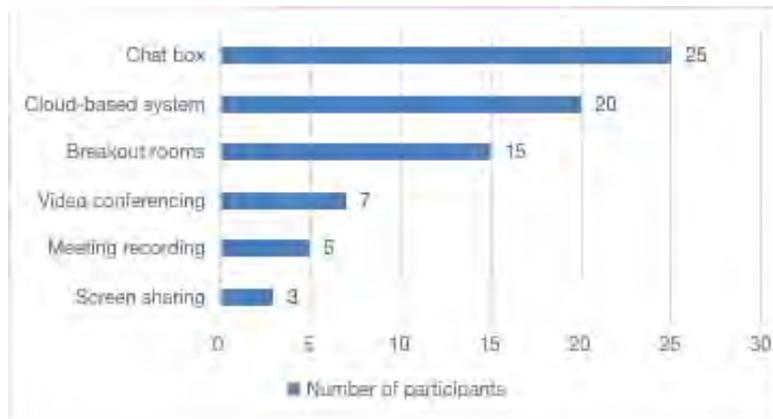


Fig. 4. Favourite features of Zoom

Most participants favoured chatbox, which provides an easy channel of textual communication between students and teachers, for three main reasons. First, the participants believed that the chatbox allowed them to interact with teachers and classmates more quickly and efficiently than they could in the traditional classroom. In traditional offline instruction, students tend to voice their opinions and questions one by one; when responses take a long time, students must delay their comments until after class and/or make appointments with teachers. Supported by Zoom, however, students expressed their opinions and raised questions by typing them in the chatbox immediately; their classmates and instructors could return feedback whenever they were available. According to participants, the chatbox made communications more rapid and efficient than traditional ways, since they “[did] not have to wait” and could have their “expressions heard, and questions answered in time”. Second, the chatbox encouraged shy or withdrawn students to engage in communication and collaboration. In an offline language classroom, shy or withdrawn students tended to feel challenged, uncomfortable and embarrassed to participate in communicative and collaborative class activities (Fallah, 2014). However, participants who admitted being shy or introverted said that they felt “more protected” and “less embarrassed” when communicating with the chatbox than in face-to-face classes. Third, the chatbox helped students to obtain information in discussions. One participant mentioned that she usually “miss[ed] people’s ideas” in face-to-face discussions in which ideas were mainly auditory information. However, the chatbox displays students’ opinions and scaffolding in static texts from which she could obtain and target information completely and precisely.

The cloud-based system of Zoom was essential for the high accessibility of the course, allowing students to receive instruction and participate in discussions and group work wherever they liked. Participants voted for this feature as their favourite because it

provided them with high convenience and flexibility when attending the course. One participant wrote in the survey that *“It’s dangerous outside in the time of the rampant spread of the epidemic, so I felt much safer to stay at home and use Zoom for study.”*

Breakout rooms provided a virtual space for participants to work on the course’s group project. The participants favoured this feature because it allowed them to have important discussions privately, for which one participant provided supporting evidence: *“Different groups had to conceive their topics for their projects so, in the beginning, the inspirations were important and [they] had to be discussed within the group. A breakout room allows a student to discuss important issues efficiently and secretly without being heard by others.”*

Five participants favoured the video conferencing of Zoom because it enabled them to engage in synchronous online learning and discussions like those in face-to-face instruction. One participant specified the usefulness of video conferencing by writing that *“with video conferencing, we could see and hear each other in online classes and discussions in the same way we could in traditional classrooms”*. Three participants considered meeting recording as their favourite feature of Zoom because it enabled them to review classes by repeating recorded meetings. As supporting evidence, one participant wrote in the survey that *“the recording function ma[de] my review and study for quizzes very convenient”*. Three participants voted for screen sharing as their favourite feature of Zoom because it allowed them to see the teacher’s instructions clearly and directly.

6. Conclusion and discussion

This study focused on pre-service teachers’ perceptions and experience of Zoom-supported synchronous online education at a Hong Kong university. Overall, perceptions were positive. Most students agreed that Zoom-supported synchronous online learning was an easy, useful, enjoyable experience, helped them learn and facilitated creative self-expression. Most indicated that they would recommend its use in other classes. The feature that most students considered useful (RQ1) was screen sharing on computers, followed by group messaging (including chat), recording video and shared content, and Mac and mobile device compatibility. The features that the students liked most were chat boxes, the cloud-based system, breakout rooms, videoconferencing, meeting recording capacity and screen sharing. Zoom-supported synchronous online learning benefited students (RQ2) by allowing them to attend class meetings remotely, access course materials and content, communicate and collaborate with their instructors and classmates and develop a sense of community and social presence.

6.1. Factors that may influence learners’ perception of Zoom-supported emergency remote learning

We identified four factors that may influence learners’ perceptions of Zoom-supported emergency remote learning. The first is the quality of online communication and collaboration. The students perceived learning methods as most useful when they incorporated convenient and synchronous peer communication and collaboration. Similarly, they reacted positively to instructors when they could express their opinions and raise questions immediately, have discussions privately and feel a sense of community and social presence. These conclusions were drawn from their answers to the questionnaire. The three aspects of Zoom that they rated the most positively were related

to its usefulness in helping them communicate and collaborate with their instructors and classmates. The fourth most positive perceived impact of Zoom was its ability to enhance their sense of community and social presence in online learning. Furthermore, the two Zoom features that the greatest number of them considered useful – screen sharing and group messaging – were related to online communication. Also, the two Zoom features that they liked the most were the chat box and breakout rooms. These results confirm an observation made in several previous studies (e.g., Chen et al., 2015; Livny & Yair, 2014; Pavlenko & Lantolf, 2000; Weiser et al., 2018) that the quality of communication is a determinant of the learning experience and learning effectiveness. They also support earlier findings of the positive effects of building students' sense of community and social presence in emergency remote teaching (Kohnke & Moorhouse, 2021; Moorhouse et al., 2021). Based on these findings, we suggest that designers of educational computer systems consider including and further improving system features that enable easy sharing and communication among students (e.g., screen sharing, chatrooms, private messages to selected users, etc.). These features could increase students' sense of belonging to and ownership of the online community. Teachers are also encouraged to make more use of such features to promote students' active participation in online learning and emergency remote teaching.

Learning efficiency is another factor that may influence students' perceptions of Zoom-supported synchronous online learning. Based on responses to the questionnaire, the second and third most negative impacts of Zoom were that it did not help the learners use the online lessons efficiently or study for quizzes and exams. In contrast, they identified its third most useful feature as its ability to record video – a feature that helped them review previous lectures. Also, the chat box was the students' favourite Zoom feature in part because it enhanced the efficiency of communication: it enabled them to raise questions, express opinions and give immediate feedback. The close relationship between students' perceptions of Zoom and the degree to which it helped them control the learning process and expedite review and communication may be a result of their desire to study efficiently for quizzes and exams. Learning efficiency is one of the things that students value most in emergency remote teaching (Tulaskar & Turunen, 2022). The requirement that students take quizzes and exams may have reinforced such expectations that they will need to study efficiently in an online course (Kohnke et al., 2021). Based on these findings, we suggest that designers of educational computer systems consider including and further improving system features that provided a variety of real-time formative assessments. Take Mentimeter as an example, its features such as enabling all users to create a word cloud together and enabling polls, quizzes, and surveys are very effective in promoting active learning (Moorhouse & Kohnke, 2020). These features could increase students' behavioural and cognitive engagement in online learning and emergency remote teaching. We also advise teachers to integrate more real-time formative assessments into their emergency remote teaching to monitor students' online learning and provide ongoing feedback.

A desire for autonomy is another factor that may influence learners' perceptions of Zoom-supported synchronous online learning. Students tend to have more positive learning attitudes and perceive high levels of effectiveness in online learning when they can decide its time, location and pace (Paradedda & Santos, 2022). In this study, most participants found Zoom useful in allowing them to attend courses wherever they liked. The second-most-favoured Zoom feature was the cloud-based system, which allowed them to access learning materials on demand. This promoted learner autonomy in online learning (Zhang & Zou, 2022b). Further evidence of the importance of autonomy was that the most negative perceived impact of Zoom was the difficulty of controlling the

online learning process. Thus, the students' sense of control over the learning process influenced their perceptions (see also Aquilera-Hermida, 2020).

Finally, learners' perceptions of technology-enhanced learning methods depend, in part, on the degree to which the technology is easy to use (Zhang & Zou, 2022a). The Zoom feature that most participants considered useful was screen sharing on computers, whereas that which the fewest participants considered useful was screen sharing on mobile devices. This reveals that the perceived usefulness of a feature may vary greatly depending on the technology used to access it. Students tend to take more control of their learning, perceive instructional materials at higher efficiency and have better attitudes towards technology-enhanced learning processes when screen sizes are larger (Kim & Kim, 2012). The screen sizes of computers are generally larger than those of mobile devices, so the students may have had a better experience of Zoom-supported synchronous online learning when using the former. The fact that the students considered the whiteboard as the second least useful Zoom feature supports the influence of usability on learners' perceptions. This feature required relatively high levels of digital literacy to manipulate, and many had difficulty in using it efficiently. These findings further provide support to the Technology Acceptance Model, which argues that students' perceived usefulness and ease of use of educational systems and their intention to use the systems influence their learning attitude and performance (Lee et al., 2003).

These findings contribute to existing research on emergency remote teaching. They reveal the pedagogical importance of developing positive student-student and student-teacher relationships (Kohnke & Moorhouse, 2021; Holmberg, 2005; Shambour & Abu-Hashem, 2022). The use of a range of features in Zoom led to positive learning experiences, despite the geographical distance between the students and teacher (Moore, 1983). This research builds upon Kearney et al. (2012), who argued that personalisation and collaboration through technologically mediated interactions are essential to enhancing students' learning experiences and giving them flexibility and autonomy. We propose the following five guidelines to develop effective Zoom-supportive teaching and learning based on our findings:

- Promote collaborative learning and interactions (e.g., pair, group) by using breakout rooms and screen sharing.
- Promote the use of non-verbal icons (e.g., thumbs up, thumbs down) to show agreement, confusion or attentiveness.
- Promote engagement by using polls and surveys to gather answers, perceptions and ideas.
- Provide supportive pedagogy by using the chat function to check in with each student at each lesson by sending an individual message.
- Promote autonomous learning by recording lessons for students to review.

Some areas of research deserve further attention. First, the data were self-reported. Future research should include follow-up interviews to probe students' attitudes and beliefs in greater detail. Second, this study only involved one course, so the findings may not be generalisable to other institutions and students. The sample size could be increased and the scope of the research broadened to include a range of courses and higher education institutions. This would provide additional evidence of the impact of Zoom-based emergency remote teaching and different pedagogical approaches for successful online teaching and learning. Third, this study focused mainly on students' attitudes toward Zoom for synchronous online learning, including their perceptions of the

usefulness of Zoom's features. Future research could investigate other aspects of the use of Zoom – for example, learner engagement and learning behaviours. Fourth, exploring the educational effectiveness of Zoom was out of the scope of this research. This promising direction should be investigated through quasi-experimental studies and statistical analyses to determine to what extent and in what ways the students' academic performance could be enhanced by Zoom. Finally, this study did not consider the cause-and-effect relationship. Future researchers could adopt regression analysis and structural equation modelling to investigate the specific factors that lead to effective Zoom-supported synchronous online learning.

The COVID-19 pandemic has had a tremendous impact on teaching and learning in higher education. The results of the current study add to the limited body of knowledge on Zoom-supported emergency online teaching and learning in higher education in Hong Kong. They offer teachers and institutions insight into students' perceptions of the value of various features of the software. We close by noting that one year after COVID-19 has declared a pandemic, remote teaching has become the norm in higher education. In Hong Kong and beyond, more research on delivering emergency remote lessons is needed to improve the effectiveness and efficiency of synchronous learning.

Author Statement

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Appendix I

Questionnaire on students’ perceptions of Zoom and Zoom-supported synchronous online learning

I. Multiple choice

Instructions:

1. If you strongly disagree the statement, please tick (√) in [1].
2. If you slightly disagree the statement, please tick (√) in [2].
3. If you hold neutral opinion of the statement, please tick (√) in [3].
4. If you slightly agree the statement, please tick (√) in [4].
5. If you strongly agree the statement, please tick (√) in [5].

Items	Perceptions
Attitudes Towards Zoom	
1. I would recommend Zoom for use in other classes.	[1] [2] [3] [4] [5]
2. I have enjoyed using Zoom in my course(s).	[1] [2] [3] [4] [5]
3. Zoom was useful for my learning.	[1] [2] [3] [4] [5]
4. Zoom was easy to use.	[1] [2] [3] [4] [5]
5. Zoom allowed me to express myself and my ideas in new and creative ways.	[1] [2] [3] [4] [5]
6. Zoom was beneficial to my overall learning in the course.	[1] [2] [3] [4] [5]
Perceived Benefits of Zoom	
1. Zoom allowed me to study for quizzes/exams.	[1] [2] [3] [4] [5]
2. Zoom allowed to be in control of my own learning in the course.	[1] [2] [3] [4] [5]
3. Zoom allowed to learn the course materials/content.	[1] [2] [3] [4] [5]
4. Zoom allowed to collaborate with my classmates.	[1] [2] [3] [4] [5]
5. Zoom allowed to make efficient use of my time in the course.	[1] [2] [3] [4] [5]
6. Zoom allowed to feel a sense of community and social presence in my course.	[1] [2] [3] [4] [5]
7. Zoom allowed me to communicate with my classmates.	[1] [2] [3] [4] [5]
8. Zoom allowed me to communicate with my instructor.	[1] [2] [3] [4] [5]
9. Zoom allowed me to attend class meetings remotely.	[1] [2] [3] [4] [5]
Perceived Usefulness of Various Features of Zoom	
1. The screen sharing on mobile devices (iPhone/iPad) of Zoom was useful.	[1] [2] [3] [4] [5]
2. The whiteboard of Zoom was useful.	[1] [2] [3] [4] [5]
3. The document sharing of Zoom was useful.	[1] [2] [3] [4] [5]
4. The Mac and mobile device compatibility of Zoom was useful.	[1] [2] [3] [4] [5]
5. The collaboration with coannotations of Zoom was useful.	[1] [2] [3] [4] [5]
6. The recording of video and shared content of Zoom was useful.	[1] [2] [3] [4] [5]
7. The group messaging including chat of Zoom was useful.	[1] [2] [3] [4] [5]
8. The screen sharing on computers of Zoom was useful.	[1] [2] [3] [4] [5]

II. Open-ended questions

1. What is your favourite Zoom feature? Why?
2. Please describe your opinions about Zoom.
3. Please describe your experiences of Zoom-supported synchronous online learning.