Contemporary Educational Technology, 2025, **17**(2), ep567
ISSN: 1309-517X (Online)

OPEN ACCESS

Research Article

Technology-enhanced personalized learning: Lessons from online teaching at three South-East Asian universities

Kaur Kiran [1]
0000-0003-3021-2576

Rohaida Mohd Saat [2]
0000-0002-0428-7366

Lieven Demeester [3]
0000-0003-1095-0256

Magdeleine Duan Ning Lew [4]
0000-0002-0662-3968

Wei Leng Neo [4*]
0000-0003-3728-1662

Nopphol Pausawasdi [5]
0000-0001-6612- 3941

Thasaneeya Ratanaroutai Nopparatjamjomras [6]
0000-0002-7813-3095

[1] Department of Library & Information Science, Faculty of Arts & Social Science, Universiti Malaya, Kuala Lumpur, MALAYSIA
[2] Faculty of Education, Universiti Malaya, Kuala Lumpur, MALAYSIA
[3] Lee Kong Chian School of Business, Singapore Management University, SINGAPORE
[4] Center for Teaching Excellence, Singapore Management University, SINGAPORE
[5] Medical Education Technology Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, THAILAND
[6] Siriraj Health Science Education Excellence Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, THAILAND
[*] Corresponding author: wlneo@smu.edu.sg

Citation: Kiran, K., Saat, R. M., Demeester, L., Lew, M. D. N., Neo, W. L., Pausawasdi, N., & Nopparatjamjomras, T. R. (2025). Technology-enhanced personalized learning: Lessons from online teaching at three South-East Asian universities. *Contemporary Educational Technology, 17*(2), ep567. https://doi.org/10.30935/cedtech/15946

ARTICLE INFO

Received: 10 Jul 2024
Accepted: 25 Sep 2024

ABSTRACT

Online teaching during the COVID-19 pandemic compelled many instructors to seek efficient and effective ways to stay connected with their students and improve the learning experience by using a wide range of available technologies. This multiple-case study, in three South-East Asian universities, investigated whether the use of technology in university teaching and learning during that period influenced personalized learning, and if so, how. The study also explored the kinds of institutional support for teachers and learners that led to increased technology-enhanced personalized learning (TEPL). Using a qualitative approach, the study analyzed 23 individual interviews and 3 document analyses (circulars, announcements, etc.), involving six administrators (AD), six faculty developers (FD), and eleven instructors. Purposeful sampling targeted AD involved in policy development and strategic planning, FD responsible for professional development programs, and instructors with high teaching evaluation scores and expertise in online learning across various disciplines. Thematic analysis revealed that technology enhanced flexibility in learning pace, time, and place, increased student choice in learning methods, enabled needs-driven teaching adjustments, and provided more and broader personalized feedback, sometimes facilitated by anonymity. The provision of training and resources, including emotional, physical, and infrastructure support for students, facilitated the growth of TEPL. The significance of this study lies in discussing how online teaching, and

institutional support for it, facilitated the growth of TEPL. Universities can explore collaborations to further advance this growth.

Keywords: technology-enhanced personalized learning, online teaching and learning, instructors, faculty developers, administrators, university support

INTRODUCTION

Technology's potential in transforming learning has consistently gained traction with education policymakers, practitioners, and researchers. One main vein of interest is technology-enhanced personalized learning (TEPL), which focuses on exploiting technology to provide diverse dimensions or degrees of personalization to serve varying learners' needs. TEPL can influence learner effectiveness, teacher effectiveness, and meta-learning (FitzGerald et al., 2018), as it facilitates "tailoring learning for each student's strengths, needs and interests–including enabling students' voices and choices in what, how, when and where they learn" (Patrick et al., 2013, p. 4).

Technologies to support learning were used extensively during the COVID-19 pandemic, with its broad quarantine measures, physical distancing, and lockdown of schools worldwide. Many universities quickly implemented different forms of online teaching to ensure learning continuity and adopted supportive measures to mitigate the teaching and learning risks posed by the disruption in face-to-face classes. This shift to online learning has been investigated worldwide. Students preferred the convenience and flexibility of online classes, such as recorded classes with quizzes at the end of each lesson (Muthuprasad et al., 2021). Students' learning experience was improved by using asynchronous, interactive learning resources because they could learn at their own pace (Hassoulas et al., 2023).

The use of social media also improved student participation and aided in building the university community (Papademetriou et al., 2022). Sobaih et al. (2020) report that university instructors and students used social media extensively, albeit differently. The instructors used it for sharing documents and getting feedback on course learning outcomes, whereas the students were more interested in building peer support, including emotional support and an online community. The instructors held diverse opinions on social media too. Some of them regarded it favorably and actively utilized its features for university teaching, while others perceived it as less appropriate and only employed it for communication purposes (Barrot & Acomular, 2022). Social media is presumed useful in developing a self-directed personalized learning environment and has a positive effect towards the undergraduates' intrinsic motivation and self-determination (Balakrishnan & Long, 2020). Looking forward, Whalley et al. (2021) argue for the use of mobile technologies in educational systems to promote student-centered pedagogy, and Hong et al. (2022), suggest enhancing learners' internet self-efficacy and self-efficacy of interacting with learning content to reduce the level of perceived ineffectiveness of online learning if another pandemic occurs.

Instructors who are proficient in using technology effectively were able to positively influence student satisfaction with online learning (Cole et al., 2014). El-Sayad et al. (2021) study suggested that student satisfaction was significantly and directly influenced by behavioral engagement and emotional engagement. Instructors who could create a warm and open online learning environment were more likely to emotionally engage with students to achieve learning success and perceptions of quality lectures (Lim et al., 2022). Interestingly, emotional engagement provided by pedagogical agents in the form of animated anthropomorphic characters in multimedia learning reduced confusion and improved intrinsic motivation (Lang et al., 2022). Studies also found that allowing anonymity could increase students' confidence when interacting in discussions (Jansson et al., 2021) and encouraged them to engage in conversations (Roberts & Rajah-Kanagasabai, 2013).

Instructors also leverage technology to provide feedback, which is associated with improved student learning (Hattie & Timperley, 2007). Learning analytics for example has the potential to scale effective, personalized, and timely feedback generated from learners' activities (Pardo et al., 2019). In a study on second-year university students' opinion on personalized recommendations and feedback based on learning analytics, Karaoğlan Yilmaz and Yilmaz (2020) concluded that students with low self-directed learning skills may benefit from this practice if the vulnerability of these students is addressed, and more focus is given on empowering the students as active participants. Kew and Tasir (2022) reported that learning analytics

interventions in e-learning improved student motivation, academic performance, cognitive engagement, and cognitive retention. A learner-centered design using self-recorded audio files, self-feedback by students, followed by instructor feedback, was reported to increase feedback responsibility, evaluative judgement, and psychological safety, culminating in higher student engagement (To, 2022). Empirical studies have found that the instructor-mediated approach to personalized feedback based on learning analytics is effective and well-received by students (Lim et al., 2021), as is focused and timely live online formative feedback (Peimani & Kamalipour, 2021).

Finally, in a more recent review of the extant literature in the context of higher education, Fariani et al. (2023) recognize that the use of technology is necessary for personalized learning. They identified some evidence that personalized learning implementation increased learning outcomes, learner satisfaction, motivation, and engagement, but also suggested the need for additional TEPL impact studies. Investigations of technologies and institutional support that influence personalized learning in practice can therefore be useful as they can identify opportunities for understanding the impact of TEPL.

While existing evidence suggests that TEPL can positively influence learning outcomes, learner satisfaction, motivation, and engagement, there is a lack of detailed understanding regarding how different types of technologies and institutional supports contribute to these improvements. Specifically, there is insufficient research on how the effectiveness of TEPL varies across different geographical locations, demographic groups, learning styles, and levels of prior knowledge.

Following the introduction, this paper begins with the motivation for the study and the research questions. The methods section then details the approach used to investigate these questions, including the selection of universities and criteria for analysis. The results section presents the study's findings on whether technology use during the COVID-19 pandemic influenced personalized learning and examines how various types of institutional support contributed to TEPL. The paper concludes by synthesizing the key findings, discussing their implications, and offering recommendations for future research and practice in personalized learning.

RESEARCH QUESTIONS

In 2020, the ASEAN University network (AUN) thematic network on TEPL (AUN-TEPL) was proposed as a strategic initiative to foster collaboration among AUN members. This network aims to harness the potential of big data and technology to enhance student success through personalized learning methodologies.

The motivation of this study is to conduct an inter-university research collaboration under the AUN-TEPL through providing a cross-country analysis of TEPL in the ASEAN region. Research involving universities from ASEAN countries offers valuable insights into TEPL implementation and effectiveness across diverse contexts. This can highlight best practices, challenges, and variations in TEPL outcomes, contributing to global understanding and advancements in personalized learning strategies. The onset of the COVID-19 pandemic presented an unexpected opportunity to investigate the impact of extensive online teaching and learning on TEPL. Two research questions led the research investigation:

RQ1: Did the use of technology in university teaching and learning during the COVID-19 pandemic influence personalized learning, and if so, how?

RQ2: Which kinds of institutional support for instructors and students led to more TEPL during the COVID-19 pandemic at universities?

METHODS

The research design was a multiple case study based on three South-East Asian public autonomous, research universities–in Malaysia, Singapore, and Thailand. Data collection methods used were 23 interviews and 3 document analysis (circulars, announcements, etc.). The interviewees consisted of six administrators (AD), six faculty developers (FD), and eleven instructors (IN). Purposeful sampling was employed to recruit interviewees who were actively involved in the promotion or enactment of online teaching and learning in the universities. The research team recruited AD who held key positions in the policy development and strategic planning of academic matters at the University; and FD who designed and conducted professional development programs for the University's academic staff. The instructors who were recruited for the study

Table 1. Characteristics of the countries involved in the research

	Malaysia	Singapore	Thailand
Years of establishment	110–120	20–30	80–90
Number of instructors (approximately)	2,200	400	4,000
Number of students (approximately)	29,000	12,000	28,000
Language of instruction	English or Bahasa Malaysia	English	Thai or English
Percentage of international students and number of countries	5.3% undergraduates and 31% postgraduates from 90 countries	8% undergraduates and 58% postgraduates from 50 countries	2.35% undergraduates and 11.3% postgraduates from 40 countries
Teaching approaches or pedagogies	- Experiential learning - Problem-based learning - Project-based learning	- Interactive pedagogy where instructors act as facilitators and students actively contribute to in-class learning - Case-based teaching - Experiential learning - TEPL	- Lecture - Experiential learning - Problem-based learning - Project-based learning - Independent study - Team-based learning - Online learning/MOOCs
Class size	From 240 or less for undergraduates and 50 or less for postgraduates.	From 45 or less for undergraduates and 70 or less for postgraduates	From 10 or less for undergraduates and 3 or less for postgraduates

performed above the university average in teaching evaluation scores, particularly in online learning, and they were each selected from different disciplines in their respective universities. As steering committee member universities of the AUN-TEPL, these institutions share a common vision to advance TEPL. Their visible efforts in promoting personalized learning through technology made them rich cases for investigation. Moreover, the selection of universities from three Southeast Asian countries provides valuable diversity in terms of university type, years of establishment, and the number of instructors and students, as detailed in **Table 1**.

Between June and September 2021, 23 semi-structured individual interviews were conducted, audio-recorded, fully transcribed and analyzed in all three cases. The interview protocol consisted of open-ended questions and prompts designed to guide the conversation while allowing flexibility to explore the participant's responses in depth. For example, "What types of tools/software were mostly used during the pandemic in the university?" and "Do you think some of these technologies have made learning more personalized? If so, why?" The prompts included some of the common tools used in the respective universities, e.g., Zoom, WebEx. The interviews were conducted in English, except for two which were conducted in Thai and their transcripts were translated into English. Thematic analysis was conducted by the three research teams in their respective universities (Braun & Clarke, 2006). Each team comprised two researchers who read the transcripts and got familiar with the data. They coded individually, discussed, and agreed upon each other's codes for internal consistency, e.g., "consultations are always good for PL [personalized learning]." The research teams looked for patterns across the transcripts to search for themes recursively, e.g., "using videos for PL." To ensure consistency in coding, the entire research team met frequently to share the processes of coding, and to review the emerging themes with the supporting codes and tagged data in each university. The researchers performed member checking by presenting the coded data and emerging themes to participants for feedback, ensuring that the interpretations accurately reflected their perspectives and experiences. The researchers also conducted an ongoing analysis to define, redefine and compare the themes supported by specific extracts of data across the three universities to tell coherent stories. The last step was to select illustrative extracts from three sets of preliminary writing that addressed the two research questions. The findings presented below represent the key themes that emerged from this thematic analysis and cross-comparison. For document analysis, the research team presented the COVID-19 response strategies of the three universities in group discussions. Common patterns and themes were identified by comparing information across the different documents. The group discussions also aided a nuanced understanding by integrating diverse viewpoints, clarifying complex sections, and building consensus on key findings and themes.

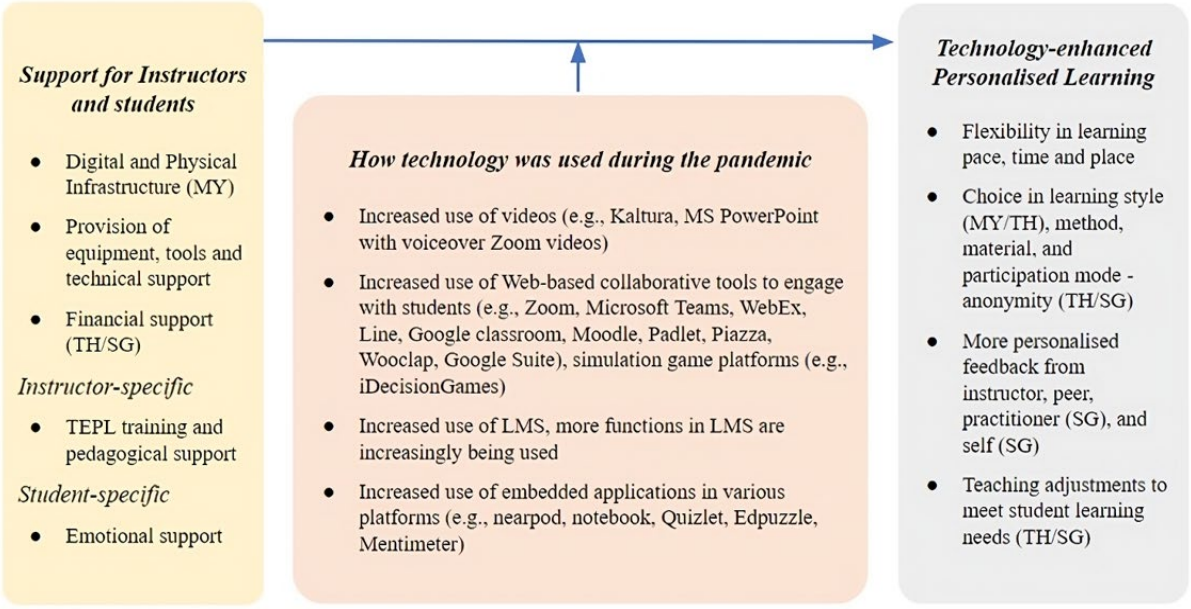

Figure 1. University support led to TEPL (Source: Authors)

RESULTS

The cross-case analysis revealed that the institutions provided infrastructure, equipment, and tools to instructors and students, and this support enabled students to engage in more personalized learning, e.g., students' choices in learning style, more personalized feedback for students, and teaching adjustments to meet students' needs (see **Figure 1**).

Elaboration on the support provided, how technology was used in teaching and learning during the pandemic, and the resulting TEPL can be found in the following sections, as answers to the research questions.

RQ1. Did the Use of Technology in University Teaching and Learning During the COVID-19 Pandemic Influence Personalized Learning, and if So, How?

Flexibility in learning pace, time, and place

The findings suggest that the use of technology brought about flexibility in learning pace, time, and place for the students, resulting in a greater degree of personalized learning. Many instructors started recording their online lectures via Zoom, Microsoft Teams, or Google Meet. The lecture recordings were helpful for students' revision because they could seek "clarification or [...] just look back at something that they may have misheard" (Singapore IN2). In addition, students who were feeling unwell or on medical leave "won't miss the lesson" because they could view the recordings instead (Singapore IN2). The interviewees perceived the benefits of technology as an impetus to flexible learning, where students could pace their learning when they were provided with "all the materials and then they organize their time and study on their own ... they could relook at the recorded lessons" (Malaysia AD2). The instructors also produced voice-over PowerPoint decks as pre-recorded lectures and found them useful for personalized learning because "students can refer to their pre-recorded lecture any time" (Singapore IN4). With video technology, learning could occur flexibly in a form of an open opportunity for self-study and not mainly rely on instructors' delivery of lessons.

> I will provide pre-recorded videos for them and provide adequate resources for learning materials. The most important is to provide adequate free time for our students to study. In the morning, they will study in synchronous learning, talk, and discuss with their friend, to talk with the teacher. In the afternoon, I'll post the recorded video, and assignment that they can learn by themselves. (Thailand IN3)

Choice in learning style, method, material, and participation mode

A key tenet of personalized learning was learning choices where the data showed students' choices in learning style, method, material, and participation mode. In Malaysia and Thailand, TEPL was related to self-study where learners could have different learning styles. When the instructors mentioned personalized learning, they thought about a self-study space where students could learn by themselves and could use their preferred methods and materials.

> I think personalized learning is self-study by choosing the learning method that makes you understand the content. Normally the learning styles of the people are not the same, so, in this case, I can choose the materials that suit me to learn and understand as much as possible. (Thailand IN1)

The students in Malaysia learned to interact with several types of content, and the instructors reported increased efficiency in materials development. According to an FD, there was a need to address student learning styles when aiming for personalized learning:

> The lecture can give more than one mode of interaction, for the same content … in diverse ways … then it becomes personalized. Those visual learners would be able to learn best from the visual information, those who are not visually inclined, then audio mode, etc. … that's personal to the student. (Malaysia FD2)

Besides learning style, technology gave students choices in their mode of class participation. Using Zoom as a video conferencing tool, Singapore students could opt to interact using the "Raise Hand" coupled with the microphone or typing in the chat box. The instructor believed in providing students with a choice of class participation, "we [instructors] engage different kinds of students" (Singapore IN2). He elaborated that "in class, they [students] may be a bit slow in raising their hands or they may be shy, but on Zoom just ask them to use the icon ["Raise Hand"] and at some point, I would call on them to begin to ask that question" (Singapore IN2). Students often chose to use the chat box function to park their questions for instructors to view during lesson breaks. This allowed the instructors to "see what questions each specific student is asking. And from that question, know that, OK, this student does not understand a certain concept. One maybe needs a little bit more explanation" (Singapore IN1). Zoom features had increased students' choice in participation mode and that facilitated instructors to give some degree of personalized attention to students who prefer to post their questions in the chat box.

Possibly due to the reserved nature of Asian students, the instructors from Thailand and Singapore commented that technology allowed their students to participate anonymously. Instructors from Singapore reported that some students chose to participate anonymously in discussion forums, e.g., Piazza and poll platforms, Mentimeter and Wooclap. In Piazza, students preferred to "anonymously share comments … a question that they were a bit afraid to ask" (Singapore IN3). Anonymous participation in polls encouraged students of different abilities to participate in the class discussion without the fear of providing wrong answers, as illustrated by the quote below:

> Especially those who are very fearful, and a bit shy … they can just write. And then as we see as a whole class and I will pick up the answers and tell them why this is correct, why this is wrong and give my comments. So, it does cater to people of different abilities, some will answer very well and some badly. … You still get to see why you're wrong without feeling like you were being picked on. (Singapore IN5)

In Thailand, the discussion board in the learning management system (LMS) and the web-based application, i.e., Padlet were used to enhance personalized learning in the asynchronous online learning environment. The Thailand instructor reported that these tools allowed students to post inquiries anonymously and other students could also see the instructor's responses to the inquiries anytime:

> After they studied from the recorded videos or reviewed them by themselves, they will have a lot of questions, so, we use the discussion forum or Padlet for them to post anonymously and the

> teacher will come to the same Padlet and answer them. And the other student can see the question and answer, that's very useful. (Thailand IN3)

More personalized feedback from instructor, peer, practitioner, and self

Technology had allowed more opportunities for students to receive personalized feedback from their instructors and peers, from practitioners whom they might not have met before, and even from themselves. The students had more personalized feedback from their instructors when they used synchronous learning platforms such as Cisco WebEx and Zoom. An instructor from Singapore reflected that he "was certainly giving more feedback than I had in any of the courses before; because there was time carved out specifically to do it. And the barrier to getting feedback was lower. Students no longer had to make an appointment [and] come for consultation" (Singapore IN3). The instructors and students found it easier to arrange one-to-one online consultations. Another Singapore instructor said that "sometimes I meet them one-on-one, even on weekends" (Singapore IN2). The instructors were now able to provide personalized feedback in real-time to students via various channels such as WhatsApp, email, and Messenger, and feedback was done faster to improve student learning. According to the FD in Malaysia, personalized feedback from instructors to individual students was made possible through the increased use of technology during the pandemic because "lecturers can give personalized feedback … automated personalized feedback … even audio comments for the students" (Malaysia FD2). Moreover, the chat box in video conferencing platforms made learning more personalized when a student wanted to communicate with an instructor during a synchronous online learning session. The synchronous learning platforms provided separate room functions for small groups of learning. The academic developer in Thailand commented that this feature provided a form of a private communication channel with a sense of more privacy during small group learning. An instructor added that such small group discussions that took place at the breakout rooms in Webex enhanced personalized learning:

> If you look at the system … not just the LMS because sometimes they need to get discussions in small groups, they can have separate rooms. When the lecturer wants students to discuss in a group, students just open their room, or in Webex, the teacher can just separate the room for the student. (Thailand AD2)

> If you use the breakout room from Webex and divide the students into smaller groups of 4-5 students each group and let them discuss … give their own opinion in the large group … that would be very useful to use the technology to enhance personalized learning. (Thailand IN3)

Asynchronous tools facilitate feedback from both instructors and peers. In Thailand, an instructor shared that "for the asynchronous session, we use a lot of platforms. We use the discussion forum in Moodle, and we use Padlet to answer our students" (Thailand IN3). Discussion forums, e.g., Piazza, pooled students' questions and answers while allowing them to direct questions to their instructors or to the whole class. One Singapore instructor commented that his students received timely feedback from their peers that supported their self-learning.

> And what I saw with Piazza, was … a lot of these smaller roadblocks were cleared for the students much faster because there were so many people signed up to the platform that there was a good chance that they would get a response within 30 minutes, sometimes 15 minutes. (Singapore IN3)

Social media platforms, e.g., LinkedIn opened a new avenue for practitioner feedback. An FD in Singapore shared that he knew an instructor used LinkedIn for his students to answer questions based on a case study and invited his friends from the industry to comment on his students' answers. This created opportunities for the students to see alternative views offered by practitioners.

> [This instructor] uses LinkedIn for that [collaborative tool]. So, he will post a case study on his LinkedIn page, then he will invite his students to go in there to comment or to give their input … his friends on LinkedIn would also go in and give their comments. (Singapore FD2)

Video as a versatile technology was used by students to generate feedback for their learning. In Singapore, an instructor described how his students used videos to improve their presentation skills when "they [students] can send in videos recording themselves … it gives them the platform where they actually [can] have that self-assessment. And I think that's very important in this case for the presentations" (Singapore IN1). Similarly, platforms that generate individual learning records could be used to support self-feedback. Another instructor from Singapore used a simulation platform called iDecisionGames to run negotiation simulations. The students were assigned distinct roles in the negotiation games, and they logged in with individual accounts to input the details of the negotiation agreement or questions based on the learning objectives. The students' weekly learning records were captured in their accounts. The instructor commented that individualized learning records were used by students to learn negotiation by reviewing their weekly performance and "see yours compared to other people" (Singapore IN5). So, self-recorded videos and platform-generated individual learning records facilitated personalized learning by creating feedback for self.

Teaching adjustments to meet student learning needs

During the pandemic, technology was harnessed for personalized learning where real-time data and analytics facilitated instructors making teaching adjustments to meet student learning needs. In the Singapore case, the iDecisionGames interactive simulation platform provided trend charts of student performance where the instructor appreciated "this immediate aggregation of stats … [that] helps us [instructors] when we do the debrief" (Singapore IN5). Similarly, the instructors from Thailand referred to the use of separate rooms and chat boxes in video conferencing platforms as powerful tools for personalized learning through the understanding of student progress from poll responses and breakout room discussions.

> The Webex or maybe Zoom video conferences … interactive session … the student can ask the teacher directly through the chat box, or maybe the teacher can know the audience's response through the poll function. (Thailand IN3)

> The chat box is powerful. Our student feedback to us is that the breakout is very useful, more than a chat box, for the synchronous session. (Thailand IN3)

Both examples illustrate that there is a positive effect on personalized learning when the instructors use interactive platforms such as simulation or video conferencing to support their consolidation of student formative performance during class debriefs.

RQ2. Which Kinds of Institutional Support for Instructors and Students Led to More TEPL During the COVID-19 Pandemic at Universities?

During the COVID-19 pandemic, the top management of the three universities was dedicated to ensuring that teaching and learning could continue online. Steps were taken to boost digital and physical infrastructure, equipment, and tools; and to provide various forms of support for instructors and students in conducting online teaching and learning.

Digital and physical infrastructure for teachers and learners

To meet the demand surge in online learning, all three universities increased their digital and physical infrastructure. Internet gateway capacity and WIFI coverage during the pandemic were expanded. Universities from Thailand and Malaysia sourced or purchased internet packages for their students.

> During the semester break, we sent out surveys to find out if students had connectivity … we then negotiated [with an internet service provider] to get cheaper rates for our students. (Malaysia AD1)

> If students have problems with their internet connection, we provide internet packages. (Thailand AD1)

In addition, the Malaysia university transformed physical learning spaces into hybrid learning spaces to cater for online students, especially international students who were not in Malaysia, "They spent RM20k per

program to transform hybrid learning spaces … normally we work as individuals … now we work as groups … to share resources" (Malaysia AD1).

Provision of equipment, tools, and technical support for instructors and students

All three universities also stepped up their provision of equipment, tools and technical support for online teaching and learning. In Malaysia, the first initiative was to upgrade the LMS system to cater for the increased frequency of use in terms of content upload and access. The university instructors in Thailand were offered audio-visual equipment, e.g., a microphone, camera, and TV screen to conduct online lessons.

> When we must teach online, I was provided one microphone, one camera, a speaker, a computer, and a screen so that our instructor can see both the slide presentation and the faces of our students to see if they are having questions, … that helps the instructor to be effective. (Thailand IN3)

The instructors mentioned that technical consultation was very crucial as instructors could not handle technical tasks, "Consult, I can learn and find in Google, but in terms of system, I need help. For example, please clear the cache for me for an exam in 10 minutes, which I cannot do" (Thailand IN2). Instructors appreciated the help rendered by the "IT Helpdesk as the first layer of technical support [for recording facilities and IT equipment]" (Singapore IN1 & Singapore IN5), and in ensuring "online exams can be conducted properly" (Singapore IN2 & Singapore IN4). Instructors' diverse needs for online teaching were addressed through "one-to-one consultations and class observations" conducted by FD (Singapore FD1 & Singapore FD2).

According to interviewees, the universities strove hard to resolve students' IT-related issues with equipment or online exams and provided equipment for rental such as "[mobile internet] dongles and laptops" (Singapore AD2 & Singapore FD1). Donation drives were organized to provide laptops for some of the underprivileged students in Malaysia and Thailand. For instance, the Thai University's donation project gathered used computers from alumni and provided them to the current students who requested computers.

> Students need some instruments, computers, laptops, and tablets. We get donations, we ask alumni … or members of the public to donate used computers and used tablets. (Thailand AD2)

Provision of financial support for instructors and students

During the onset of the pandemic, the Malaysian university sponsored students who needed to return home due to the lockdown. The university arranged for transportation (Malaysia AD1) and during the extended semester break of five weeks announced by the government, a survey was conducted to identify the constraints faced by the students. One of the assistances offered was the reduction of multiple fees and this was also observed in the university in Thailand.

> We also decided to reduce their burden … to give them a waiver on the service fee, sports and recreation fees, and library fees. (Malaysia AD1)

> For the tuition reduction, we started during the pandemic … students have some more money they could buy some more equipment on their own, for their home. (Thailand AD1)

In Singapore, financial measures were taken to support students during the pandemic, e.g., a freeze in local students' tuition fees, suspension of student loans and waiver of interest for one year and a dedicated fund were established to provide timely and much-needed relief for students facing financial difficulties because of the pandemic. The provision of institutional licensed digital tools or platforms was another way the university provided financial support to students (Singapore AD2). Furthermore, the instructors were given an individualized fund for "acquiring licensed digital tools or platforms" (Singapore AD2) and "purchasing IT equipment and supplies" (Singapore FD1 & Singapore IN5).

The Thai university started assisting instructors to develop online courses before the pandemic and it was observed that the number of massive open online courses (MOOCs) and SPOCs increased significantly during the pandemic.

> We have the budget to support the lecturer to do the MOOCs and SPOCs and for online learning. (Thailand AD2)

TEPL training and pedagogical support for instructors and students

Before the pandemic, the instructors in all three universities were trained for online teaching. In the Malaysian university, the academic center collaborated with the quality center to develop the Online Teaching and Learning Guideline (University of Malaya, 2019), to assist instructors in online teaching and learning policies and online assessment policies (as mandated by the Ministry of Higher Education). Increased training for online teaching and learning methods (as per informal feedback from instructors) began to be initiated by the academic development center. All materials were uploaded on the academic development center website for seamless access. AD1 informed that the university had been monitoring the teaching methods even before the pandemic and was aware of the need for technologically enhanced teaching and learning among the staff.

> We have been conducting e-learning since 2016 and monitoring who was progressing towards online teaching … knowing the lecturers' capabilities, we knew training had to be done. (Malaysia AD1)

The university in Thailand supported training sessions for the instructors related to tools (Webex, MS Teams, Google classroom, MATLAB, Adobe, OBS), media production, instructional design for online learning, and E-learning platforms. When the pandemic began, the instructors already had some baseline proficiency in conducting online lessons. The Malaysian university provided support in the form of training on remote teaching and learning methods and online assessment methods. The academic development center was tasked to carry out these training sessions which were mostly held in the form of webinars. Gradually the training became more structured and the use of a variety of other learning platforms, besides the official LMS, such as Microsoft Teams, Zoom, and Google Meet was being taught. FD2 (Malaysia) also confirms providing one-to-one consultations to the instructors. The Thailand university arranged knowledge-sharing sessions that allow the instructors to share their online teaching techniques with others.

> We have both technological tool use and flexible learning methods in the training. We have a KM platform that collects the content from instructors with experience in using digital teaching tools so the staff could learn about it. (Thailand FD2)

> It could be the applications, tools, or online tools, e.g., Edmodo, Canva that are used for easy graphic design, or easy video applications. (Thailand FD1)

Similarly, training was provided for Singapore instructors in the use of recording videos and streaming, and the use of Zoom and breakout rooms:

> We organized our workshops to build capacity … how do you design an online course, how do you put interactivity, how do you do asynchronous online discussions through forums, how do you create your own video? (Singapore FD1)

> Those [workshops] are useful. I learn things like how to use Zoom to break out groups and how to give them [students] something to do and put up on Google Drive through Zoom. (Singapore IN2)

Besides instructors, students from Singapore and Thailand universities received training for online learning. The university in Singapore launched a series of online learning readiness, study skills and netiquette workshops (FD1, FD2, AD2, & IN5). A contingency-prepared learning booklet was also created for students to guide them on the use of digital tools and for taking online exams. In Thailand, the FD revealed that students needed help concerning the LMS system.

> I support the students by giving them suggestions, mostly on how to use the [LMS] system and answering questions for instructors. (Thailand FD1)

Emotional Support for Students

Students were not only physically distanced from their instructors during the pandemic, but they also faced social distancing. Students' uncertainties and anxieties about the learning and especially the assessments needed immediate attention. In Thailand, there were formal and informal solutions to reduce students' stress levels during the pandemic. This includes peer support (Thailand IN3), changing the assessment grading system to 'satisfactory' or unsatisfactory' (Thailand IN3), and consultation with psychiatrists and doctors (Thailand AD1). A mobile chat application, namely LINE, was also used as a communication tool by instructors to provide guidance for learning, deliver assignments, and facilitate other learning activities.

> [We] use the LINE application to tell the students what is going on today and what to catch up [on] during our course. (Thailand IN3)

In Singapore, the student wellness center was instrumental in ensuring that students' socio-emotional well-being was taken care of during the pandemic. Singapore students took wellness modules online or attended online sessions with professional counsellors (Singapore AD2, Singapore IN1, Singapore IN4, & Singapore IN5). The AD from Malaysia said that although the students were scoring higher during the pandemic period, it was not true for all fields of study. There was concern about this matter, however, due to a lack of qualified counsellors the university could not extend the services to all students in need.

> We do not have many counsellors [in the university] to make the service [counselling] more accessible to all students. (Malaysia AD2)

DISCUSSION

The pandemic has accelerated digital transformation processes in universities (Rof et al., 2022), prompting educators worldwide to explore various technological tools independently and collaboratively (Sum & Oancea, 2022). These works of literature are consistent with our findings, which reveals that online teaching during this period facilitated the growth of TEPL. Based on the results, we discuss five suggestions to leverage TEPL in the post-COVID-19 era. Pedagogy-wise, universities can leverage increased accessibility of learning, additional feedback avenues, and learning analytics to adjust teaching to students' learning needs. To support such TEPL, universities can increase training and resources and provide emotional support to students to further extract the benefits and manage the risks of TEPL.

Leverage Increased Accessibility of Learning

The use of videos, collaborative tools, LMS functions and various embedded applications (see **Figure 1**) increased the accessibility of learning through flexibility, choices, and asynchronous modes. With these technologies, students could review content they might have misheard, revisit recorded lessons, and refer to pre-recorded lectures, which explains why many prefer recorded lessons as reported by Muthuprasad et al. (2021). Additionally, students could choose their preferred learning methods and materials, allowing for personalized learning experiences that could be conducted at their own time, place, and pace (Hassoulas et al., 2023). Such increases in learning accessibility enable student-content interaction, akin to the learning experience observed in MOOCs (Julia et al., 2021). By continuing to leverage these technologies to increase the accessibility of learning, universities can personalize students' learning experiences in all programs.

Leverage Additional Feedback Avenues

This study also revealed that the use of technology-based platforms increased personalized feedback from instructors, peers, practitioners, and self. Since providing and receiving feedback is a recommended strategy for online learning (Abou-Khalil et al., 2021), we suggest universities leverage such additional avenues for feedback to students to make learning more personalized.

Platforms such as Cisco Webex, Zoom and social media allowed instructors to give individual feedback more easily and timely than face-to-face classes. Moreover, these platforms provided more opportunities for one-on-one consultations. This finding is aligned with the learning experiences of the UK undergraduates,

where the instructor feedback was focused and timely for their learning (Peimani & Kamalipour, 2021). Social media platforms such as LinkedIn facilitated feedback from practitioners or other community members and thus widened the range of personalized feedback. Technologies facilitating self-feedback, e.g., students producing videos of themselves, enabled a learner-centered design that can lead to personalized learning (To, 2022). In the Singapore case, the real-time data and analytics from the interactive simulation platform were used by instructors to consolidate learning (FitzGerald et al., 2018), and the Thai students received more feedback from the breakout rooms and chat boxes (Moorhouse & Wong, 2022).

Our study also revealed that online platforms, such as chat box, polling tools, discussion forums, and Padlet enabled anonymous class participation. They offered students choices in participation modes in both synchronous and asynchronous learning, lowering the barrier for shy students to ask questions, give comments, and receive personalized feedback. The outreach of personalized learning to more students led to a change in learning engagement behaviors. The anonymous participation could be seen by students as a 'more inviting and open' learning environment that is positively associated with learning success (Lim et al., 2022) and student satisfaction (Cole et al., 2014). While much is discussed about anonymity and its effect on student discussions (Jansson et al., 2021; Roberts & Rajah-Kanagasabai, 2013), universities can continue to explore how anonymous participation can widen the reach of personalized feedback, and future studies can delve into the effects of anonymous participation in TEPL.

Leverage Learning Analytics to Adjust Teaching to Students' Learning Needs

Instructors also appreciated the use of learning analytics provided by third-party simulation platforms, with timely feedback to tailor their teaching to their students' learning needs (Kew & Tasir, 2022; Lim et al., 2021; Pardo et al., 2019; Peimani & Kamalipour, 2021). While this does not necessarily customize or personalize learning for each student, it does allow for customization at the student group level, which can be seen as a weaker, but still useful, form of personalized learning. In general, instructors at universities can leverage the learning analytics features in various platforms to monitor students' learning and adjust their teaching to the needs of the students in their classrooms.

Increase Training and Resources

This study also identified types of institutional support provided to instructors and students during the pandemic, resulting in more TEPL. The influx of training and resources to enable online learning positively impacted the development of TEPL as both instructors and students embarked on a different learning experience that required rethinking how students expect to learn and how instructors teach at universities. Additional training of both instructors and students can help universities take advantage of evolving TEPL opportunities. In this context, the university's academic development center should play a more important role in designing and updating trainings for the instructors.

TEPL also required physical campus modifications, illustrated in the Malaysia case, as students also need different physical environments that support the different modes of learning, e.g., multiple small study corners to join online discussion or consultation or soundproof booths for self-recording audio or video. Efforts can be invested to consider whether the current university physical spaces could be used to support TEPL and how much of these spaces were needed for modifications to support online or blended learning modes (Giovannella, 2021).

Provide Emotional Support to Students

Interestingly, one disadvantage of learning at home was the risk of isolation and reduced social interaction, which raised dissatisfaction with online learning (Bai et al., 2020; Hu & Li, 2017; Komolafe et al., 2020). The emotional support for students reported by all three universities during the pandemic, focusing on wellbeing, concerns about assessment stress, and availability of counsellors, can be seen as a countermeasure for this disadvantage. Since TEPL can also involve more learning by oneself, such emotional support may be equally important when TEPL is rolled out at universities. Such support may also alleviate the students' stress that Karaoğlan Yilmaz & Yilmaz (2020) cautioned about when, in another manifestation of TEPL, learning analytics is used for personalized feedback, and students may feel vulnerable at being constantly monitored. So far, little is discussed in the literature about the effect of emotional support, emotional engagement, and its

interplay with TEPL. Social media platforms can significantly help universities provide emotional support and prevent isolation, just as how learning support was given in the Thailand case (using LINE) and the Malaysia case (using WhatsApp). Further studies could be conducted to investigate if the use of social media can facilitate TEPL by rendering emotional support for students, particularly to meet first-year social needs (Sobaih et al., 2020) and building a university community (Papademetriou et al., 2022), contributing towards a student-centered pedagogy (Whalley et al., 2021).

CONCLUSION

Summary of Findings

This paper uncovers how online teaching during the pandemic, along with institutional support for it, expedited the progress of TEPL in three ASEAN universities. The findings of the multiple-case study involving AD, FD, and instructors indicate that TEPL is in the early stages of development, with considerable potential for growth and inter-university collaborations. The research reveals several key benefits of TEPL for students. Notably, it offers students flexibility in learning pace, time, and place, while also enhancing student autonomy in terms of learning choices and participatory methods, including anonymous ones. In Thailand, the expansion of MOOCs has provided a greater range of learning options for university students, thereby making learning more personalized. Students also benefit from personalized feedback from multiple sources–instructors, peers, practitioners, and themselves. Additionally, they gain from specific teaching adjustments made possible by technology and driven by students' needs. For example, iDecisionGames enhances decision-making skills by immersing students in role-playing scenarios that involve complex choices. It also consolidates student preferences and provides real-time feedback to instructors. This enables educators to adapt their teaching strategies to meet students' evolving needs and preferences, resulting in more personalized and effective instruction.

A wide range of technologies was employed across the universities to facilitate collaboration and self-directed learning. These included videos, web collaborative tools, LMS and numerous embedded applications. University support, both for instructors and students was conducive for TEPL. Enhancement of the IT infrastructure was crucial, in addition to provision of equipment, tools and the related technical support to ensure a seamless online learning environment. Universities had to redirect their financial support for this purpose. Technological support was also supplemented by skill enhancement for instructors and emotional support for students. The affective quality of student experiences in online learning brought forth an important aspect of TEPL–emotional wellbeing of students related to lack of social interactions.

Limitations of Findings

Despite the contributions of this study, it is essential to acknowledge its limitations. Firstly, the generalizability of our findings is limited due to the study's focus on only three main universities in Southeast Asia which may not fully capture the diversity of TEPL implementation across all ASEAN countries or various types of higher education institutions. Secondly, the timing of the research during the COVID-19 pandemic may have influenced the findings. The rapid and necessary shift to online learning during the pandemic might not reflect the normal circumstances under which TEPL would be implemented and evaluated. Lastly, the perspectives gathered from AD, FD, and instructors, while valuable, may not represent the full spectrum of stakeholder experiences with TEPL.

Directions for Further Research

Although this study is not widely generalizable, it has brought forward additional evidence from three main universities in Southeast Asia on how technology enhances personalized learning and what universities can do to support this. It is recommended that more studies be conducted, involving a larger set of universities, to better understand how personalized learning can be enhanced by technology on a large scale. Further university collaboration in such research can be valuable to the future advancement of TEPL, fostering innovation and best practices in higher education across Southeast Asia and beyond. Future research can focus on conducting follow-up studies in a post-pandemic context to compare TEPL implementation and effectiveness under normal circumstances. This approach would reveal the sustainability of changes made

during the pandemic and identify necessary adjustments. Additionally, it is crucial to include students as key stakeholders in future studies. Their experiences and perceptions of TEPL could provide invaluable insights into its effectiveness and highlight areas for improvement.

Author contributions: All authors confirm contribution to the study conception and design, analysis and interpretation of results, and draft manuscript preparation. All authors approved the final version of the article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Acknowledgments: The authors would like to thank the participants for sharing their experiences on online teaching and learning during the COVID-19 pandemic, and the ASEAN University Network-Technology-Enhanced Personalised Learning for assisting with the formation of the inter-university research collaboration.

Ethics declaration: Consent from participants was obtained prior to conducting the interviews, as stipulated by the respective ethics review boards from the 3 universities: (1) Reference Number: UM.TNC2/UMREC_1419 by Universiti Malaya Research Ethics Committee, University of Malaya; (2) Approval Number: IRB-21-069-A064(421) by Institutional Review Board, Singapore Management University; & (3) SIRB Protocol Number: 397/2564(IRB2) by Siriraj Institutional Review Board, Mahidol University.

Declaration of interest: The authors declare no competing interest.

Data availability: The datasets generated and/or analyzed during the current study are not publicly available due to interview data are stored separately by the three countries' university teams under their own review board regulations. Data generated or analyzed during this study are available from the authors on request.

REFERENCES

Abou-Khalil, V., Helou, S., Khalifé, E., Chen, M. A., Majumdar, R., & Ogata, H. (2021). Emergency online learning in low-resource settings: Effective student engagement strategies. *Education Sciences, 11*(1), Article 24. https://doi.org/10.3390/educsci11010024

Bai, X., Ola, A., Reese, S., Eyob, E., & Bazemore, S. (2020). A study of the effectiveness of remote instruction from students' perspectives. *Issues in Information Systems, 21*(4), 143–155. https://doi.org/10.48009/4_iis_2020_143-155

Balakrishnan, B., & Long, C. Y. (2020). An effective self-directed personalized learning environment for engineering students during the COVID-19 pandemic. *Advances in Engineering Education, 8*(4), 1–8.

Barrot, J. S., & Acomular, D. R. (2022). How university teachers navigate social networking sites in a fully online space: Provisional views from a developing nation. *International Journal of Educational Technology in Higher Education, 19*(1), Article 51. https://doi.org/10.1186/s41239-022-00357-3

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative *Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cole, M. T., Shelley, D. J., & Swartz, L. B. (2014). Online instruction, e-learning, and student satisfaction: A three year study. *The International Review of Research in Open and Distributed Learning, 15*(6), 111–131. https://doi.org/10.19173/irrodl.v15i6.1748

El-Sayad, G., Saad, N. H. M., & Thurasamy, R. (2021). How higher education students in Egypt perceived online learning engagement and satisfaction during the COVID-19 pandemic. *Journal of Computers in Education, 8*(4), 527–550. https://doi.org/10.1007/s40692-021-00191-y

Fariani, R. I., Junus, K., & Santoso, H. B. (2023). A systematic literature review on personalized learning in the higher education context. *Technology, Knowledge and Learning, 28*, 449–476. https://doi.org/10.1007/s10758-022-09628-4

FitzGerald, E., Jones, A., Kucirkova, N., & Scanlon, E. (2018). A literature synthesis of personalized technology-enhanced learning: What works and why. *Research in Learning Technology, 26.* https://doi.org/10.25304/rlt.v26.2095

Giovannella, C. (2021). Effect induced by the COVID-19 pandemic on students' perception about technologies and distance learning. In Ó. Mealha, M. Rehm, T. Rebedea (Eds.), *Ludic, Co-design and Tools Supporting Smart Learning Ecosystems and Smart Education. Smart Innovation, Systems and Technologies* (vol. 197, pp. 105–116). Springer. https://doi.org/10.1007/978-981-15-7383-5_9

Hassoulas, A., de Almeida, A., West, H., Abdelrazek, M., & Coffey, M. J. (2023). Developing a personalized, evidence-based and inclusive learning (PEBIL) model of blended learning: A cross-sectional survey. *Education and Information Technologies, 28*, 4187–14204. https://doi.org/10.1007/s10639-023-11770-0

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112. https://doi.org/10.3102/003465430298487

Hong, J.-C., Liu, X., Cao, W., Tai, K.-H., & Zhao, L. (2022). Effects of self-efficacy and online learning mind states on learning ineffectiveness during the COVID-19 lockdown. *Educational Technology & Society, 25*(1), 142–154.

Hu, M., & Li, H. (2017). Student engagement in online learning: A review. In *Proceedings of the 2017 International Symposium on Educational Technology* (pp. 39–43). IEEE. https://doi.org/10.1109/ISET.2017.17

Jansson, M., Hrastinski, S., Stenbom, S., & Enoksson, F. (2021). Online question and answer sessions: How students support their own and other students' processes of inquiry in a text-based learning environment. *The Internet and Higher Education, 51*, Article 100817. https://doi.org/10.1016/j.iheduc.2021.100817

Julia, K., Peter, V. R., & Marco, K. (2021). Educational scalability in MOOCs: Analysing instructional designs to find best practices. *Computers and Education, 161*, Article 104054. https://doi.org/10.1016/j.compedu.2020.104054

Karaoğlan Yilmaz, F. G., & Yilmaz, R. (2020). Student opinions about personalized recommendation and feedback based on learning analytics. *Technology, Knowledge and Learning, 25*, 753–768. https://doi.org/10.1007/s10758-020-09460-8

Kew, S. N., & Tasir, Z. (2022). Developing a learning analytics intervention in e-learning to enhance students' learning performance: A case study. *Education and Information Technologies, 27*(5). 7099–7134. https://doi.org/10.1007/s10639-022-10904-0

Komolafe, B. F., Fakayode, O. T., Osidipe, A., Zhang, F., & Qian, X. (2020). Evaluation of online pedagogy among higher education international students in China during the COVID-19 outbreak. *Creative Education, 11*(11), 2262–2279. https://doi.org/10.4236/ce.2020.1111166

Lang, Y., Xie, K., Gong, S., Wang, Y., & Cao, Y. (2022). The impact of emotional feedback and elaborated feedback of a pedagogical agent on multimedia learning. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.810194

Lim, H., Denise Murdoch, Y., & Cho, J. (2022). Online EMI learner engagement and perceptions of teaching and learning during the COVID-19 pandemic. *Innovations in Education and Teaching International, 59*(5), 597–608. https://doi.org/10.1080/14703297.2021.1905030

Lim, L. A., Dawson, S., Gašević, D., Joksimović, S., Pardo, A., Fudge, A., & Gentili, S. (2021). Students' perceptions of, and emotional responses to, personalized learning analytics-based feedback: An exploratory study of four courses. *Assessment and Evaluation in Higher Education, 46*(3), 339–359. https://doi.org/10.1080/02602938.2020.1782831

Moorhouse, B. L., & Wong, K. M. (2022). Blending asynchronous and synchronous digital technologies and instructional approaches to facilitate remote learning. *Journal of Computers in Education, 9*(1), 51–70. https://doi.org/10.1007/s40692-021-00195-8

Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID-19 pandemic. *Social Sciences & Humanities Open, 3*(1), Article 100101. https://doi.org/10.1016/j.ssaho.2020.100101

Papademetriou, C., Anastasiadou, S., Konteos, G., & Papalexandris, S. (2022). COVID-19 pandemic: The impact of the social media technology on higher education. *Education Sciences, 12*(4), Article 261. https://doi.org/10.3390/educsci12040261

Pardo, A., Jovanovic, J., Dawson, S., Gašević, D., & Mirriahi, N. (2019). Using learning analytics to scale the provision of personalized feedback. *British Journal of Educational Technology, 50*(1), 128–138. https://doi.org/10.1111/bjet.12592

Patrick, S., Kennedy, K., & Powell, A. (2013). Mean what you say: Defining and integrating personalized, blended and competency education. *International Association for K-12 Online Learning*. https://files.eric.ed.gov/fulltext/ED561301.pdf

Peimani, N., & Kamalipour, H. (2021). Online education in the post COVID-19 era: Students' perception and learning experience. *Education Sciences, 11*(10), Article 633. https://doi.org/10.3390/educsci11100633

Roberts, L. D., & Rajah-Kanagasabai, C. J. (2013). "I'd be so much more comfortable posting anonymously": Identified versus anonymous participation in student discussion boards. *Australasian Journal of Educational Technology, 29*(5), 612–625. https://doi.org/10.14742/ajet.452

Rof, A., Bikfalvi, A., & Marques, P. (2022). Pandemic-accelerated digital transformation of a born digital higher education institution: Towards a customized multimode learning strategy. *Educational Technology & Society, 25*(1), 124–141. https://doi.org/10.30191/ETS.202201_25(1).0010

Sobaih, A. E. E., Hasanein, A. M., & Elnasr, A. E. A. (2020). Responses to COVID-19 in higher education: Social media usage for sustaining formal academic communication in developing countries. *Sustainability, 12*(16), Article 6520. https://doi.org/10.3390/su12166520

Sum, M., & Oancea, A. (2022). The use of technology in higher education teaching by academics during the COVID-19 emergency remote teaching period: A systematic review. *International Journal of Educational Technology in Higher Education*, *19*, Article 59. https://doi.org/10.1186/s41239-022-00364-4

To, J. (2022). Using learner-centred feedback design to promote students' engagement with feedback. *Higher Education Research & Development, 41*(4), 1309–1324. https://doi.org/10.1080/07294360.2021.1882403

University of Malaya. (2019). *Online teaching and learning guideline*. https://aspd.um.edu.my/doc/FINALv4a%20Online%20Teaching%20and%20Learning%20Guideline.pdf

Whalley, B., France, D., Park, J., Mauchline, A., & Welsh, K. (2021). Towards flexible personalized learning and the future educational system in the fourth industrial revolution in the wake of COVID-19. *Higher Education Pedagogies, 6*(1), 79–99. https://doi.org/10.1080/23752696.2021.1883458