



# A Meta-synthesis on Technology-Based Learning Among Healthcare Students in Southeast Asia

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Accepted: 27 April 2022 / Published online: 7 May 2022

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## Abstract

Healthcare education providers are eager to apply technologies in teaching and learning activities; however, students are the consumers in higher education, and their opinion and experience should be considered. We performed a meta-synthesis of qualitative studies to help inform our understanding of Southeast Asian healthcare students' perceptions and experience of technology-based teaching and learning in their education. Our search strategy located 1599 articles from a dozen electronic research databases. Articles were analyzed for quality using the Hawker's Evidence Appraisal Tool, and 23 qualitative studies were included in the final meta-synthesis. Technologies investigated largely involved online or blended learning, with fewer exploring virtual reality, simulations, telehealth, game-based learning, and videos. Three overarching themes were synthesized: (i) culture does matter in the implementation of technology-based learning; (ii) the values and limitations of technology used for learning; and (iii) technology is part of daily life and creates new challenges in education. Technology is an asset to enhance the learning experience, but educators must be aware of its limitations. Pre-coronavirus disease 2019 (COVID-19) studies were more focused on technology and product, and were optimistically reported, whereas COVID-19–spanning studies focused on life experience and paid more attention to reporting on the inherent challenges. The educational approaches, theories, cultural aspects, and availability of facilities all play a vital role in steering successful technology use in learning.

**Keywords** E-learning · Internet of Things · Industrial Revolution 4.0 · Systematic review · COVID-19

## Introduction

The role of technology in education is becoming apparent. The advancement of technology has penetrated every aspect of human life [1]. Nowadays, education technology has become a sophisticated learning aid that provides richer learning experiences to students. The world is also becoming more technologically reliant. It embraces automation because of the advancement of Industrial Revolution 4.0 and the Internet of Things [1]. Today, the world requires the education system to adapt and equip learners for technology use by exposing them to and familiarizing them with relevant technologies utilized in the industry—including medical and health sectors—for students to remain relevant. For example,

telehealth and the use of internet media for public education and health promotion have become common [2].

However, several issues obstruct the optimal embrace of technology use in education practices. There is a gap in technology between developed, developing, and less-developed countries [3]. Technologies have become more sophisticated, rapidly introduced, attractive, and affordable for developed countries but beyond the reach of developing and less-developed countries. Culture affects learning styles and the education system [4]. The education system in developing countries does not prepare students for the technology transition from schools to higher education [5, 6]. Traditional learning is commonly used in schools [7]. Technology-based learning encourages active learning [8]. In contrast, Asian education practices passive learning and strongly emphasizes teacher-centered instruction [9]. Evidence suggests that Western culture empathizes with education that is more liberal, explorative, experience-based, and flexible and nurtures critical

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thinking, whereas Asian education is more competitive, rigid, and exam-oriented and emphasizes memorization of knowledge [10–12]. The application of technology in education is pioneered in Western countries; thus, Asian students might face difficulties in accepting a practice that does not suit their societal beliefs and practices [13]. The distinction between cultural, environmental, and educational objectives may affect technology utilization as part of educational approaches.

There is a need to evaluate medical and health professions' educational practices from a regional perspective while remaining open to the global paradigm to provide efficient guides to regional educators [14]. Highly populous Southeast Asia has a unique socio-geo-demographic composition, strategic location, constant weather, a rich history of local civilization and colonization, dynamic culture, and politics [5, 15], providing a paradigm distinct from other world regions. The region experiences rapid developments in technology, economy, health, and education, and these developments have created a conflict between preserving traditional values and accepting modern globalization. Medical and health professional education is also not spared from this conflict.

With the existing cultural and technological infrastructure challenges still prevailing, the coronavirus disease 2019 (COVID-19) pandemic has disrupted the education landscape and instantly shifted the educational practices from conventional physical attendance to remote and online learning. Transitioning to technology for health professional education causes anxiety to learners and educators. The reported issues that interrupt learning are lack of facilities, lack of preparation in teaching and learning, interrupted learning engagement, inconducive learning environment, and a lack of readiness for full online learning and support [16–18]. Several studies found that remote and online learning because of the COVID-19 pandemic has emerged as a new challenge for students preparing and adapting to the new norm [19, 20]. Although the new learning norm may be successfully implemented, several concerns are present, with inadequate facilities, an inconducive learning environment, difficulty maintaining engagement, academic integrity, and family burden [21–25]. Learning to use technology is presumed to be less effective, lacking reality, and with limited use for skills and clinical learning [26–28]. Other issues on mental health were also identified from online learning because of COVID-19. It impacted delayed graduation, and taking a toll on students' mental health such as stress [29]. The impact of these abrupt and sudden changes on the mental health of nursing students is pertinent [30]. A significant number of studies indicated that students still prefer conventional learning [19, 26, 29, 31, 32]. However, the majority of these studies were conducted during the early pandemic. This sudden emergence of bulk literature requires

a careful analysis either because this is a situational response or because of the technology application.

These studies might be influenced by the anxiety over the pandemic, rather than over the use of technology. Technology use in health professional education has been researched over the past several decades, indicating that it is not something new and can be anticipated in practice [33]. Quantitative evidence supported technology use in health profession education as effective and beneficial [34–36]. However, as discussed previously, misalignment between evidence and perception is plausible. The eagerness of education providers and policymakers to adopt technology use in education should always consider the end consumers (i.e., students). Learning from consumers' experience in time will facilitate improvement and customization of teaching delivery. Systematic reviews on technology-based learning are available, but meta-synthesis is negligible [33, 34]. A recent systematic review of reviews recommends future studies to conduct meta-synthesis [35]. This is supported by another systematic literature review that requires further investigation into developing more substantial insights into students' engagement in digital technologies in teaching and learning [36]. A meta-synthesis is required as limited comprehensive understanding is available on the perception of technology-based learning, and the perception fluctuates according to surrounding factors. Therefore, it is essential to understand learners' perception over time, before and during the COVID-19 pandemic, and learn how the perception is influenced by technology and the roles of other factors.

## Methods

This meta-synthesis was based on thematic synthesis, and it adopted Lachal et al. [37] protocol, as illustrated in Table 1. A detailed description of each stage in the meta-synthesis is presented as subheadings. The framework on technology-based review was informed by Romli et al. [33]. The authors expanded it to the population of postgraduate students but limited the studies to Southeast Asia. Romli et al.'s [33] paper is a protocol for an overview of systematic reviews pertaining to the effectiveness of technology-based learning in health professional education. Thus, several aspects in the methodology, such as the definition of technology-based learning, generated keywords, and database selection, were adopted from Romli et al. [33].

## Defining Research Questions and Selection Criteria

The questions were developed based on the population, exposure, comparison, and outcome (PECO) concept [38]. The first review question was "How does the investigation on the learner's perception and experience compare between

**Table 1** Meta-synthesis framework and its description according to Lachal et al. [37], and how this current study addressed the framework

Stage	Description [37]	Addressed
<i>Define research question and election criteria</i>	<ul style="list-style-type: none"> <li>• Involved multidisciplinary</li> <li>• Topics well-known by researchers</li> <li>• First quick literature reviews</li> <li>• Considering all perspectives</li> <li>• Consider diversity of methods</li> </ul>	<ul style="list-style-type: none"> <li>• Authors are from variety of backgrounds</li> <li>• Several authors are experts in medical education and in technology learning</li> <li>• Preliminary search reported in the introduction indicates there is absent of such meta-synthesis</li> <li>• Including studies consider various students population and technologies</li> <li>• Similar to Lachal et al. [37], this current study only considers pure qualitative research</li> </ul>
<i>Driving the selection of the studies</i>	<ul style="list-style-type: none"> <li>• Conducting systematic search</li> <li>• Mixed and recognized databases</li> <li>• Mixed thesaurus and free-text terms</li> <li>• At least involved two authors in screening</li> <li>• Inclusion of studies from many origins and cultures</li> </ul>	<ul style="list-style-type: none"> <li>• Several mainstream and emerging databases were selected and the searching is systematically conducted</li> <li>• Keywords generated based on multiple sources and discussion (see Romli et al. [33] for further reading)</li> <li>• Several authors involved in independent screening and pre-consensus agreement is calculated</li> <li>• The studies included from various countries in Southeast Asia</li> </ul>
<i>Quality assessment</i>	<ul style="list-style-type: none"> <li>• Use standardized quality measurement tool</li> <li>• Involved at least two authors</li> <li>• Present the assessment result</li> </ul>	<ul style="list-style-type: none"> <li>• The valid quality measurement tool was selected for analysis (refer HEAT [39])</li> <li>• A pair of authors independently assess and the findings were compared and discussed</li> <li>• The consensus quality is presented for each included study in the result section (see Table 2)</li> </ul>
<i>Extracting and presenting formal data</i>	<ul style="list-style-type: none"> <li>• Details of each study are published</li> </ul>	<ul style="list-style-type: none"> <li>• The data extracted from each included study is presented in a matrix table (see Table 3)</li> </ul>
<i>Data analysis</i>	<ul style="list-style-type: none"> <li>• Follow a well-known method and the method is described</li> <li>• Involved at least two authors</li> <li>• Report the contribution</li> </ul>	<ul style="list-style-type: none"> <li>• Themes were generated based on holistic impression and specific reference to original findings</li> <li>• Several authors involved in the validation and discussion on the analysis</li> <li>• The findings are reported in narrative and in table (see Table 4)</li> </ul>
<i>Expressing the synthesis</i>	<ul style="list-style-type: none"> <li>• Follow ENTREQ</li> <li>• Details given for each step</li> <li>• Good level of reflexivity</li> <li>• Validation by reviewers and scientific community</li> </ul>	<ul style="list-style-type: none"> <li>• ENTREQ was followed and reported as non-published supplemental material</li> <li>• The methodology, result, and discussion are explicitly described in the manuscript</li> <li>• Reasoning has been made in the discussion with support from recent literature</li> <li>• Submission to a reputable peer-review journal</li> </ul>

the pre-COVID-19 and COVID-19 eras in Southeast Asia?” The second question was, “What are the perceptions and experiences of Southeast Asian healthcare students on technology-based teaching and learning in their education?” The inclusion criteria were customized from Romli et al. [33], which were (i) studies involved undergraduate or postgraduate students; (ii) studies investigated technology related to Industrial Revolution 4.0 (IR4.0) or the Internet of Things (IoT); (iii) qualitative studies; and (iv) studies explored on perception or experience of students in using technology for teaching and learning purposes. The exclusion criteria were (i) studies with no full text available; (ii) gray literature; (iii)

studies in non-English languages; (iv) studies in journals without a peer-review process; and (v) the studies were not of a “pure” qualitative design (e.g., Delphi, Q-methodology). However, a mixed-method study is considered if the qualitative part is apparent. No restriction was imposed on the publication year.

### Study Selection

Selections of electronic databases and keywords searched were based on Romli et al. [33] and discussed by the authors. The selected databases were Academic Search

Complete, CINAHL, Cochrane Libraries, MEDLINE, Psychology and Behavioral Sciences Collection, SPORTDiscus, and Scopus, with the addition of Dentistry & Oral Sciences Source, Education Source, ERIC, Health Business Elite, and ASEAN Citation Index. The keywords selected were identified by healthcare students (e.g., “*medic\**” OR “*health science\**” OR “*nurs\**”, etc.), Southeast Asia and the name of each country member, technology-related terms (e.g., “*e-learning*” OR “*online*” OR “*web-based*” OR “*blended*”, etc.), and qualitative-related terms (e.g., “*qualitative*” OR “*focus group discussion\**” OR “*grounded theor\**”, etc.). Boolean operators, wildcards, exact, truncation, and other appropriate commands were used. A manual search was conducted by reviewing the included articles’ reference list, and any citation deemed suitable was selected for screening. A full list of the keywords is available in the registered protocol (Registration Number: INPLASY202120053). Electronic searching began on January 21, 2021, updated on July 7, 2021, and a second update was completed on February 24, 2022.

The searched electronic articles were imported to End-Note X8. The first author screened the articles on title against the predefined criteria. Next, the abstract and full text were screened independently by the first and second authors. Pre-consensus agreement on accepted full texts was performed by comparing the two authors’ decisions using kappa analysis and percentage. The status of disputed articles was resolved through a discussion between the first and second authors, or an arbiter was consulted if there was no consensus.

### Quality Assessments for Included Studies

This review opted for Hawker’s Evidence Appraisal Tool (HEAT) [39] as an instrument to evaluate the quality of the included qualitative studies. HEAT has nine items assessing (i) abstract and title, (ii) introduction and aims, (iii) method and data, (iv) sampling, (v) data analysis, (vi) ethics and bias, (vii) results, (viii) transferability and generalizability, and (ix) implication and usefulness. Each item was rated in four categories of 1 = very poor, 2 = poor, 3 = fair, and 4 = good. A total score was calculated by summing the rating and then grouping the score into the following quality: low (9–23), medium (24–29), or high (30–36) [40]. A pair of authors (first and either third, fourth, fifth, or sixth author) rated each article independently and compared it subsequently; any disagreement was resolved through discussion. Prior to the consensus, the inter-rater reliability of the total score was calculated and considered as good agreement (ICC = 0.789;  $p < 0.001$ ).

### Extracting and Presenting Formal Data

Data on each included article were extracted into a matrix table. The table consists of information on the study objective and location, participants’ details, data collection method, analysis method, technology investigated and teaching and learning technique used, and findings. The first author was responsible for data extraction, whereas the other authors verified the information extracted by referring to the article.

### Data Analyses and Synthesis

QDA Miner Lite software was used in the data analysis process. The authors read and reread each article to obtain their essence to collate a synthesizable set of accounts on their qualitative richness. Next, the authors independently developed codes on each article according to their understanding and objective of the review. Subsequently, the authors discussed their coding results, compared, and harmonized them in parallel, and shared similarities between articles. Later, an analytical synthesis was developed through a group discussion among the researchers to obtain a novel model of a phenomenon with a higher level of interpretation beyond the descriptive synthesis in the original studies. The ENTREQ [41] statement guides the reporting of this meta-synthesis.

### Results

A corpus of 1599 articles was obtained from the literature search. After screening, 33 articles were eligible (pre-consensus agreement: 62.5%). Articles with low quality [42–51] assessed by the HEAT (Table 2) were excluded. The pre-rejected mean quality score was 26.73 (95% CI = 24.74–28.72). In the end, only 23 articles, the majority of which were published during the pre-COVID-19 pandemic [52–66] and the remaining [67–74] during the COVID-19 period, were included, with the final mean quality score of 29.78 (95% CI = 28.34–31.22). For the mixed-method study, only the qualitative section was evaluated and extracted. The process is shown in Fig. 1.

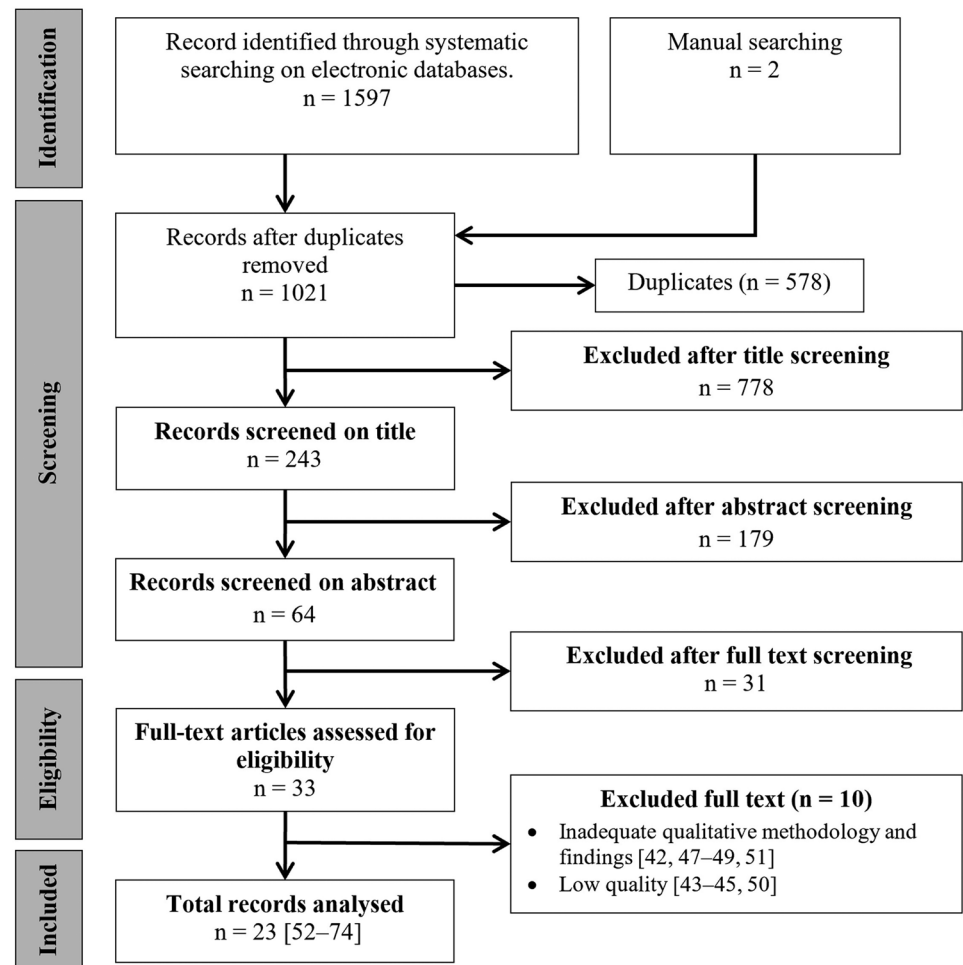
Studies were conducted in Singapore ( $n = 11$ ), Malaysia ( $n = 7$ ), Indonesia ( $n = 2$ ), the Philippines ( $n = 1$ ), and Thailand ( $n = 1$ ). One study [69] involved multiple countries. No study was conducted in other countries (i.e., Brunei, Cambodia, East Timor, Laos, and Myanmar). These studies involved nursing ( $n = 11$ ), medical ( $n = 7$ ), dental ( $n = 1$ ), and allied health ( $n = 4$ ) students. Each included study is described in detail in Table 3.

**Table 2** Quality analyses of the included qualitative studies using Hawker’s Evidence Appraisal Tool

Citation	HEAT (score: 1 = very poor, 2 = poor, 3 = fair, 4 = good)										Total score	Quality
	Abstract and title	Introduction and aims	Method and data	Sampling	Data analysis	Ethics and bias	Results	Transferability and generalizability	Implication and usefulness			
Ambrose et al. [52]	4	4	3	4	2	4	4	4	4	4	33	High
Arunasalam [53]	3	3	3	2	2	3	3	2	2	3	24	Medium
Austria [54]	3	3	4	4	4	3	4	2	2	4	31	High
*Choo et al. [42]	3	3	2	2	3	2	2	2	2	3	22	Low
Eachempati et al. [43]	3	1	1	2	2	2	2	2	2	2	17	Low
Eka Riantini et al. [44]	2	3	2	2	1	1	2	2	2	2	17	Low
Fedriandi et al. [45]	4	3	2	1	2	1	2	1	2	2	18	Low
Greviana et al. [55]	4	3	4	4	3	3	4	4	3	3	32	High
Hu et al. [67]	4	4	3	4	4	4	3	3	4	4	33	High
*Ignacio and Chen [56]	3	3	3	3	3	3	3	3	3	3	28	Medium
Ismail et al. [57]	3	4	4	3	4	4	4	3	3	3	32	High
*Kok et al. [68]	3	4	3	3	3	4	4	3	3	3	30	High
Kowitlawakul et al. [58]	4	4	3	4	4	3	3	3	4	4	32	High
Kunaviktikul et al. [69]	3	4	4	4	3	3	4	3	3	3	31	High
*Liaw et al. [46]	3	3	1	2	2	2	3	2	2	3	21	Low
Liaw et al. [59]	3	3	2	3	2	3	3	3	3	3	25	Medium
Liaw et al. [70]	4	4	3	4	4	3	4	3	3	3	32	High
*Mai et al. [47]	2	2	2	2	2	3	3	2	2	2	20	Low
*Mogali et al. [48]	3	3	2	2	2	2	3	2	2	3	22	Low
Mohamad et al. [60]	2	3	3	3	3	3	2	3	2	2	24	Medium
*Nadarajan et al. [71]	3	4	2	1	2	3	3	2	4	4	24	Medium
Nugroho and Prihanto [50]	4	3	2	1	1	3	4	1	3	3	22	Low
Ohn and Ohn [61]	4	3	4	3	4	3	3	3	3	3	30	High
Razak and Hua [49]	2	3	2	1	2	1	2	1	2	2	16	Low
*Roslan and Halim [72]	3	4	3	4	3	4	3	3	4	4	31	High
Salim et al. [62]	4	4	4	4	4	4	4	3	3	3	34	High
Shorey et al. [63]	4	4	3	4	4	3	4	3	4	4	33	High
Shorey et al. [64]	4	4	2	3	3	3	3	3	4	4	29	Medium
*Siah et al. [51]	3	3	2	2	2	3	2	2	3	3	22	Low
*Tan et al. [73]	3	4	3	3	2	4	4	3	3	3	29	Medium
Woo et al. [74]	4	3	4	3	4	4	4	3	3	3	32	High
Youngwanichsetha [65]	4	3	2	2	2	3	3	2	3	3	24	Medium
Zhang et al. [66]	4	4	4	3	4	3	4	3	3	3	32	High

\*Quality evaluation was confined to qualitative investigation of the study

Fig. 1 Screening process



## Investigated Technology

The majority of past studies investigated the e-learning technologies for general purposes, either as a complementary method (substituting selected parts of teaching and learning activities with online learning or blended learning) or as the main method (full online learning) [52–54, 60, 62, 64, 65, 67, 69, 72]. A small number of advanced technologies were available, such as virtual reality [59, 63, 68, 70] and telesimulation [71]. Technologies such as Kahoot!™ and GaMed©™ were used to complement (e.g., enhance motivation and engagement) teaching and learning activities [56, 57, 61], or EHRNE software was used to mimic the real clinical practice of online health documentation [58]. Several technologies were used for supplementation, such as an e-portfolio [55], video-briefing [66], a digital serious board game [73], and an online forum [60] to provide reflection and records of learning.

## Question 1: How Does the Investigation on the Learner's Perception and Experience Compare Between the Pre-COVID-19 and COVID-19 Eras in Southeast Asia?

### Different Spectrums of Focus—Investigation Specific to Technology vs. Broad Attention in Life Courses

It is worth noting that research focuses and objectives from the included studies show a distinct difference between studies published before and during the COVID-19 pandemic. The studies in the pre-COVID-19 pandemic had focused on the learners' perceptions of the particular learning technology intended. For example, past researchers explored learners' perceptions of Kahoot!, apps, virtual reality, and software uses, even for online or blended learning, focusing on the technology itself. However, the COVID-19 studies explored the learners' experiences on how technology becomes a part of daily life, focusing on life experiences

**Table 3** Characteristics of the included qualitative studies

Author	Objective of the study	Country	Participants	Data collection method	Analysis method	Technology investigated	Findings and themes
Ambrose et al. [52]	To explore the experience of students in a reciprocal intercultural participatory peer e-learning activity (RIPPLE)	Indonesia	22 Indonesian, 49 international undergraduate medical students	Open-ended questions survey	Not specified	Online learning	Pre-participation: (i) curiosity, (ii) knowledge expansion, (iii) building relationships for professional and personal growth, (iv) innovative learning opportunity with global peers. Post-participation: (i) benefits of “sharing,” (ii) benefits of improving content knowledge, (iii) frustration
Arunasalam [53]	To explore Malaysian nurses’ views of the technology-enhanced teaching and learning in transnational higher education post-registration top-up nursing degree courses	Malaysia	18 Malaysian nurses undertaking top-up degree	Individual interview	Hermeneutic phenomeno-logical	Online learning	Online learning limited effective communication between students and lecturers, constrains with technology availability, and challenging to navigate the online technology. Online learning emphasized on independent learning and technology skills
Austria [54]	To explore the experience of nursing students on the impact of ICT and informatics on theory foundations and clinical competency	Philippines	6 nursing students	Individual interview	Phenomeno-logical	ICT use in learning activity	Two major themes: (i) Today’s learner in the light of informatics and technological advancement, and (ii) emerging technology in today’s global health
Greviana et al. [55]	To explore undergraduate dental students’ evidence of professionalism through self-reflective in e-portfolio	Indonesia	Not exactly mentioned (approximately between 28 and 40 undergraduate dental students)	Recurrent focus group discussion, reflective writing	Phenomeno-logical	e-portfolio	Three themes were developed: (i) the process of selecting and reflecting on evidence in the reflective e-portfolio, (ii) factors associated with the process of constructing the e-portfolio, (iii) categorization of trainees’ reflections
Ignacio and Chen [56]	To gain insights into how the students perceived the effectiveness or non-effectiveness of integrating web-based classroom gaming in learning	Singapore	14 nursing undergraduate students	Focus group discussion	Explanatory	Kahoot!™ application	Three themes were generated: (i) useful for revision, (ii) linking of concepts, and (iii) gaming as a challenge
Ismail et al. [57]	To address the influence of Kahoot! on students’ learning as formative assessment tool in medical education	Malaysia	36 undergraduate medical students	Focus group discussion	Phenomeno-logical	Kahoot!™ application	Three themes collated: (i) attractive learning tool, (ii) source of motivation, and (iii) learning guidance

Table 3 (continued)

Author	Objective of the study	Country	Participants	Data collection method	Analysis method	Technology investigated	Findings and themes
Kowitlawakul et al. [58]	To evaluate the EHRNE software usability in nursing education	Singapore	9 undergraduate nursing students	Focus group discussion	Exploratory	Electronic health records for nursing education (EHRNE)	Four themes related to the EHRNE program were identified: (i) functionality, (ii) data management, (iii) timing and complexity, and (iv) accessibility Three themes were constructed: (i) gaining insights into mutual roles, (ii) seeing the patient as a whole, and (iii) gaps in real-world application
Liaw et al. [59]	To evaluate the perspective of healthcare students on the transferability of virtual simulation learning to clinical practice	Singapore	16 healthcare students (i.e., medicine, nursing, occupational therapy, physiotherapy, pharmacy, social work)	Focus group discussion	Not specified	Inter-professional virtual reality simulation	Six benefits of asynchronous online forum were identified: (i) Expand each other's ideas and confirm each other's understanding. (ii) Provide motivation, express their agreements and criticisms, and seek comments, confirmation, and feedback. (iii) Work collaboratively to solve each other's problems and difficulties. (iv) Have ample time to read extensively. (v) Have adequate time to compose and (vi) gain a lot of information from a myriad of sources
Mohamad et al. [60]	To evaluate the impact of online forum learning among mature and working students	Malaysia	7 qualified allied health part-timer students	Individual interview online forum extraction	Not specified	Online learning	The GaMed™ learning system contributed five themes on three domains: Attitude and perceptions (i) motivation and engagement is encouraged by GaMed™, (ii) participants and experts are interested in the concept of gamified learning), experience (iii) simplicity of the GaMed™ simulation, (iv) usability issues of the game design), and limitation (v) limitation of GaMed™
Ohn and Ohn KM [61]	To evaluate the medical students' experience and acceptance of GaMed™ for ECG lessons	Malaysia	32 medical students	Focus group discussion	Not specified	Web-based gamified learning platform (GaMed™)	The GaMed™ learning system contributed five themes on three domains: Attitude and perceptions (i) motivation and engagement is encouraged by GaMed™, (ii) participants and experts are interested in the concept of gamified learning), experience (iii) simplicity of the GaMed™ simulation, (iv) usability issues of the game design), and limitation (v) limitation of GaMed™



**Table 3** (continued)

Author	Objective of the study	Country	Participants	Data collection method	Analysis method	Technology investigated	Findings and themes
Salim et al. [62]	To explore the perceptions of family medicine trainees regarding blended learning	Malaysia	12 postgraduate family medicine trainees	Focus group discussion	Exploratory	Blended-learning	Four themes emerged: (i) blended-learning encourages continuous learning, (ii) blended-learning bridges the gap in student–teacher interactions, (iii) the different perceptions of teaching and learning styles, and (iv) perceived blended-learning as an extra burden
Shorey et al. [63]	To examine students' attitude and experience post-virtual patients training	Singapore	24 undergraduate nursing students	Focus group discussion	Not specified	Virtual counselling application using artificial intelligence (VCAAI)	Four themes (out of six) were generated from student's perspective: (i) attitudes toward virtual patient training, (ii) virtual patient's role in student development, (iii) enhanced features and implementation suggestions, and (iv) value of technology in teaching communication
Shorey et al. [64]	To explore the experience of nursing students on blended-learning for communication module	Singapore	74 undergraduate nursing students	Reflective writing	Not specified	Blended-learning	Six themes yielded from the reflective writing: (i) helpful and engaging classroom experience, (ii) valuable online activities, (iii) meaningful assessment, (iv) appreciation for interprofessional education, (v) personal enrichment, and (vi) overall feedback and recommendations
Youngwanichsetha [65]	To examine students learning outcome on active learning using the read, reflect, display, and do (R2D2) technique via blended-learning	Thailand	6 graduate midwifery students	Individual interview Reflective writing	Not specified	Blended-learning	Four themes were identified from implementation of R2D2 technique in online learning which are (i) intending to read, (ii) reflecting challenge to, (iii) displaying creatively, and (iv) doing it interestingly

Table 3 (continued)

Author	Objective of the study	Country	Participants	Data collection method	Analysis method	Technology investigated	Findings and themes
Zhang et al. [66]	To evaluate the perspective and experience of students on video-assisted debriefing feedback reflection on recorded high-fidelity simulation activity	Singapore	27 undergraduate nursing students	Focus group discussion	Exploratory	Video-recording	Three themes were derived: (i) journey from traditional verbal debriefing to video-assisted debriefing, (ii) praise and criticism of video-assisted debriefing, and (iii) the road to successful video-assisted debriefing
Hu et al. [67]	To explore the nursing students' experience on home-based learning pedagogy during the COVID-19 pandemic	Singapore	23 undergraduate nursing students	Individual semi-structured videoconferencing interview	Thematic	Full online learning	Three themes were generated: (1) challenges of home-based learning, (2) the effectiveness of home-based learning, and (3) students' motivation to learn
Kok et al. [68]	To investigate the health sciences students perception on the use of vLAB	Malaysia	23 biomedical science and medical biotechnology undergraduates	In-depth interview	Thematic	Virtual laboratory simulations (vLAB)	Three themes were made: Theme 1: educational values (experiential learning instructional design; learning environment). Theme 2: individualisation of learning (individualized learning to personal needs). Theme 3: areas of enhancement (user experience; feedback; collaborative learning)
Kunaviktikul et al. [69]	To further elucidate the understanding on full online learning during COVID-19 and validate the perception using Photovoice	Southeast Asia (Indonesia, Malaysia, Philippines, Thailand, Vietnam, Hong Kong)	52 nursing students and 28 nursing faculties	Photovoice	Thematic	Full online learning	Three themes with nine sub-themes were extracted: (1) Psychological roadblocks to online education (motivation and concentration; fear in time of pandemic); (2) developing resilience despite adversities (courage and a sense of duty tied to profession; camaraderie and strong positive relationships); and (3) online education: what worked and what did not (continuity of learning; work-study-life balance; interaction and engagement; personal and professional growth; the duality of technology)

**Table 3** (continued)

Author	Objective of the study	Country	Participants	Data collection method	Analysis method	Technology investigated	Findings and themes
Liaw et al. [70]	To unravel the experience of users on interprofessional simulation in 3DWW	Singapore	30 healthcare students (i.e., medicine, nursing, occupational therapy, physiotherapy, pharmacy, social work) and 12 facilitators	Focus group discussion	Thematic	Interprofessional virtual reality simulation	Four themes emerged: (i) the “wow experience”, (ii) authentic experience on collaborative care, (iii) ease of learning, and (iv) preeminent role of the facilitator
Nadarajan et al. [71]	To evaluate the feasibility of telesimulation for emergency medicine clerkship	Singapore	42 final year medical students	Open-ended questions survey	Thematic	Telesimulation	Four themes were developed: (i) Fidelity-physical, psychological and conceptual; (ii) realism; (iii) engagement; (iv) outcomes-knowledge, skills, and attitudes
Roslan and Halim [72]	To investigate the students' readiness on online learning at home due to the COVID-19 pandemic	Malaysia	15 medical students	In-depth Interview	Explanatory	Full online learning	The students' experience on online learning has several themes developed: (i) benefits of online learning, (ii) disadvantages of online learning, (iii) enablers of online learning
Tan et al. [73]	To evaluate the applicability of digital serious board game for anatomy learning and rehearsal	Singapore	12 pre-clinical year medical students	Focus group discussion	Inductive thematic	Digital serious board game	Several themes identified on (i) provides fun and enjoyment, (ii) engaging, (iii) appreciative on the rehearsal activity, (iv) natural flow, (v) improvement recommendation
Woo et al. [74]	To explore the perception of Master of Nursing students on the impact of COVID-19 on learning and Advanced Practice Nursing development	Singapore	14 Master of Nursing students	Individual semi-structured videoconferencing interview	Thematic	Full online learning	Theme 1: overcome adversity through innovation (proofing face-to-face learning and assessment; discovering alternative ways to learn). Theme 2: acceptance of remote learning (initial apprehension and setbacks; patience and appreciation toward remote learning)

rather than on technology. It can be summarized where the pre-COVID studies observed consumer and design studies on the use of technology [54–66], except for some [52, 53], whereas COVID-19 studies observed life experience as learners utilizing technology in learning [67, 69, 71, 72, 74], except for some [68, 70, 73]. Studies focusing on the technology and product emphasized their advantages and were optimistically reported, whereas studies on life experience paid more attention to reporting on the challenges and limitations in learning.

### Being Prepared vs. Spontaneous

Studies in the pre-COVID-19 era were usually made by initial planning, including what technology to use, in a controlled situation, pre-determined the learning activities such as using the software or app, and were experimental in nature (the participants are intentionally exposed to the technology). However, COVID-19 studies were conducted primarily by chance when the learners had used the technology not specifically for research but from actual practice. Thus, the researchers mostly conducted the studies spontaneously, taking the available opportunity.

### Question 2: What Are the Perceptions and Experiences of Southeast Asian Healthcare Students on Technology-Based Teaching and Learning in Their Education?

Although there are discrepancies between studies during the pre-COVID-19 and COVID-19 eras, the essence of technology-based learning is relatively sharable and can be synthesized into the same theme. Therefore, three themes were generated from the synthesis: (i) culture does matter in the implementation of technology-based learning; (ii) the values and limitations of technology used for learning; and (iii) technology is part of daily life and creates new challenges in education. Quotes were extracted from the included articles, either the first-order construct, which is the original direct quotation of the study's participant, or the second-order construct, which is the excerpt from the included article's researcher's synthesis. The example quotes supporting the themes and sub-themes are presented in Table 4.

#### Theme 1: Culture Does Matter in the Implementation of Technology-Based Learning

The cultural role of Southeast Asian education plays a role in influencing the perceptions of learners on technology acceptance in learning. Under this theme, three sub-themes are identified.

## Cultural Conflicts in Learning

Technology is a medium to deliver teaching and learning activities efficiently. However, culture has influences on learning perceptions. Hence, imposing an unfamiliar Western learning culture on Asian students might create dissonance, although lessons were delivered through online learning [52, 53, 60, 62, 63, 65]. Western education emphasizes independent and active learning, whereas Asian students expect guidance. For example, students will remain quiet during online learning when asked questions and let the lecturers guide the session. Therefore, those technologies that promote independent and active learning are less appreciated. When online learning is delivered in a familiar style to Asian students, it is easier to be accepted among the students. The findings indicated that learners are more receptive to technology use in learning if they have been exposed to it early, are made familiar with it, and when they have experienced it over a period of time [67, 72, 74]; however, for strangers to online learning, sudden exposure to it creates a higher level of anxiety [53, 69]. The use of technology is considered for the purpose of revision rather than the main learning approach. Therefore, technology use in learning is considered optional, preparatory, and complementary in nature [56–58, 63, 66–68, 73, 74]. Using technology as the main approach is acceptable but only for a short duration, during an emergency, or for non-skill required lessons [53, 65–67, 69, 71, 72].

## Educational Approaches Are Pivotal

Educational approaches are critical elements in a successful teaching and learning environment. The educators' preparation in using technology in making teaching and learning activities interesting, fun, and interactive makes technology favorable. Merely using technology without imposing any contemporary pedagogical elements will have little benefit [53, 67, 69, 70, 72, 74]. For example, a traditional didactic one-way lecture even delivered through online learning makes learning activities bland. Creating a more active and living-learning environment is helpful for engaging and critical thinking to happen. However, the requirement of didactic teaching as the primary educational approach is still demanded by learners [53, 59, 62, 63, 66, 69, 71, 72].

## Reduce Trend of Generational Divide but Economic Factor Plays a Role in Technological Gap

Chronologically, the generational divide is noticed during the early publications. However, it is becoming less as technology has become more common, especially during the COVID-19 period. A more pertinent factor creating the

technological divide is the economy. High-income countries, such as Singapore, found that learners are more embracing of and receptive to technology use. In contrast, in lower-income countries, such as the Philippines and Indonesia, learners have voiced dissatisfaction. The issue arises because the facilities provided, such as a limited internet connection and possession of ICT equipment (i.e., computer, smartphone), hindered the optimal usability [52–54, 57, 58, 60, 65, 72]. Some expensive technologies are also less affordable. It makes lower-income countries utilize commercial and cost-effective technologies for learning purposes, restricting the learning of some skills [69]. Even for some countries, already available technologies are still under investigation or in the development phase. Therefore, most technologies are not entirely ready for massive use [58, 59, 61, 63, 73]; only a small number are ready [70]. Thus, the technologies are immature and below par with the existing technology used in real practice.

### **Theme 2: The Values and Limitations of Technology Used for Learning**

The use of technology to facilitate learning and teaching is beneficial. Technology has overcome barriers in traditional teaching and learning activities. However, technology is just one of the media for teaching and learning and has its limitations.

### **Benefits of Technology**

The included studies found that technology can eliminate the boundaries restricting wide-reaching learning, such as geographical structure, time, social, and cultural contexts [52, 53, 59, 60, 62, 67, 69, 72, 74]. Technology-based learning provides a “safe environment” where the learners do not worry to make mistakes and errors and can learn from it [63, 66, 68, 70, 71]. The availability of learning materials 24/7 or all the time enables students to return and revise when needed [55, 60, 63, 64, 66, 68, 70], which are not available in conventional learning (e.g., lecture recordings). Technology has also made learning and understanding easier because of sensory-rich experiences, such as visuomotor coordination and simulation [54, 56, 57, 59, 63, 65, 66, 68, 70, 73], and is a valuable alternative for skills learning at least [68, 70, 71, 74].

### **Limitation of Technology**

However, technology has limitations. It does not reflect the actual technology used in some practice, lacks reality and human interaction, and hands-on skills cannot be fully

transferred into technology to date [58, 59, 61, 63, 68, 72]. For example, the virtual patients using artificial technology provide limited, awkward, and repeated responses, and fail to detect the student’s speech (see [63]). Moreover, clinical learning was most interrupted because of online learning [67, 69, 71, 74].

### **Theme 3: Technology Is Part of Daily Life and Creates New Challenges in Education**

Technology is becoming an accepted element of everyday life. Although technology has penetrated widely in educational practice, this is not without issues. Identifying the issues makes for an efficient contingency plan and remediation action.

### **Enriching yet Burdening to Daily Life Activities**

Students and educators are busy with other roles and responsibilities in their life, on top of their educational responsibilities. This makes technology use for teaching and learning purposes an additional burden because of the extra tasks [52, 55, 60, 62, 65–67, 69, 71, 74]. The use of technology is no longer separated from personal life activities and educational responsibilities. It may also impede learners’ quality of life, such as disturbing social life, interrupting personal activities, and taking a toll on health and well-being [67, 69, 72, 74]. However, some positive notes were also identified, where the students feel that online learning allows them to multitask and perform their preferred leisure activities while learning, which gives them an opportunity to relax [67, 69, 72].

### **Creating New and Unique Challenges in Education**

Easy accessibility to technology has made learning activities broader. However, it has developed toward technology dependence and misuse [54, 57, 65]. Students’ use of technology is difficult to monitor as it is based more on individual preference. The use of technology might drift from formal to personal applications, such as computer and internet use [65, 67, 69]. Another issue is the query on the integrity of assessment, reflecting the quality of knowledge or skills acquired. There is a concern over the integrity of the assessments and evaluation as no substantial standard is available on handling assessment activities [69, 74]. Furthermore, the learning and assessment of skills, especially clinical skills, are limited and may not reflect the actual practice contributing to the perception of lack of competence [69, 74].

## Discussion

This meta-synthesis serves as the foundation in synthesizing literature on the perceptions and experiences of higher education students on implementing technology in teaching and learning activities. The findings of this study align with previous studies. The use of technology is beneficial [75, 76], overcoming boundaries [77, 78], but requires precautions from misuse [79] and technology-dependency, whereas full learning by technology received mixed perceptions and uncertainty [80–82]. Technology-based learning is perceived as having little difference from other non-technology-based learning (e.g., flipped classroom, didactic teaching) in exercising critical thinking and deep learning. This conclusion is supported by other studies in Southeast Asia [42, 47], but contradicts international studies [83]. Nonetheless, technology is perceived to be unable to fully replace face-to-face learning experiences and clinical skills [48, 84]. Perceptions found in studies in this meta-synthesis pertaining to the COVID-19 pandemic, especially the early studies, are shared with other related literature, which is mostly skeptical [85, 86]. However, a trend shows that the use of technology in health professional education is becoming tolerable and learners are adapting to it. This is no longer avoidable and should be anticipated in future practice. Literature suggests that some students quickly realize and gradually adapt their practice on technology application for learning [87].

In this meta-synthesis, the studies were conducted mostly in higher-income countries (except Brunei); no study was conducted in lower-income countries. Lower-income Southeast Asian countries might prioritize providing basic healthcare needs and training, or requiring support from other countries [88–90]. Higher-income Southeast Asian countries have the privilege and begin to train their local healthcare professionals [91]. Lower-income countries might have to rely on manual labor and traditional (e.g., face-to-face) approaches and have basic facilities, whereas higher-income countries could utilize advanced technologies and modern (e.g., blended, flipped) approaches [1, 15, 90]. The scenario would widen the gap between the countries. As a result, lower-income countries might be left out of technology-based learning. Hence, future research in providing affordable technology and assistance for education is needed. It is hoped that the research would enable more technology to be used for health professional education in the region.

Technology-based learning in the Southeast Asian context is provisional, especially among less-income countries. Higher-income Southeast Asian countries are gradually instilling technology in their mainstream education; however, conventional learning prevails. Various factors,

such as readily available technology, familiarity in using technology in learning since school or the pre-pandemic period, stigma about technology inferiority over real practice, facilities issues, and social surroundings, contribute toward the acceptance of technology in health professional education. This phenomenon echoes other studies in the region [16] and internationally [76, 92]. Traditional teaching and learning activities, such as classroom attendance and face-to-face guidance, still have their merit [41]. Teacher guidance is needed to affirm knowledge and provide comfort and confidence on what is learned. However, the world is now moving toward technology use, including healthcare sectors, but many healthcare professionals are still lagging behind [93–96]. Industries, including education, that quickly adapt with technology-based learning have a greater chance of survival with their business nature and remain relevant for the future [97]. The COVID-19 pandemic has driven authorities to support such initiatives to ensure the sustainability of the higher education industry, including health professional education [98]. Thus, it is important to expose the future and new-generation healthcare practitioners to technology to prepare them for future-proof practices [1]. Maintaining the existing practice would develop resistance to technology-based learning adoption as it requires students and educators to venture outside their comfort zone. Therefore, it is essential for technology-enhanced and active learning to be introduced in schools and early years in the university for it to become a norm in the education system.

Technology adds burden to students and educators [77]. However, its benefits outweigh its challenges [41]. Technology-enhanced learning should not be viewed as an additional task; instead, it is embedded as part of the education. Thus, revising the curriculum to ensure only critical topics are selected will allow more time and space for students to explore learning. Institutions need to ensure sufficient manpower, training, and facilities to allow high-quality teaching and learning delivery via technology. Faculty development initiatives that promote staff knowledge, skills, and competence have been found to be effective [99]. Faculty development is one of the ways in which educators can embrace and accelerate the use of technology in the classroom. However, with the rapid advancements in technology, adopting faculty development strategies, such as seminars, workshops, and longitudinal programs, is becoming less appropriate [100]. As a result, having a self-regulatory approach to faculty development is desirable. Several rapid and always-on-demand strategies, including just-in-time learning, performance analytics, virtual community of practice in society, interactivity with streaming videos, and investing in champions who educate via technology, can be used to hasten educator technology

**Table 4** Representative quotations from themes

Themes	Sub-themes	Quotation
Culture does matter in the implementation of technology-based learning	Cultural conflicts in learning	“Online ... Ooh difficult, everything have to learn ... maybe that is their way [delivery of teaching via online] but we here they have to teach more [give in-depth and explicit information with increased face-to-face contact hours for delivery of teaching] only then we will understand.” (First-order construct, Arunasalam [53])
		“Many UTAS [i.e. Australia] students expressed curiosity about the idea of RIPPLE... We found that ‘curiosity’ was not overtly reported by the UNDANA [i.e. Indonesia] students.” (Second-order construct, Ambrose et al. [52])
		“One commented that the trainees, being in the Y generation, they are technology-competent and enthusiastic in learning content that is internet-based.” but “Most trainees still preferred traditional face-to-face learning.” (Second-order construct, Salim et al. [62])
		“While online materials were useful in providing the students with knowledge, the students also appreciated face-to-face interactions with their facilitators.” (Second-order construct, Shorey et al. [64])
	Educational approaches are pivotal	“How much can we ask [by email], right. Even when we ask you see there is another cultural and language barrier. The way we ask they don’t understand what exactly we want and they will be understanding different thing and they will be replying different thing.” (First-order construct, Arunasalam [53])
		“in terms of both learning activity entries and narratives, were categorised in into the ‘understanding’ level. These reflections showed that trainees tried to provide theory without means to link it with their experience.” (Second-order construct, Greviana et al. [55])
		“Learning with Kahoot! was perceived as fun mainly because of the gamification features and the audio-visual stimuli” (second-order construct, Ismail et al. [57])
		“The healthcare students highlighted the role of the facilitator as critical in their learning particularly during debriefing.” (Second-order construct, Liaw et al. [70])
		“It’s the balance between the length and content. The good one will be the shorter class because students can only focus for 30 to 45 min and we need short break after that. Lecturers can split the heavy topics into several sessions.” (First-order construct, Kunaviktikul et al. [69])
		“The main reason [preferring traditional learning] is that from undergraduate level, our learning had always been face-to-face. That’s how we learnt. At this age, a change is difficult” (first-order construct, Salim et al. [62])
Reduce trend of generational divide but economic factor playing a role on technological gap	“In our generation nowadays, if you know how to use technology like gadgets, it makes work easier” (first-order construct, Austria [54])	
	“I used to be quite sceptical about virtual learning. I always think, especially for nursing has to be quite hands on. So, virtual learning to me it’s always something to complement, rather than to completely replace it. So when this thing happened, I realised that probably a lot of teaching could be done, a lot more than I expected, can be done virtually. And it could be just as attractive, and maybe even more convenient for us... I have learned to embrace virtual learning as a learning platform after this [sic].” (First-order construct, Woo et al. [74])	
	“Sometimes inequities occur based on the family’s socioeconomic status. Many children do not have a chance to access basic internet which created a discrepancy” (first-order construct, Kunaviktikul et al. [69])	
	“To get global health information, especially in Australia; have foreign friends; to know the different health challenges in Indonesia and Australia and then discuss together” (first-order construct, Ambrose et al. [52])	
	“[The virtual patient] provided safe practice environments that allowed more privacy and room for trial and error” (second-order construct, Shorey et al. [63])	
	“After experiencing real-life interprofessional rounds at workplaces to supplement the prior virtual reality simulation experiences, several students appreciated their values in fostering holistic patient-centered care” (second-order construct, Liaw et al. [59])	
The value and limitation of technology in learning	Benefits of technology	“[T]he students could demonstrate learned knowledge interestingly by presenting in class and online via LMS” (second-order construct, Youngwanichsetha [65])
		“Then I was surprised with the fact that, I mean, if you put all the academics aside, it really functions as like a real game and real strategies.” (First-order construct, Tan et al. [73])
		“So, you have to keep exercising your critical thinking and improving your knowledge, so with all these gaming apps right, it helps us to um, it throws us questions so that we can keep improving on our knowledge.” (First-order construct, Ignacio and Chen [56])
		“It allows me to do it by myself, ‘cause if in a in a real life setting, I think I’ll be in the group and sometimes work is distributed among all of us that I will miss up some steps. I won’t see certain steps. But for this in the virtual lab, I’ll be able to do everything step by step by myself.” (First-order construct, Kok et al. [68])
		“I think it’s quite an interesting way to be introduced to clinical ward rounds because I’ve never been on ward rounds before.” (First-order construct, Liaw et al. [70])
	Limitations of technology	“I think having pre-recorded lectures is good for a slow learner like me, I can listen to the lecture again... which helped me... I can see my grades improved for that module when I listened two to three times” (first-order construct, Hu et al. [67])
		“Our worry is we will become the OL [online learning] version of medical graduates—lack of experience, lack of communication skills in patient care because it’s just not the same when you clerk online. We got to clerk only one patient for each posting because you cannot get many patients in every online classes.” (First-order construct, Roslan and Halim [72])
		“Because of too much dependence to internet, students become lazy and may neglect exhausting all possible references and become content to what is being offered in internet sites where even credibility of information is sometimes at stake” (second-order construct, Austria [54])
		“Some participants stated that it was easy to use [the technology] and relevant to practice. However, others felt that it was not easy to use and some features may not be used in clinical practice” (second-order construct, Kowitlawakul et al. [58])
		“The theme of “frustration” also emerged in the answers of most students, especially in regards to establishing consistent online communication, time-management, and successfully using technology” (second-order construct, Ambrose [52])
“The connection is very slow and most of the time we can’t avail of the internet services...” (First-order construct, Austria [54])		
“Distance learning difficult especially if one is not IT [information technology] savvy or have facility” (first-order construct, Arunasalam [53])		
“...the limited accessibility of this platform may be an obstacle to the integration of this platform with other systems that may enhance student engagement.” (First-order construct, Ohn et al. [61])		
“A few students expected the VP [virtual patients] to be smoother and more realistic when they compared it to interactions with standardized patients” (second-order construct, Shorey [63])		

**Table 4** (continued)

Themes	Sub-themes	Quotation
Technology is part of daily life and created new challenges in education	Enriching yet burdening to daily life activities	<p>“Some students found it was time-consuming to watch the entire video” (second-order construct, Zhang et al. [66])</p> <p>“But this [online exercise] is an extra work to do after work. More like an extra burden!” (First-order construct, Salim et al. [62])</p> <p>“Technological advancement is not only focused purely on educational enhancement. Individuals belonging to the computer generation have witnessed the encompassing influence of technology to their daily lives” (second-order construct, Austria [54])</p> <p>“The blurring of work and personal life boundaries was met with mixed emotions.” (Second-order construct, Kunavikitikul et al. [69])</p> <p>“it’s rather challenging for me, so people at home might think that you are quite free... it is very hard to establish a separation between schoolwork and home duties” (first-order construct, Hu [67])</p> <p>“It (online learning) is perfect because I can do so many things in one time. I can join the lectures, participates in workshops, learn another language or new hobbies like interior design or yoga or poems. Actually, I didn’t think it was going to be this great, but now I am enjoying it.” (First-order construct, Lorenc et al. [40])</p>
	Creating new and unique challenges in education	<p>“Before, almost all instructors allowed the use of gadgets during class hours, but because others use their gadgets the wrong way it became restricted. So, students should learn to use technology appropriately during class hours.” (First-order construct, Austria [54])</p> <p>“Because I stay with my dad, so it’s very awkward if I use him as a model to practise my [physical examination] skill. And then if you ask me to practise on a pillow, it’s not alive, not real, I find it very awkward. So, I rather practise on a real person. But a real person, because of the COVID-19, it’s hard for us to meet each other [sic].” (First-order construct, Woo [74])</p> <p>“The lack of a physical ‘patient’ on which to carry out procedures and physical examination could limit the effectiveness of the telesimulation experience.” (Second-order construct, Nadarajan et al. [71])</p> <p>“...they [the university] use ExamSoft [webbased digital assessment software]. We [MN students] just do it [pharmacology written exam] at home by ourselves. Then they [invigilators] asked us to turn on Zoom. So, they [invigilators] monitor us during the exam.” (First-order construct, Woo et al. [74])</p>

training [100]. In addition, future technology in clinical practice should be prioritized and investigated in medical and health professional education, such as telehealth as a typical practice to enable a better inclusion of technology [101, 102]. These methods will familiarize educators with technology and help them swiftly adopt it as a normal and mainstream practice.

Learning with technology requires that learners have a certain degree of self-control to ensure that the education process takes place. Good self-regulated learning or self-care was found to be the factor that makes the students persevere and succeed in maneuvering around the challenges in online learning [17, 18, 78, 80]. Self-regulation focuses on an individual’s initiative to continually improve oneself through a cyclic process of thought and action. As a result, reflection necessitates the metacognitive function—where a person is aware of one cognitive condition to continue learning and overcome any barriers, motivation to propel an individual into the learning process, and emotion to motivate an individual to engage in the chosen activities [103]. Self-regulated learning is widely practiced in health professional education [104]. Health professional education is one of the advanced fields that utilize and conduct research on technology use in teaching and learning [33, 35]. Even clinical teaching has been quickly adapted for the students by implementing telehealth and web-based online learning [87, 105]. These should be integrated as a harmonious symbiosis and ecosystem for contemporary health professional education.

However, self-regulation relies on student-centered learning and the independence level of the learners on their initiative in learning. In Asian culture, teachers are regarded as an authority and learning is a process of knowledge transfer

rather than knowledge construction [4]. The Asian culture inhibits active interactions in traditional classrooms and the power distance is significant. Thus, transforming the active role of students to in charge of their learning will put them in a conflict and discomfort as this practice is challenging the tradition [4]. Depending on education technology, one method enables student anonymity (e.g., Kahoot) and they feel safe to express their opinions, which can be quickly accepted, but the other strives for independent learning (e.g., full online learning with assignments), which requires time to develop. However, independent learning can be developed with the wisdom of educators to gradually instill the new learning style, with environmental and psychological support provided [4]. Hence, this requires a balance between adopting technology and adapting it according to the local culture.

There is a different attention between publication in the pre-COVID-19 and COVID-19 periods. The issue is that investigations either before or during the COVID-19 pandemic do not consider the impact of changes in life events and the process of psychological transition. Transition refers to any event or non-event that results in a change in relationships, routines, assumptions, and roles [106], and the impact is based on the perception of the individual experienter. Transition in life events contributes to a stressful psychological impact to the affected individuals [107, 108]. Major life and catastrophic events, such as the COVID-19 situation, can significantly impact the mental health of affected individuals. The transition process may give stress to the person and requires some time before it is successfully overcome. Normally, it will take around 6 months to 1 year before a person manages to adapt to the changed situation. Therefore, studies on the COVID-19 period should not denote



those findings wholly on technology use in education, whereas the pre-COVID-19 studies have a narrow focus, mainly on the product or technology, with less attention paid to observe the learners holistically. Researchers should be aware of this bias when searching and interpreting the results, in desire to align with the researcher's interest or agenda [109]. The perceptions from the included studies might be bias toward volunteered participants rather than a collective and shared experience from the population [110]. Different perspectives may result if the practice is mainstream and enforced on the mass in general. General students feel restricted, helpless, and highly dependent if learning is mostly conducted via technology, with negligible real-world teacher–student relationship, practice, and guidance [16]. This might become a major issue for healthcare students, which requires heavy training on psychomotor skill development. Researchers need to consider a neutral stance and investigate from a holistic view.

### Limitation and Recommendation

This study was pioneered to explore the perceptions of students on technology-based learning in the Southeast Asian context, but after screening, records were not found in several countries. It is unsure whether technology-based learning is under-reported or lacking in these countries, or whether studies were not reported in the English language. Therefore, researching technology-based learning in these countries is warranted to identify possible barriers and solutions.

This meta-synthesis did not consider low-quality studies. The selection may have confined the scope and array of technology observed. For example, mobile learning [48, 50] has been missed as a result. However, as justified, qualitative studies with acceptable quality were selected to minimize bias in the analysis.

In this study, researcher biases were almost unavoidable [109, 110] as the authors (human) were the instruments who analyzed the literature. Efforts were made to minimize the bias, such as calculating inter-rater reliability and conducting discussions between the raters. In addition, the authors are from diverse backgrounds (e.g., practitioners and educators, medical and allied healthcare), which may have helped to prevent a dominant perspective in interpreting the data.

### Conclusion

Investigations were conducted on technology-based learning in Southeast Asia; these investigations were dominated by higher-income countries. Perceptions of technology-based learning were influenced by either the research focus (technological products or life experiences, and surrounding of the learners—including education culture, socioeconomic status, or the situations of that time), especially the pre-COVID-19 pandemic, or comparisons with the impacts of the COVID-19 pandemic.

Students accepted the use of technology, valued its benefits, and recognized its limitations and challenges. This meta-synthesis was confined to the available but limited past studies in the Southeast Asian region; hence, future research on providing affordable technologies for education in lower-income countries, using technologies to meet local needs, and initiating the use of technologies in primary education may be considered. Our study shows a scarcity of research on students' opinions and relating their learning experiences with technologies for practical applications in medical and health sciences, such as using clinical equipment. Finally, emerging technologies for healthcare education should meet students' needs post the COVID-19 pandemic. Medical educators must plan beyond the general educational arena for instructional approaches and investigations, and subsequently establish a distinctive and focused research for the demands in the medical and health sciences. Healthcare students, on the other hand, should prepare themselves for effective engagement in technology-based learning. Enhancing self-regulation skills among students may be the key to accommodate technology-based learning.

**Acknowledgements** This study is part of the first author's work for the Master of Medical Education. The protocol for this meta-synthesis was registered on INPLASY (INPLASY202120053) and is available in full on <https://doi.org/10.37766/inplasy2021.2.0053>.

**Author Contribution** MHR major role was initiating the idea, involving in every aspect of searching, screening, disseminating, quality evaluation, extracting, and synthesizing the data, and writing the manuscript. FWY role was in screening and decision of included studies. MSC, HAH, MZM, and NFMH roles were in evaluating the quality and extracting the data. MHJ is the expert in meta-synthesis and the consultant of the project. CCF and WHH roles were in synthesizing and charting the data. All authors were involved in providing critical and significant intellectual feedback in writing the manuscript. All authors approved the final version of the article for publication.

**Availability of Data and Materials** All data generated or analyzed during this study are included in this published article.

### Declarations

**Ethics Approval** Not applicable. No human subjects were involved this study.

**Informed Consent** NA

**Conflict of Interest** The authors declare no competing interests.

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**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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