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Emergency remote teaching or andragogical innovation? Higher education in Singapore during the COVID-19 pandemic

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Abstract

Singapore higher education's intraperiod response to the novel coronavirus (COVID-19) pandemic was unique compared to other countries, being praised by the World Health Organisation (WHO) for its early response. Like many other countries, alarming growth in cases appeared, and careful strategies for the continuation of learning were implemented. This paper provides a critical case study and reflection-in-action (Green et al., 2020) of the Singaporean intraperiod response, exploring individual responses from a sample of six autonomous universities, two international universities with campuses in Singapore, and four Private Education Institutions. Through a defined qualitative content analysis of university documentation, scant academic literature, and government and media sources, an understanding of the pandemic response in Singapore was possible. We chose to ensure full coverage of the city-state to enable a comprehensive country analysis in contrast to the growing volume of single-institution pandemic and emergency remote teaching case studies applying a sociotechnical theoretical framework to guide an analysis between educational technology systems and the people using it to teach, work, and learn. This study identified that while tasks and technology were presented with depth, the social elements – people and systems – were often lacking accurate description. We discuss how this technical focus has practical and research implications, and how future research and university teaching and learning practice can better respond to future challenges through reflection of the sociotechnical perspective.

Introduction

The novel coronavirus (COVID-19) pandemic poses significant challenges and opportunities for higher education (HE) globally. There has been a rapid expansion in temporary or emergent digital delivery strategies to enable HE to continue to educate their students in periods of lockdown (or so-called 'circuit breaker' periods in Singapore). While each country and each university has had nuanced responses, internationally these have largely been grouped into three consistent responses of rapid adaptation (Crawford et al., 2020a). These include: (1) responding to minimum governmental regulations (e.g., physical distancing and maximum indoor gatherings); (2) delayed commencement of the next teaching period; and (3) digitalisation. For Singapore, this initially largely resulted in digitalisation.

There has been a progression towards localised education models to support the temporary period of reduced international access to education and travel (Bonk et al., 2020). For institutions relying heavily on international students, especially in the three main HE import countries (the U.S., the UK, and Australia), there have been drastic social and economic challenges (*The Economist*, 2020; Marshman & Larkins, 2020). The Singapore education sector has not faced the same drastic challenges, with the majority of HE students being domestic and overall, HE demand exceeding supply, particularly in the Autonomous Universities (AUs). In the Singapore context, Autonomous Universities refer to corporatized, not-for-profit universities that are autonomous in the sense that they are heavily government-funded, yet have flexibility to decide on matters such as their internal governance, budget utilisation, tuition fees and admission requirements (Ministry of Education [MOE], Singapore 2005, Mok, 2010).

Thus, Singapore was not as adversely affected as countries where partial, and often over-, reliance on international students is key expansionary business. This major difference presents Singapore as a largely unique case study compared to the traditional three responses observed across international learning and teaching. In particular, a focus on domestic consumption of education mitigates the needs for government lobbying for border easing (ICEF Monitor, 2021; Ziguras, 2021), establishing quarantining arrangements for new and existing international students in Japan and New Zealand (Kakuchi, 2021), and allowing legislative changes to allow international student visas to be fulfilled without entrance to the country (Tudge, 2020).

The research objective of this paper is to examine the Singapore response to date in-depth. There are a number of studies with single institutional responses (e.g., Cleland et al., 2020; Compton et al., 2020; Fung & Lam, 2020; Goh & Sanders, 2020; Müller et al., 2021; Rai, 2020). There is also a survey of adult educators' perceptions towards their 'digital resettlement' during lockdowns and beyond in Singapore (Watermeyer et al., 2021a) and there are some articles that co-present Singapore's HE with other jurisdictions (Crawford et al., 2020a; Bonk et al., 2020; Kefalaki et al., 2021; Rudolph et al., 2021). Consequently, more cross-cultural and cross-institutional studies are needed (Crawford et al., 2020b). This manuscript focuses on analysing a sample of institutions within the Singaporean HE environment with a focus on the Autonomous Universities (AUs). The value of this research is in the opportunity to examine the synergies of responses when international student load is not a primary driver for rapid adaptation. We propose two research questions to guide our research:

> Research Question 1. What was the intra-period Singapore higher education response to COVID-19?
>
> Research Question 2. How does an understanding of COVID-19 responses change at institution and country-level analyses?

To examine these research questions, we have organised this manuscript in the following way. First, we begin with an overview of the Singaporean HE and COVID-19 contexts. Next, we provide an overview of the method adopted for this qualitative content analysis, and a presentation of the findings at the institutional level. Finally, we discuss the synthesis of these findings and consider the practical implications and opportunities for future research in our conclusions.

Brief literature review and context

Singapore and higher education

Since its independence in 1965, Singapore has continued to value education as a key social and economic driver. In 1976, only 16 percent of high school leavers pursued post-secondary education (Sam, 2017). At present, more than 40 percent cohort participation of Primary One students (who are typically seven years of age) in the Autonomous Universities alone is eventually achieved (Davie, 2020; Leow, 2020a; Ministry of Education, 2018).

Singapore's higher education includes diverse types of university offerings: local autonomous universities (AUs); international university transnational satellite campuses; and private education institutions (PEIs). PEI's in Singapore are non-government funded education providers that oftentimes offer post-secondary education, leading to the award of certificates and diplomas (Sam, 2017). The latter model frequently involves providing transnational higher education programmes via cooperation with international universities, ranging from fly-in faculty with full control to models with full local faculty. PEIs occupy a unique facet of the education sector with a limited proprietary offering under the regulatory supervision of the government's SkillsFuture Singapore's (SSG) Committee of Private Education (CPE) (Skills Future Singapore, 2020b).

In Singapore, there are six AUs, eight international branch campuses (IBCs), and 329 PEIs (Lo, 2017; Skills Future Singapore, 2020a; Immigration and Checkpoint Authority, 2020). Out of 329 PEIs, only approximately one third are permitted to offer external degree programmes through EduTrust certification (Skills Future Singapore, 2020b).

Singapore's positioning as a 'Boston of the East' and a 'Global Schoolhouse' to capture a growing global HE market has been socially and economically successful (Ye, 2016). Singapore's Global Schoolhouse project was started in 2003 with the aim of attracting world-class universities (Garrett, 2005; Lo, 2017; Ng & Tan, 2010; Waring, 2014; Ye, 2016;). Initially, the project was dominated by research-intensive American institutions (e.g., Johns Hopkins University and the Chicago Graduate School of Business: Sidhu et al., 2011). Additionally, Wharton Business School was contracted to provide expertise in setting up Singapore's third university, Singapore Management University (SMU: Sidhu et al., 2011), and MIT collaborated with the Singapore University of Technology and Design (SUTD) from 2010 to 2017 (SUTD, 2017). International diversification led to the transnational campuses of INSEAD (a highly-ranked French business school) and the Indian Jain School of Management establishment (Sidhu et al., 2011).

Higher education and COVID-19

In early 2020, Singapore's use of public health best practices in response to the novel coronavirus (COVID-19) pandemic had garnered praise from the World Health Organisation (WHO) and international media (Vaswani, 2020; Evers, 2020). The intraperiod response from Singapore was influenced by early detection and high sanitisation and social distancing efforts, compared with other countries. Universities remained open, teaching either fully online or through blended learning approaches. In the second quarter of 2020, the rate of new infections increased alarmingly, especially among foreign workers staying in dormitories (Bonk et al., 2020). As of 15 February, 2022, there were 514,000 cases and 926 deceased in Singapore, contrasted to global numbers of 415 million cases and 5.84 million deceased (COVID-19 SG, 2022; Global COVID Dashboard, 2022).

Prior to the circuit breaker, Universities made a preliminary response by delivering all learning activities online and converting summative assessments (e.g., invigilated examinations) into a variety of online or take-home modalities. The Singapore government's technocratic approach to COVID-19 began after an initial circuit breaker (lockdown) had been imposed to contain the spread of COVID-19 from 7 April to 1 June, activities within Singapore were planned to be resumed gradually over three subsequent phases: safe reopening, safe transition, and 'the new normal' (Ministry of Health, 2020a). At the time of writing (February, 2022), the city-state is in Phase 3, after having had to go back to Phase 2 (heightened alert) from 22 July to 18 August, 2021 (gov.sg, 2021). A brief overview of these phases is provided for context.

Phase 1 ('safe reopening': 2 - 18 June, 2020) saw the recommencement of low risk economic activities. This included higher education institutions whose terms were in session returning to campus for practical and laboratory-based sessions, with instructional learning remaining online. However, co-curricular activities, enrichment activities and tuition were not to resume (Ministry of Health, 2020a). In Phase 2 ('safe transition': 19 June - 27 December, 2020), some medium risk economic and social activities have resumed (Medina, 2020). Phase 3 (the 'new normal': from 28 December, 2020 onwards) is still ongoing. Among other things, Phase 3 involves the gradual re-opening of Singapore's borders (Ministry of Health, 2020b; Medina, 2020).

Dependence on international students is marginal. 104,000 students were enrolled in AUs in 2018 (data.gov.sg, 2019); foreign campus universities and PEIs are excluded from these numbers. Such differences to other countries are balanced by different government policy landscapes that create environments to incentivise international places (e.g., less domestic funding). From 2020 onwards, the cohort participation rate in AUs was higher than the original target of 40 percent, due to the pandemic (Davie, 2020; Leow, 2020a; Ng, 2021). This is contrasted to Australia (Yezdani, 2021), United Kingdom (Britton et al., 2020), and United States, that are currently responding to the effects of challenging transnational education and reduced international student intakes on institutional bottom-lines.

Strong domestic demand for local university places and the politicisation of the composition of the student population has resulted in most places at the AUs being domestic (Loke & Gopinathan, 2017; Davie, 2021; Ng, 2021). Proportions in 2012 and 2015 were consistent, with only 15-16 percent in international students in the Autonomous Universities with capped foreign intake at 2011 levels and while expanding domestic university places (Henson, 2015). In 2016, 77,000 Singapore residents and 29,000 foreigners attended Private Education Institutions (Lee, 2016). In 2020, 35 percent of the 68,200 foreign students studied at PEIs (Leow, 2020b). The number of international students had fallen from 89,400 in 2012 to 67,200 international students in 2019 (Leow, 2019, 2020b; Sharma, 2019). The cohort participation rate in Singapore's autonomous universities reached an all-time high of 42% during the pandemic in 2020 (Loke & Gopinathan, 2017; Davie, 2021). In 2020, Singapore's six autonomous universities increased admissions by 2,000 offers, and in 2021, by an additional 1,000 places, while upholding admission standards and ensuring a quality education (Ng, 2021). The increase in demand for places in domestic universities was largely due to Singaporeans' being less inclined to study abroad as a result of the pandemic, rising anti-Asian hate crimes and deferring work due to a weak job market (Ng, 2021; Davie, 2021).

Singapore presents a unique case study for COVID-19. During the pandemic, there are numerous published examples of universities globally experiencing financial difficulties (e.g., Marshman & Larkins, 2020; Wang et al., 2020), often from decreased international student intake. In Singapore, there has been minimal reporting of educational institutions experiencing COVID-19-based financial difficulty. There is no shortage of international students who would like to study at the AUs, with some 25,000 applications for 3,000 international places each year (Sam, 2017). Despite this, AUs often charge double for international students, whereas PEIs do not typically have much price differentiation at all for domestic and international places (Sam, 2017). While major HE-exporting nations like Australian, UK, and the U.S.-based higher education are focusing on decisions partially based on cost-savings (see Yezdani, 2021), low-income countries

are avoiding online learning considering cost of electricity, data, and learning devices on student communities (Kuguyo et al., 2020). For Singapore however, higher education communities are articulating a 'paradigm change' and 'education without limits' mentality, characterised by a future-focused digital mobility and innovation over dollar savings (Fung & Lam, 2020; Watermeyer et al., 2021a).

Theoretical framework

The socio-technical systems framework was described by Lewitt (1965) as two independent but interrelated systems – the social and the technical. The social system is broken into people (attributes, knowledge, skills, values, and needs) and organisational structure (authority structures, reward systems, and policy), whereas the technical system is divided into tasks (processes performed by humans or machines) and technology (hardware, software, or facilities) (Bostrom & Heinen, 1977; Oosthuizen & Pretorius, 2016). The socio-technical systems framework focuses on how interactions between people and technology are shaped, and how applying it may help ensure that technical solutions meet social requirements (Coiera, 2006; Li et al., 2019). The framework aims to understand how the social system contributes to the performance of the technical system, also in light of the "poor acceptability, uptake and performance" of many information and communication technology (ICT) innovations (Coiera, 2006, p. S98). Recognising that both social and technical systems have mutual systemic consequences and are thus intrinsically entwined, the framework can thus contribute to the process of developing higher-performing ICT systems (Coiera, 2006). While this framework has been adapted over time, this original framework with four attributes is still applicable today to identify the joint optimisation of both systems to solve complex issues, such as during the implementation of a technology or design-led change (Oosthuizen & Pretorius, 2016; Sony & Naik, 2020).

Within higher education, there is limited application to date of the socio-technical theoretical framework to learning and teaching. There are studies thatv discuss the opportunity to adopt the socio-technical approach to consider the efficacy of e-learning (Upadhyaya & Mallik, 2013) and distance education (Wang et al., 2010). However, there are limited other applications in higher education. Despite this, there is extensive evidence about the effect of the online learning systems (technology) on the student (people) learning experience (task) when implemented as an organisation-wide (structure) policy (Kebritchi et al., 2017; Nortvig et al., 2018). With emergency remote teaching introduced to replace face-to-face teaching in classroom environments in early 2020, academic staff and students in Singapore and elsewhere had to adapt quickly to a complex technical system. The socio-technical systems framework provides a sound structure for analysis of higher education's response to the pandemic. Applying the four attributes of the framework: people comprises the attributes, skills, values, and needs of students and academics; structure comprises policy, support, and incentives; technology includes hardware, learning systems, teaching software, web resources, and other technologies; and, tasks include design, instruction, assessment, and evaluation.

Method

To support the research objectives of this study, a multiple-unit case study method adopting a qualitative content analysis was employed (Mayring, 2004). This comprises 12 individually reviewed educational organisations at an institutional level that are subsequently synthesised within-case at the national level. Our content analysis approach includes quality assessment of information sources, given access to peer-reviewed information is restricted by such sources only just beginning to be published. For transparency, we used 141 sources, and provided a summary of sources used in Table 1. Direct university and government sources (43.1%) are supplemented by news articles, higher education news outlets, and other forms of communication. In Singapore, all but one mainstream newspaper are owned by one company, Singapore Press Holdings (with the Today newspaper owned by Mediacorp – Edge, 2004). These newspapers are of a pro-government-nature and they are extremely unlikely to misquote government sources. The goal was to ascertain information regarding how such institutions were progressing through the pandemic – using an iterative analysis of documents – and the locations these were published are not always traditional sources (e.g., institutional blogs).

Table 1: Source types.

Source type	**Examples**	***N***	**%**
HE institution website	Nanyang Technological University	44	31.2
Academic journal articles	Journal of Applied Learning and Teaching	31	21.9
News articles	*The Straits Times*	20	14.2
Government website	Government press releases	11	7.8
HE institution communications	Direct emails to student cohorts	7	5.0
Blogs	Mothership	3	2.1
Academic Books		3	2.1
Report		2	1.4

In terms of institutional selection, we included all six Autonomous Universities for the purpose of this article. It was obviously not possible to discuss the approximately 300 Private Education Institutions, and instead the largest four by student population were included (SIM Global, Kaplan Singapore, PSB Academy and MDIS). There are eight

international branch campuses in Singapore, and a group of two universities were selected to include James Cook University and INSEAD based on student population size and institutional ranking, respectively. Table 2 provides a high-level summary of the institutions included. The rationale for this purposively selected sample of 12 institutions was to present the full diversity of Singapore's higher education offerings by having all three delivery models represented. To address the research questions of this study, we adopted purposive (non-probabilistic) sampling, with the focus on getting a maximal variation (Patton, 2002) of voices, through analysing the responses of six AUs, two IBCs and four PEIs (n = 12). Purposive sampling does not aim at being representative or being generalisable (Campbell et al., 2020), thus limiting its external validity (Etikan et al., 2016; Andrade, 2021).

Table 2: Basic statistics of selected institutions offering HE in Singapore in 2020.

Type *	Institution	Established	Staff	Students
AU	*National University of Singapore (NUS)*	1980	10,200	42,600
	Nanyang Technological University (NTU)	1991	8,300	32,000
	Singapore Management University (SMU)	2000	600	22,800
	Singapore University of Social Sciences (SUSS)	2005	1,400	15,000
	Singapore Institute of Technology (SIT)	2009	500	7,000
	Singapore University of Technology and Design (SUTD)	2009	600	400
PEI	*Singapore Institute of Management (SIM)*	1964	n.a.	17,200
	Management Development Institute of Singapore (MDIS)	1956	n.a.	13,000
	PSB Academy	1964	n.a.	>12,000
	Kaplan Singapore	1989	300	12,000
IU	*James Cook University Singapore (JCU)*	1970	n.a.	4,200
	The Business School of the World (INSEAD)	1957	300	1,400

**PEI = Private Education Institution, AU = Autonomous University, IU = International University*

For Table 2, staff and student numbers are rounded to the nearest 100. Sources: INSEAD, n.d.a; Kaplan Inc, 2021; James Cook University, 2020c; Nanyang Technological University, 2020a, 2020b; Management Development Institute of Singapore, n.d.; National University of Singapore, 2020a; Singapore Institute of Management, 2020a; Singapore Institute of Technology, 2020b; Singapore Management University, 2020a, 2020b; Singapore University of Social Sciences, 2020c; Singapore University of Technology and Design, 2020g; PSB Academy, n.d.

Results

This section commences with a brief overview of the response to the pandemic from the institutions included in our sample (see Table 2). There have been three types of rapid adaptation identified (Crawford et al., 2020a), although only rapid digitalisation was identified in this article's sample. We also articulate the date of the first rapid adaptation, where this was available (see Table 3). In addition, we have taken into account a constructive alignment lens (Biggs & Tang, 2011; Biggs et al., 2019) in considering assessment and learning activity changes. We acknowledge the role of intended learning outcomes (ILOs) in these discussions. However, the published literature does not speak to changes in this regard and they were thus not typically identified explicitly through our qualitative content analysis.

Autonomous universities

National University of Singapore (NUS)

After the end of the circuit breaker on 2 June 2020, the National University of Singapore (NUS) embarked on controlled resumption of learning activities safely (Ministry of Health, 2020a). Instructional learning continued as pre-recorded and online for flexibility and accessibility. Use of project management and polling apps facilitated teaching methods such as group projects to allow peer-to-peer and peer-to-teacher synchronous communication. The changes made to assessments and examinations enabled student flexibility in managing which subjects applied to their Grade Point Average (GPA) (Yeo, 2020). NUS has incorporated innovative and advanced technologies, virtual reality and AI to optimise the learning experience of the students (Sen, 2020). NUS has also applied learning analytics regarding student attendance and online access to improve remote learning (Madan, 2020; Sen, 2020).

The duration of Phase 2 lasted six months (19 June 2020 - 27 Dec 2020), and on 9 October 2020, NUS updated students about the relaxation of certain guidelines, such as: allowing co-curricular activities (CCAs) to gradually resume and in-class lessons with less than 50 students to resume. NUS also informed students that from 2 November 2020 onwards, students could return to campus regardless of whether they had lessons. As Singapore moved to Phase 3 in late December, 2020, NUS released a circular informing students that resuming in-class lessons would be encouraged and all safety measures would continue to apply until further notice (National University School, 2020b).

Nanyang Technological University (NTU)

Similar to NUS, NTU also allowed student choice for competency-based pass/fail grades for all semester 1 2020 undergraduate courses that began in August (Mahmud, 2020). However, NTU students faced several uncertainties. The university's first online adaptation was on 13 February, 2020. On 24 March, 2020, invigilated exams were converted to continual assessments causing some students distress and anxiety (Fan, 2020; Mahmud, 2020), as they feared failing

to meet the new deadlines and workload requirements. NTU also employs the Massive Open Online Course (MOOC) platform Coursera for up to 12 academic units (approximately four modules: Chia, 2020).

NTU made adjustments to its COVID-19 guidelines when entering Phase 3. Similar to NUS, classes with more than 50 students would still be conducted online whereas those below 50 students could return to in-class lessons. Students are still required to ensure safe distancing, wipe down tabletops after utilising them, and are encouraged to only enter school campuses when necessary (especially for tutorial and lab lessons). CCAs are to resume progressively (requiring booking) with safe distancing measures (Nanyang Technological University, 2020c, 2020d).

Singapore Management University (SMU)

Singapore Management University (SMU) moved selected classes to online learning on 10 February, 2020, and subsequently, added new educational technology to support and facilitate an online curriculum (SMU Engage, 2020). The university revamped its IT system support to facilitate fully online learning formats by 30 March 2020; all academic materials were available through its learning management systems.

For students who were completing their graded assessments and preparing for invigilated examinations, the institution changed its modality to online examinations with providing students flexibility to choose a diverse range of grading options. Such measures were aimed at minimising any delay to student progression, and reduce student stress and anxiety. Following governmental post-circuit breaker strategy releases, SMU announced its resumption of traditional operations in August 2020. The majority of instruction and learning activities remain conducted online, with only a proportion of courses adopting blended and flipped approaches. For these courses, partitions of the cohort may attend in person while the rest continue online learning over one- and two-week cycles (Clark, 2020; SMU Engage, 2020).

SMU introduced a Day Pass Entry Registration System which allowed students the flexibility to enter school premises on days they do not have classes in order to access the library and do printing (Singapore Management University, 2020c). Similar to other AUs, classes with up to 50 students were to be held fully on campus starting January 2021. SMU would gradually allow for all lessons to be conducted physically, and international students were to make travel plans back to Singapore before the start of the term (starting 11 January 2021: Singapore Management University, 2020c). Examinations were also to be reintroduced to campus gradually.

Singapore Institute of Technology (SIT)

Singapore Institute of Technology (SIT) implemented e-learning from 24 February 2020 for classes with more than 50 students, and has been garnering positive responses from both students and lecturers, as an effort to reduce physical contact amongst the university (*Channel News Asia*, 2020; Singapore Institute of Technology, 2020a). Despite having competencies in utilising the following digital platforms of live-streaming, pre-recorded instructional workshops, and facilitating discussions digitally, faculty members and students required additional preparation to embrace and transition to online learning (Lim, 2020). SIT attained the licenses to digital platforms such as Zoom, Microsoft Teams, and Respondus for both students and lecturers, which allowed flexibility to apply appropriate platforms for educational purposes, with student usage guidance. Laboratory workshops were continued in small groups in line with government policy. For the students in quarantine or on leave of absence, the university provided alternative learning instruction and activities online (Lim, 2020). SIT's success in its transition amidst the pandemic was perhaps due to understanding students' concerns prior to the implementation of remote learning. SIT had previously surveyed their student cohort regarding concerns and challenges when engaging in online learning. Responses from students included querying the effectiveness of online lectures, suggesting changes in assessment, and their realisation that online learning required greater self-discipline (Lim, 2020).

From 7 September 2020 onwards, SIT welcomed its new cohort of students on campus for lessons, CCAs, and various activities. The school stepped up on ensuring cleanliness of the campus and a team of Safe Management Officers and Safe Distancing Ambassadors were deployed to help everyone keep to the safe management measures as the campus reopened (Singapore Institute of Technology, 2020c).

Singapore University of Social Sciences (SUSS)

On 6 April 2020, Singapore University of Social Sciences (SUSS) suspended its campus learning and teaching and implemented full campus closure from 7 April 2020. To ensure continuity of learning and teaching, the university implemented new operational plans during the duration of campus closure. All on-campus examinations were replaced with timed online assessments (Singapore University of Social Sciences, 2020a). Such measures continued after the reopening of the campus on 19 July 2020 (Singapore University of Social Sciences, 2020b). The University and its partnering organisations offered 14 free online courses on SUSS's UniLEARN platform, an e-learning initiative for continued learning experiences of its community. The platform emphasises social and workplace skills to empower its community to grow within their personal and professional capacity during this challenging time. For a period of time, the courses were freely accessible to the public in areas such as wellness, digitalisation and business management (Singapore University of Social Sciences, 2020d).

The SUSS campus reopened on 12 October 2020. However, only authorised staff and students were allowed on campus. Temperature checks and online health declarations were prerequisites for access. Students were required to present lesson schedules to Safe Management and Security Officers

who enforced contact tracing and safe distancing measures (Singapore University of Social Sciences, 2020b).

An amount of $1 million was raised by the University to aid students who encountered financial difficulties due to the pandemic. This allowed some 400 students to continue payment of their school fees despite income losses. SUSS also supported their alumni through programmes such as the Venture Builder programmes, aimed at cultivating an entrepreneurial spirit in addition to specific career guidance and professional grooming to boost employability (Singapore University of Social Sciences, 2020e).

Singapore University of Technology and Design (SUTD)

Singapore University of Technology and Design (SUTD) closed its campuses from 8 April 2020, and implemented e-learning strategies. SUTD adopted digital platforms like eDimension which complement teaching and learning, facilitate communication, and enable content creation and collaboration (Singapore University of Technology and Design, 2020b). The Learning Catalytics as well as the Subject and Instructor Evaluation platforms facilitate synchronous course feedback, while the Respondus Lockdown Browser aims to ensure academic integrity during online exams (Singapore University of Technology and Design, 2020c, 2020d, 2020e). SUTD also uses Academic Media Studio, an online learning environment, to facilitate student audio and visual learning projects (e.g. recordings). 2 June 2020 saw SUTD announce a gradual return to campus, with authorised students allowed to return for assigned classes or laboratory work (Singapore University of Technology and Design, 2020f). However, the new academic year started in September 2020 with home-based learning as the new norm.

SUTD started increasing on-campus activities from 28 September, 2020, with staff divided into teams and returning to campus every other week. Employees were to adhere to safe distancing measures, temperature checks, health and travel declarations. Online meetings remain highly encouraged. Safe Management Officers were deployed to facilitate contact tracing and maintain a safe working environment (Singapore University of Technology and Design, 2020f).

International branch campuses

James Cook University Singapore (JCU)

In 2018, James Cook University (JCU) Singapore had 3,500 students – 60 percent were international students (Leow, 2020b). JCU suspended all teaching for a week from 23 March 2020 to enable the lecturers to prepare for transition to online learning. By 30 March 2020, instruction and learning activities were largely digitised, with fully online delivery from 6 April 2020 (James Cook University Singapore, 2020c). JCU began its new semester (March 2020) with home-based learning through the learning management system, LearnJCU built on Blackboard's Learning Management System. Lecture materials, readings, collaboration tools, and information about their subjects, assessment information and outlines

Table 3: Institutional responses to Covid-19 within the sociotechnical framework: autonomous universities.

Institution	First adaptation of e-learning	Structure	People	Technology	Tasks
NUS	10 Feb	Singapore government (specifically, MOE) dictates specific policies during the COVID-19 period.	NUS recognised that the pandemic posed a serious health crisis and thus acted in a particularly student-centric manner. Academics had to work hard to ensure that emergency remote teaching was feasible. During the three phases thus far, blended learning became more routine and both students and academics have become increasingly well-versed in it.	Learning activities were converted online using platforms such as Zoom and Canvas. Lectures were pre-recorded.	Invigilated exams were converted to online examinations, or continual assessments such as quizzes, projects, and other assignments. Undergraduate courses included competency-based assessment for interim grading.
NTU	13 Feb	See above.	Similar observations as for NUS (see above) can be made. Students were able to seamlessly transition from traditional classes to online classes. .	NTU additionally engaged in online learning via the Massive Open Online Courses (MOOCs), specifically Coursera.	Invigilated exams were converted into continuous assessments such as quizzes, projects, and other assessments. Students could attain certification for selected courses at no extra cost, and these could be taken even while in an internship or overseas exchange. The use of MOOCs allowed students to attain knowledge and graduate without delay.
SMU	10 Feb	See above.	Similar observations as for NUS (see above) can be made.	All learning activities were converted to online platforms using WebEx, videos and eLearn. SMU also ensured that students were aware of the channels and resources available, should they encounter challenges in their learning experience.	Invigilated exams were converted into continuous assessments such as quizzes and projects. SMU decided to exercise the Satisfactory/Unsatisfac-tory (S/U) option for all undergraduate courses taken in the semester between August 2020 and January 2021.
SIT	24 Feb	See above.	Similar observations as for NUS (see above) can be made.	All learning activities were converted online using digital platforms such as Zoom, Microsoft Teams, and Respondus. The variety of online platforms utilised was to provide students options in choosing the most appropriate platform to work with.	Invigilated exams were converted into continuous assessments such as quizzes and projects. Learning was executed via digital platforms with live streaming, pre-recorded teaching sessions, and facilitating discussions digitally.
SUSS	24 Mar	See above.	Similar observations as for NUS (see above) can be made.	All learning activities were converted online, using Zoom with an integrated Canvas learning management system, which offers an easy-to-use interface and real-time online classes.	Invigilated examinations were converted to online timed exams. Digital learning allowed an easy-to-use interface and real-time online classes.
SUTD	24 Mar	See above.	Similar observations as for NUS (see above) can be made.	All learning activities were converted online through Blackboard. SUTD uses the digital platforms of eDimension, Learning Catalytics, Subject and Instructor Evaluation, and Lockdown Browser, to maximise the interaction and learning experience of the students and to also ensure the academic integrity of assessments.	All exams were converted to online or continual assessments such as quizzes and projects.

Sources: Channel News Asia, 2020; Chia, 2020; Clark, 2020; Fan, 2020; Hutton, 2020; Lim, 2020; Mahmud, 2020; Ministry of Education, 2020; Sen, 2020; Singapore Institute of Technology, 2020a; Singapore University of Social Sciences, 2020a; Singapore University of Technology and Design, 2020a, 2020b, 2020c, 2020d, 2020e, 2020f; SMU Engage, 2020; *The Straits Times*, 2020a; Yeo, 2020.

were primarily available through this medium (James Cook University Singapore, 2020a). JCU also adopted a different scoring system for first and second year subjects: students would be issued with competency-based satisfactory/ unsatisfactory grades, with the exception of some degree programmes that continued with constructively aligned rubric-based grading due to professional accreditation requirements. Third and final year subjects applied the standard grading system (James Cook University Singapore, 2020b).

JCU continued with blended learning as Singapore moved from Phase 2 to Phase 3. Students were to have lessons either on campus or online. From 29 June 2020 onwards, both students and staff were allowed to return to campus. Facilities and services such as the Learning Centre, the library, IT labs, science lab, aquaculture lab, trading room and counselling services were available on campus. Self-study on campus has also been allowed during operating hours. At present, only the gym facilities remain closed (James Cook University Singapore, 2020b).

INSEAD

Institut Européen d'Administration des Affaires (INSEAD), a world-class French business school that positions itself as the Business School for the World, converted all face-to-face delivery to synchronous online learning using Zoom in March 2020. Invigilated examinations were converted to online examinations and other learning resources (e.g., INSEAD Go-live) were accessible online (INSEAD, 2020a). INSEAD Go-Live emulates traditional classroom teaching online and engages students through breakout rooms and chats. Another function of Go-Live is that lecturers can easily view answers from every student in one glance (INSEAD, 2020b). For INSEAD's asynchronous Online Programmes, students have access to their Online Learning Platform which houses the content notes for the chosen programme as well as discussion forums (INSEAD, n.d. a). There was no information regarding any potential changes in the scoring system of the university.

In response to the COVID-19 situation, INSEAD formed the Crisis Management Taskforce (CMT) which consists of staff from multiple divisions. Members consult each other daily to monitor the pandemic, formulate plans of action and inform students and staff about any changes regarding the pandemic (Mihov, n.d.). Cleaning regimes and airflow have been amped up, with sanitisers dispersed throughout the campus and clean-as-you-go kits in lecture theaters. Food provided by INSEAD switched from buffet-style to prepared lunch boxes, and contact tracing, temperature checks and safe distancing measures were implemented in compliance with the local government (INSEAD, n.d. b).

On-campus activities and events from September to December 2020 were subject to approval by the Student Life Office. However, virtual alternatives must still be considered. From 2 September 2020, physical lessons were to resume and if not possible, lessons were to be conducted via Zoom. Students were given the choice to participate virtually but they had to provide a valid reason that was to be assessed for approval. INSEAD has introduced a module with one quiz on COVID-19 awareness for its students to finish in order to have campus access. Students also need to sign the INSEAD Community Commitment before they can be admitted to campus (INSEAD, 2020c). As a result of a student survey, the MBA programme which was set to begin on 21 August, 2020, was postponed to 5 October, 2020. INSEAD also trimmed the core curriculum for incoming students and lengthened the programme timeline to allow more time for elective credits (Bryne, 2020).

Table 4: Institutional responses to Covid-19 within the sociotechnical framework: international branch campuses.

Institution	First adaptation of e-learning	Structure	People	Technology	Tasks
JCU	30 Mar	Singapore government (specifically, MOE) dictates specific policies during the COVID-19 period.	Similar observations as for NUS (see Table 3) can be made.	All learning activities were converted online using LearnJCU, a virtual learning environment that is built on the Blackboard Learning Management System to support students' learning. JCU also utilises a personal learning space called PebblePad in Blackboard Ultra for students to complete their assessments in an interactive workbook.	Invigilated exams were converted into continuous assessments such as quizzes, projects, and other assignments. The university had replaced its mid-term examination with non-invigilated examinations or a written assignment, and final examinations were replaced with alternative assessments submitted via their Learning Management System (LearnJCU).
INSEAD	Mar	See above.	See above.	All classes were converted online and students were expected to access all course materials online, participate in classroom discussions, and stream videos (Zoom). All learning activities were converted online using Zoom. The school also took the initiative to organise events with speakers from around the world, and hosting webinars, connecting students with virtual project opportunities.	Invigilated exams were converted into continuous assessments such as quizzes, projects, and other assignments. Students were to complete and submit online assignments and tests through INSEAD's online platform.

Sources: INSEAD, 2020a, 2020b; James Cook University, 2020a, 2020b, 2020c; Lim, 2020; Ministry of Education, 2020; *The Straits Times*, 2020.

Private education institutions

Kaplan Higher Education Singapore

Kaplan Higher Education Singapore, with 12,000 students (approximately 25% international: Leow, 2020b), collaborates with ten different university partners on external degree programmes and also offers its own proprietary programmes. The responses from Kaplan varied depending

on partner university requirements. Kaplan Singapore's largest university partner, Murdoch University (Australia), is the focus of this section. On 27 March 2020, Kaplan notified all Murdoch University students of the digitalisation of all instruction and learning activities due to COVID-19. The students in the first trimester of 2020 were taking their lessons on-campus from 1-7 April 2020, and were given the option to attend lessons through synchronous live-streams on Zoom or continue on-campus lessons (Kaplan email circular, 27 March 2020). On 3 April 2020, students were notified of campus closure from 4 April, with all lessons to be digitised using Zoom (Kaplan email circular, 3 April 2020). Changes were made to invigilated examinations to include flexible timed online examinations (asynchronous and synchronous), and take-home exams (Kaplan email circular, 4 April 2020). For student failures, the grade was to be withheld from their Academic Transcript and Grade Point Averages (GPA) (Kaplan email circular, April 4, 2020). As of 13 April 2020, online learning was confirmed through Blackboard Collaborate with usage guidance (Kaplan email circular, 13 April 2020). As Singapore gradually exited the circuit breaker, Kaplan applied a phased approach to campus recommencement, and notified students that home-based learning would continue except for essential face-to-face study (Kaplan email circular, May 28, 2020). Finally, as Singapore progressed into the second phase from 19 June 2020 onwards, the institution announced its reopening from 29 June 2020. However, students were not required to go back to campus and online learning was continued (Kaplan email circular, 28 May 2020).

For 2021, Murdoch University and other partner universities of Kaplan continued to deliver its programmes online. Murdoch University also continued offering additional courses that are in high demand due to COVID-19: innovation, cyber-security and mental health are some example areas (*The Straits Times*, 2020b).

Management Development Institute of Singapore (MDIS)

The Management Development Institute of Singapore (MDIS) suspended all physical classes from 8 April to 1 June 2020 to decrease COVID-19 transmission (Management Development Institute of Singapore, 2020a). MDIS encouraged their students to stay at home and delivered their courses via their Blackboard Learning Management System (LMS). Students could also access an online library to supplement their learning during the circuit breaker (Management Development Institute of Singapore, 2020b). To relieve students of financial difficulties brought about by the pandemic, MDIS started the "MDIS Education Recovery Grant" for Singaporean Residents enrolling in programmes beginning 1 January 2021 through 30 June 2021 (Management Development Institute of Singapore, 2020c). The grant enabled undisrupted learning, upskilling and an easier adaptation period for students (Management Development Institute of Singapore, 2020d).

PSB Academy

PSB Academy which brands itself as 'The Future Academy' was engaged in online learning and teaching before the circuit breaker. The Academy fully transitioned to online learning from 1 April 2020 (PSB Academy, 2020a), so students could continue learning away from campus. Digital resources, student video consultations, online sessions with academics and student support services were provided for additional synchronous support (PSB Academy, 2020b). On 25 May 2020, the Academy announced that selected students would be allowed to return for specific learning activities (e.g. laboratory work), with the remaining learning and teaching continuing online. From 13 July 2020, PSB Academy increased on-campus activities progressively by resuming smaller classes, project work discussions, and academic consultations across both campuses (PSB Academy, 2020a).

From 21 September 2020, PSB Academy increased the frequency of physical lessons. Students previously needed to pre-book campus services, such as collecting certificates, payments and borrowing of learning resources, which was by then no longer necessary. Students were allowed to self-study individually at selected areas but were not permitted to mingle or linger. Meetings for graded group projects were permissible in certain areas which were available in two-hour reservation slots (PSB Academy, 2020c).

Singapore Institute of Management (SIM)

Like other PEIs, Singapore Institute of Management (SIM) also closed its campus and moved to full home-based learning from 8 April 2020 to 1 June 2020 to curb the spread of COVID-19. The school continued to engage students through the use of their Learning Management System (LMS) in delivering lessons (Hutton, 2020). The campus reopened from 13 July 2020 for selected learning activities and assessments (e.g. in-person training), with the balance remaining online (Singapore Institute of Management, 2020a).

SIM resumed in-person classes from August 2020 and students having in-person lessons had to provide proof of their class schedule. Otherwise, they were prohibited to be on campus. Online learning was to continue until further notice. Other safety measures continued to be adhered to: safe distancing, safe entry, small group gathering, washing of hands, and mask wearing (Singapore Institute of Management, 2020a). As of 4 January 2021, more services and facilities in SIM were made available (library, food and beverage, and retail) for students who made prior booking but mingling and loitering on campus was not allowed.

Table 5: Institutional responses to Covid-19 within the sociotechnical framework: private education institutions.

Institution	First adaptation of e-learning	Structure	People	Technology	Tasks
Kaplan	27 Mar	Singapore government (specifically, CPE) dictates specific policies during the COVID-19 period.	Similar observations as for NUS (see Table 3) can be made.	Zoom or Blackboard Collaborate. For instance, Murdoch University also used platforms such as Studiosity, Endnote, and Urkund to facilitate online learning	Invigilated examinations were converted to online examinations including take-home exams (usually for a duration of 24 to 48 hours); or flexible asynchronous and timed exams (e.g. a three-hour exam any time within a 24-hour window); or a timed synchronous examination.
MDIS	24 Feb	See above.	See above.	All classes were converted online and students were expected to access all course materials online, participate in classroom discussions, and stream instructional videos via Zoom. Students gain easy access to resources globally, and allow lecturers to address students' queries and needs more effectively	All course materials are to be accessed online, and to complete and submit online assignments and tests, as well as view grades and feedback through an online platform.
PSB	24 Feb	See above.	See above.	PSB Academy uses Blackboard Ultra to conduct online learning and the school also actively engages with its students through communication platforms such as email, Facebook, Wechat, Instagram and PSB Academy's website. All learning activities were converted online using the university's LMS.	All invigilated examinations were converted to online, assessments and activities were delivered online.
SIM	24 Feb	See above.	See above.	All classes were converted online using the institution's LMS. Students were expected to access all course materials online. All learning activities were converted to online.	All invigilated examinations were converted to online, assessments and activities were delivered online. Students who had examinations during this period were informed separately of alternative arrangements.

Sources: Lim, 2020; Management Development Institute of Singapore, 2020a, 2020b; Ministry of Education, 2020; PSB Academy, 2020a, 2020b; Singapore Institute of Management, 2020a.

Discussion

Autonomous universities

With local universities being labelled as Autonomous Universities in Singaporean nomenclature, one could expect their approaches to be independent from each other. In fact, their responses are quite similar. During the lockdown between 7 April and 1 June 2020, strong government directives led to a uniformity of responses: no face-to-face classes, rapid digitalisation with some learning management and videoconferencing software variance. Several universities used a fairly radical approach towards grading, adopting competency-based satisfactory and unsatisfactory grades, rather than employing a constructively aligned gradient. With Singapore being, at the time of writing, in Phase 3 of reopening, there has been a gradual and incomplete return to face-to-face classes. However, online learning continues to be important, and the prevalence of blended learning has accelerated due to the pandemic.

International branch campuses

International branch campuses typically have more international students than the AUs. Their approaches were more varied than AUs (for instance, in terms of speed of conversion to online classes and potential changes in grading). Nonetheless, there are many similarities, such as a voluntary conversion to online and alternate forms of learning prior to the lockdown. This may be in part due to consistently applied management decisions from their home nation campuses where cases, and international revenue, were more dire. Similar to the AUs discussed in the previous section, a gradual and incomplete return to face-to-face classes within a blended learning approach could be observed by early 2021.

Private education institutions

The four selected PEIs often moved faster than the AUs and international branch campuses in moving online, perhaps because of them being smaller (especially in terms of permanent staff numbers) and more agile organisations. In conjunction with their partner universities, the PEIs had ready online strategies commencing Emergency Remote Teaching immediately from early April 2020.The PEIs have since moved to more systematic and robust pedagogical approaches to online learning. With the gradual and yet-incomplete reopening of Singapore's economy as of September 2021, PEIs have recognised that their focus will return to face-to-face delivery, but within a blended learning approach, not unlike the AUs and IBCs discussed in previous sections.

The Singaporean higher education experience

As explained in the Theoretical Framework section, we chose the socio-technical system as a theoretical framework. The socio-technical framework is surrounded by a complex environment which in our case is of course the pandemic. Tables 3, 4 and 5 show the differences and similarities in responses between the 12 selected educational institutions (six AUs, two IBCs and four PEIs) in response to the pandemic, and show the dates of their first adaptation across the selected 12 institutions. The tables also discuss the four aspects of the socio-technical framework (people, structure, technology and tasks) as much as possible within the confines of a qualitative content review.

The first adaptation of e-learning in response to the pandemic in the 12 institutions occurred within a relatively short window between 10 February and 30 March, 2020. All the dates were well before the circuit breaker (lockdown) that occurred in the city-state between 7 April and 1 June and show some foresight by the various institutions. In our

study, the people aspect of the socio-technical model largely refers to students and the staff (especially academics) of the educational organisations. It is noteworthy that in the public discourse (via the wide variety of sources used for this article), the people aspect was under-represented. There was a certain uniformity in approaches, with institutions acting in a student-centric manner in recognition of the serious health crisis. Not only students were stressed by the sudden transition to full online delivery during the lockdown, but academics also needed to rush their conversion to the emergency online delivery and assessments. During the three phases of Singapore's reopening thus far, online and blended learning have become more routine, and both students and academics have become increasingly well-versed in it.

Organisational structure largely refers to the nation-wide policies by the Ministry of Education (MOE), and for the PEIs, the Committee of Private Education (CPE). In terms of structure, the educational institutions' policies are dictated by the Singapore government, with the Ministry of Education (MOE) and the Committee of Private Education (CPE) – in the case of PEIs – giving fairly precise directives as regards the control of people on-campus.

Technology includes hardware, learning systems, teaching software, web resources, and other technologies. In our context, it largely refers to EdTech and more generic platforms utilised as a result of the pandemic. Examples include: Zoom, Canvas, MOOCs (in cooperation with providers such as Coursera), WebEx, eLEARN, Microsoft Teams, Respondus, Blackboard, eDimension, Learning Analytics, PebblePad as well as various customised Learning Management Systems (LMS). These learning platforms and video conferencing tools enabled the continuation of learning for the students in Singapore without major interruptions.

Tasks include design, instruction, assessment, and evaluation. As the lockdown between 7 April and 1 June was announced with short notice, learning activities oftentimes had to be converted to an online format at great speed, leading to a phenomenon that has been aptly described as "emergency remote teaching". Live or pre-recorded lectures had to be delivered via the digital platforms described under the technology aspect of the socio-technical model. In terms of assessment, the standard invigilated exams were converted into other types of assessment, ranging from online examinations to continual assessments, including quizzes, projects, and assignments. Several institutions, including some of the most reputable ones, decided to exercise a Satisfactory/Unsatisfactory (S/U) option in lieu of the standard grades.

This work takes a critical review against the literature, but also highlights opportunities for local and international learnings. The study highlighted that while a technology focus was prominent and remained at the fore, such a perspective conflicts with effective pedagogy and andragogy. That is, the methods to educate and facilitate individual learning serves as the first point of analysis, and the technology second. For us, we saw this as a common perspective for the emergency remote teaching practices, but needed to be beyond such as the universities became more sophisticated. However, in identifying a direct entrance to technology, there was likely a lack of consideration to the educator, the learner, and those staff supporting learning. This could have long-term human and sociocultural implications, and some of these are already being seen (e.g., Watermeyer et al., 2021b). These are important, as the nation collectively learns from the COVID-19 experience, and Singapore beginning this journey earlier than many may set useful foundations for andragogical innovation.

Conclusion

The pandemic has brought rapid changes to the way individuals attain knowledge. In the efforts to prevent disruption of the learning process, some of the leading institutes of higher learning in Singapore such as National University of Singapore or Singapore Management University embraced technology well ahead of the curve by integrating online learning in their curriculum (Hutton, 2020). Educational institutes were forced to adapt to full online learning solutions using platforms such as Zoom and Blackboard to facilitate the learning process. Apart from having to adapt to these solutions rapidly, ensuring privacy and security was also a challenge. Early into online learning solutions, there were hacking incidents reported by the Ministry of Education (MOE) where a video-conferencing platform was hijacked by pornographers. While this incident was swiftly resolved, it raised an alert on security and privacy issues (Hutton, 2020).

Despite such disruptions during the sudden move from traditional classes to online learning, it has been argued that the pandemic would also accelerate the integration of information technology in education and eventually become an integral component of education (World Economic Forum, 2020). While COVID created great challenges, it led to long-term opportunities to change higher education. With in-person examinations and tests replaced with alternative assessments or moved to online examinations, the large examination halls may be a thing of the past. The rapid digitisation of lectures may eliminate the need for large, long, and passive lectures. Moreover, the Singapore government's successful technocratic approach towards COVID-19 may lead to a post-pandemic boom in tertiary students from other Asian countries (Leow, 2020b).

The question posed in the title of our article, where a choice was provided between emergency remote teaching and andragogical innovation, should not necessarily be viewed as a binary option. When the whole of Singapore was speedily proceeding to a lockdown, emergency remote teaching was the norm for all but the best-prepared institutions. In the meantime, many potential andragogical innovations have surfaced, the discussion of which would go well beyond the confines of this article. There are many opportunities for research. Our study is based on qualitative content research, and qualitative, quantitative or mixed-methods research is needed to further illuminate the Singapore scenario, also in international contexts. However, this is only the beginning of a new journey. The analysis in this paper identified some institutions having simply digitised their content - taking face to face practices and replicating them in an online

environment. The next stage will be to incorporate online pedagogical principles to shift from technology being the driver of curriculum design and delivery, to technology being the tool or facilitator of a quality curriculum. This change in practice needs to be driven by whole-of-system policy reform, potentially including a national higher education quality framework, institutional policies for online delivery, digital capability building for academics and students, and reimagining the role of the academic, educational designer and educational technologist in the post-pandemic era.

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