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Wei Hsiu Weng
National Chengchi University, Taiwan, wengvictor@gmail.com

Wei-Hsi Hung
National Chengchi University, Taiwan, fhung@nccu.edu.tw

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Supporting Learning and Working in Disastrous Pandemics by Smart Technologies: A Qualitative Analysis

Wei Hsiu Weng [1,2,*]
Wei-Hsi Hung [1,3]

*Corresponding author
[1] Department of Management Information Systems, National Chengchi University, Taiwan
[2] Doctoral Student, wengvictor@gmail.com
[3] Professor, fhung@nccu.edu.tw

ABSTRACT

During the breakout of coronavirus disease (COVID-19), smart technologies were perceived to provide convenience and assistance for people, enterprises, and government units. Although there is literature maintaining that smart technology can facilitate pandemic strategy and response in ways that are difficult to achieve manually, some other literature indicated that smart technologies were not desirable alternatives to people during this pandemic. MIS education is a career preparation for IT professionals who use smart technology in organizations. IT professionals with MIS education backgrounds may have important roles when facing COVID-19. Moreover, many MIS students will become IT professionals and join the workforce for combatting the pandemic using smart technologies with their background of MIS education. This study intends to analyze smart technology utilization in the confrontation of the COVID-19 pandemic with a qualitative approach. The results could provide reflective insights for MIS education providers, human resource units, IT firms, and organizations confronting COVID-19 outbreaks.

Keywords: Management information system, education, IT professional, smart technology, COVID-19.

INTRODUCTION

Since the beginning of 2020, the world has been confronting the epidemic of coronavirus disease (COVID-19). To prevent the contagion, many countries have restricted transportation, grounded airlines, closed public facilities, blocked traffics, sealed cities, and quarantined residents, making the provision of goods and services extremely difficult (Whitelaw *et al.*, 2020). During this abnormal period, electronic governments and businesses taking advantage of digital technologies (DT) provide emergency reliefs to the people and organizations in need at home or worldwide under this disastrous situation (Tuli *et al.*, 2020).

However, the perceptions of using smart technologies to assist the countering of the pandemic are divided. There is literature that maintains that digital technology can facilitate pandemic strategy and response in ways that are difficult to achieve manually (Whitelaw *et al.*, 2020). Some other literature indicated that technologies such as smartphones, tablets, and PC were not desirable alternatives to regular voice-based phones during this pandemic (Kjerkol *et al.*, 2021). These opposite views on the effectiveness of using smart technologies for coping with the COVID-19 pandemic require further study for deeper insight into pandemic confrontation.

Moreover, IT professionals are key actors in the utilization of smart technologies. They are people with IT skills to help the confrontation of contingencies for governments, enterprises, and other organizations. Therefore, IT professionals could be an important linkage resource between digital technologies and the COVID-19 confrontation. Furthermore, many IT professionals have an educational background in management information systems (MIS). Their professional careers start with the knowledge obtained from MIS education. Thus, the role of MIS education may also be relevant in the connection between digital technologies and the confrontation with COVID-19. However, despite these possible connections, so far, the research on the relations of COVID-19 confrontation, smart technology utilization, IT professionals, and MIS education are very scant. Therefore, the objective of this research is to investigate and clarify the possible linkages.

The paper begins with a review of the relevant literature about the relationships among the COVID-19 pandemic, smart technologies, IT professionals, and MIS education. Then it explains the research setting for this study. Following that, the process of data collection and the results of data analysis are elaborated. Finally, a discussion with implications and conclusions with suggestions are provided.

RESEARCH BACKGROUND

Smart Technology and COVID-19 Outbreaks

The year 2020 was a difficult time for the whole world. The outbreak and widespread of the COVID-19 pandemic changed the lives of many people. During this hard time, governments and enterprises worldwide have utilized various smart technologies to avert further deterioration of the situation (Gong *et al.*, 2020; Whitelaw *et al.*, 2020).

Contemporary smart technology is considered as "the next big thing" (Borgia, 2014; Marinova *et al.*, 2017; Porter & Heppelmann, 2015) by many countries and organizations. Several researchers have elaborated the technological features of the smart technologies (Agarwal & Brem, 2015; Atzori *et al*., 2010; Borgia, 2014; Bradley *et al*., 2015; Gubbi *et al*., 2013; Krotov, 2017; Miorandi *et al*., 2012; Porter & Heppelmann, 2015; Yoo *et al*., 2010). In Table 1, these features are classified and summarized using the layered modular architecture (Yoo *et al*., 2010).

Table 1: Layered modular architecture of smart technologies.

Layer	Module	Feature	Reference
Content	Real-time analytics	Sensor monitored and detected information is invisibly embedded in the environment around users, resulting in the generation of big data in real-time, which are distributed, stored, processed, presented, and interpreted in a seamless, efficient, and easily understandable form.	(Gubbi *et al*., 2013; Krotov, 2017; Weng & Lin, 2013)
	Cyber-physical convergence	The convergence of computer networks, telecom networks, and the IoT triggers further convergence of cyberspace and physical space and results in various smart spaces, such as smart home, smart office, smart factory, smart laboratory, smart store, smart marketplace, smart hospital, smart museum, and smart city.	(Agarwal & Brem, 2015; Bradley *et al*., 2015; Gubbi *et al*., 2013; Miorandi *et al*., 2012)
Service	Cloud support	Cloud services are deployed to assist the processing and storage of big data analytics and provide users ubiquitous access to supporting services initiated by devices around the smart environment.	(Atzori *et al*., 2010; Bradley *et al*., 2015; Gubbi *et al*., 2013; Weng & Lin, 2014)
	Intelligent interface	Visualization, touching, and voice are critical for smart applications as they allow the awareness and interaction of users with the environment. 3D viewing and printing technologies, personal mobile assistants, wearable devices, and augmented-reality devices provide a novel interface for users to interact with the smart environment.	(Bradley *et al*., 2015; Gubbi *et al*., 2013)
Network	Pervasive connectivity	Smart mobile devices and the IoT contains multiple layers of communication networking infrastructure to provide pervasive communications between people and people, people and things, and things and things, to form a smart environment.	(Atzori *et al*., 2010; Gubbi *et al*., 2013; Yoo *et al*., 2010)
	Seamless streaming	Wireless broadband technologies enable robust streaming of digital content data through broadband wireless networks for multimedia applications and services on demand.	(Borgia, 2014; Gubbi *et al*., 2013; Krotov, 2017)
Device	Ubiquitous sensing	This is the mechanism that the "things" or devices in the IoT perceive the surrounding physical environment, detect and record the changes in the environment, and respond to the changes. Ubiquitous sensing is enabled by wireless sensor network (WSN) technologies.	(Borgia, 2014; Bradley *et al*., 2015; Gubbi *et al*., 2013)
	Embedded computing	Smart mobile devices contain embedded hardware and software to work intelligently within the environment. The embedded hardware includes processor chips, data storage units, and power units. The embedded software includes embedded operating systems, mobile apps, and middleware. In particular, the devices can be modularly embedded further in other devices.	(Gubbi *et al*., 2013; Krotov, 2017; Weng & Lin, 2015)
	Interconnected smart products	Smart technologies enable the evolution of various products such as smart home appliances, robots, drones, unmanned cars, automated factory machines and business equipment, and many other innovative devices.	(Krotov, 2017; Miorandi *et al*., 2012; Porter & Heppelmann, 2015; Weng, 2021)

Source: This study.

The critical capabilities of smart technologies include the empowerment of highly personalized, customized, and adaptable products and services (Porter & Heppelmann, 2015) and the dynamic decision support through situational sensing, monitoring, and learning (Marinova *et al.*, 2017).

With these technological features, smart technologies have been applied in various confrontation scenarios of COVID-19. Table 2 provides examples of applications using smart technologies for confronting the COVID-19 epidemic. The industry experts and literature suggest that critical functionalities coping with pandemic situations include management of surveillance (Ibrahim, 2020), collaboration (Zhao & Wu, 2020), and mobility (Moslem *et al.*, 2020).

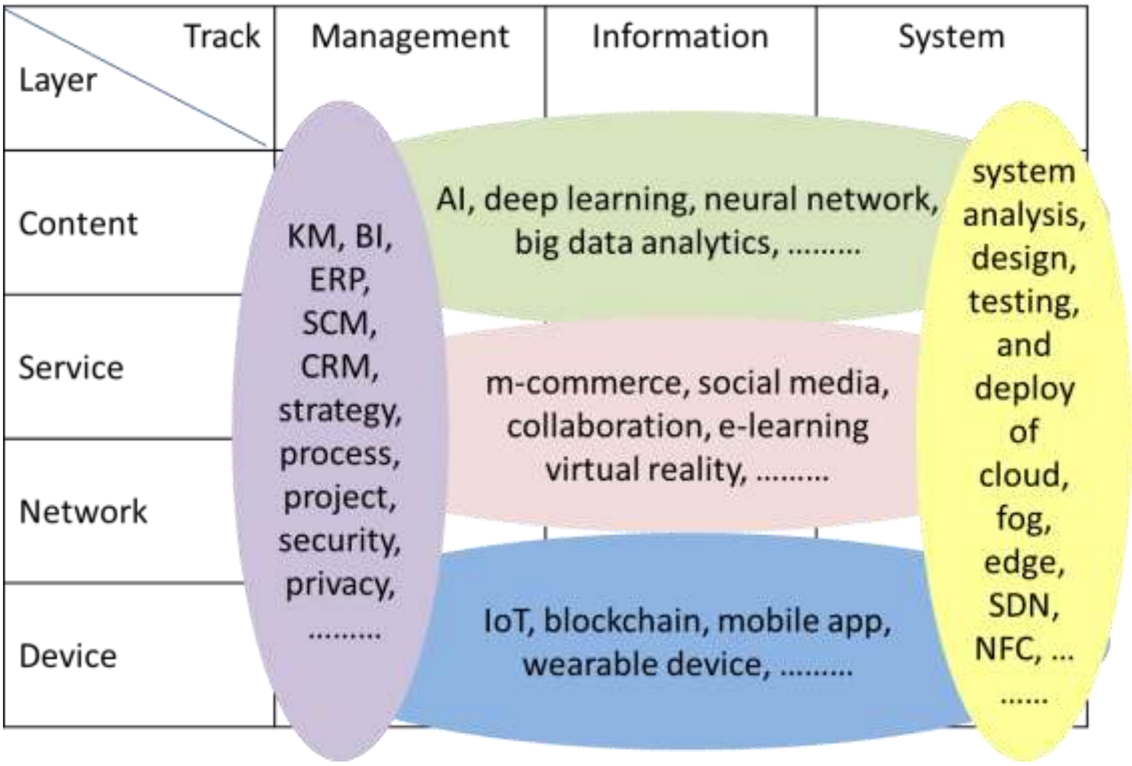
Table 2: Examples of IT applications for COVID-19 confrontation.

Sector / Functionality	Government	Business	Individual
Surveillance	Public health status and medical data detection	Employee locations and health status tracing	Personal health information; Footprint timeline tracing
Collaboration	Logistics and distribution of healthcare materials	Remote co-working and employee collaboration; Supply chain flexibility	Social media and instant messaging
Mobility	Remote public services and distance education	Online marketing and selling; Mobile commerce	Mobile shopping and entertainment on demand

Source: This study.

MIS Education and IT Professionals

Each year, many students who graduated from university MIS (or similar) education programs join the workforce of IT professionals and play a pivotal role in the utilization of digital technologies to serve in various sectors of organizations. Figure 1 exhibits an example of a smart technology curriculum in the MIS education program.



Source: This study.

Figure 1: A smart technology curriculum in MIS education program.

Figure 1 shows that a core MIS curriculum is designed to invoke the attention and relevance of MIS students to the development and application of smart technologies. With this educational background in the MIS discipline, they are expected to be confident and perform their duties with satisfying results.

However, the real world is always full of various challenges. Starting from the year 2020, MIS graduates are facing one more challenge that is not seen in human history: the outbreak of COVID-19.

MIS Students and COVID-19 Outbreaks

There is literature that maintains that digital technology can facilitate pandemic strategy and response in ways that are difficult to achieve manually (Whitelaw *et al.*, 2020). Since MIS education is a career preparation for IT professionals who use digital technology in organizations, MIS education and IT professionals should become critical when facing COVID-19 (Dwivedi *et al.*, 2020).

However, some other literature argued that technologies such as smartphones, tablets, and PC were not desirable alternatives to regular voice-based phones during this pandemic situation (Kjerkol *et al.*, 2021). This counter proposition weakened the role of digital technologies facing COVID-19; thus, it may also depreciate the impacts of MIS education and IT professionals on coping with the pandemic (Pflügler *et al.*, 2018).

Therefore, opposite views exist on the connections between smart technologies and COVID-19 confrontation. This contradiction triggers the question that many MIS students will become IT professionals and join the workforce for combatting the pandemic using digital technologies with their background of MIS education. How do they use smart technologies to face the pandemic?

Therefore, this study aims to answer the following research question: How useful are smart technologies to MIS students (i.e., the future IT professionals) for COVID-19 confrontation and life transition?

RESEARCH METHOD

Research Setting and Data Collection

This study intends to depict the relevance of smart technologies in the confrontation of the COVID-19 pandemic. A qualitative approach with participatory observation is adopted (Clark *et al.*, 2009).

Data for this study were collected through participatory observation, archived data, and informal conversation. Data collection activities were started in the middle of April 2021 and took about thirty days to complete. Table 3 exhibits data collection methods.

Table 3: Data Collection.

Data source	Data collection process
Participatory observation	● Totally seven occasions with an average time length of ninety minutes. Include: ● two online course meetings ● one online homework discussion with classmates ● two distance conferences with work colleagues ● two occasions of working from home
Informal dialog	● Five conversations with two MIS professors, one of which has been a department chair ● Three conversations with a corporate CIO and an MIS team ● Four conversations with a senior VP of a recruitment website
Archived data	● MIS education program descriptions on the university websites ● Recruiting advertisements for IT professionals ● Attending two public, corporate conferences held by IT companies ● Discussion of life and social experience on social media ● News and commentaries about COVID-19 outbreaks and social phenomena

Source: This study.

Recruiting Procedure

This study used purposive sampling with a snowballing method to recruit participants. In the sampling, we have ruled out students of our affiliated school. Data collection by interviews was conducted in April of 2021. Totally six interviewees with diverse backgrounds from different universities in Taiwan and USA participated in this study. At the time of the study, some of them were senior MIS students, some of them were master-level MIS students, and the others were recent graduates from MIS programs and worked for less than two years. These participants are as shown in Table 4.

Table 4: Participant description.

Case name	Status at the time of this study	Affiliated school location
Student Chen	● Senior undergraduate MIS student ● Studied accounting before transferring to MIS ● Part-time work in pharmacy sector for one year	Northern Taiwan
Student Fang	● Senior undergraduate MIS student ● Assisting a project about cloud security and social media privacy ● Summer practicum at a medical equipment manufacturer ● Summer practicum at an online retailer	California, USA
Student Guo	● First-year master level MIS graduate student ● Two years of working experience in the finance sector ● Part-time working experience at a gym	Northern Taiwan

	● Self-study of herbal medicine	
Student Lin	● Second-year master level MIS graduate student ● Working on a thesis about comparing agile development model and waterfall model ● One year of working experience in the media sector ● Part-time volunteer service in the healthcare sector	Texas, USA
Student Wu	● Graduated from undergraduate MIS program ● Working for two years in the MIS unit of the manufacturing sector ● Traveled to China and Korea several times for work assignments during the COVID-19 outbreak	Northern Taiwan
Student Yeh	● Graduated from master MIS program ● Master project of using neural network and data mining to analyze supply chain data ● Working for one year in the MIS unit of the retail sector ● Six months of civil service in a hospital on an outer island of Taiwan	California, USA

Source: This study.

Data Analysis

The data of this study were analyzed after the data collection stage. The observation logs were transcribed to form the significant data for analysis in this study. Data clarification was made by contacting the participants when there were ambiguous or missing contexts. After the observations, the researcher analyzed the behavior of the participants and extracted the encapsulated meanings.

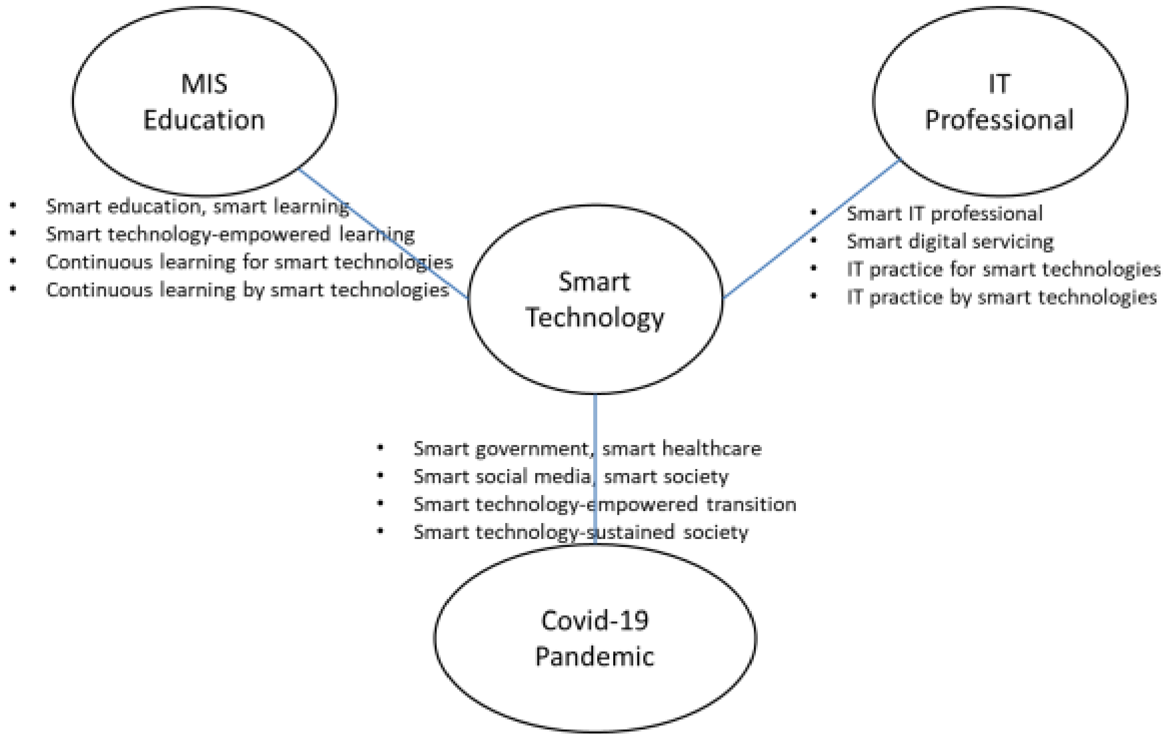
RESULTS

The results are discussed toward two focal points: the role of smart technologies and the possible transitions by smart technologies. These focal points are illustrated as follows.

Smart Technologies as a Supportive Platform

In our analysis of the data, we found the role of smart technology quite subtle. It was a hidden role since we did not specifically ask the participants about their perceptions of smart technologies. However, it became clear in the observations that smart technology is actually a leading role. Its role is inevitable and indispensable. This is further evidenced by our participatory observation (see Table 3).

Figure 2 depicts the empowering role of smart technologies from the lens of the participants.



Source: This study.

Figure 2: Exploiting smart technologies.

For example, we observed how the participants achieved their continuous learning and intellectual preparation during the disruptive time of COVID-19 outbreaks. They need to do that using their smart mobile devices through the established digital infrastructure and technology integration. Their learning and adapting are empowered, for example, by smart mobile devices, cloud-supported learning, streaming of contents, and cyber-physical convergence for virtual classrooms (see Table 1).

Also, we observed how the recent graduates as IT professionals perform their agile servicing and technology integration practices under COVID-19 disasters. They can do that efficiently with the remote and mobile collaboration of work through smart technologies they had learned since their MIS education and continuous learning. Their practice and service are empowered, for example, by real-time big data analytics for requirement changes, pervasive connectivity for work collaboration, intelligent interface for prototype demonstration, and embedded computing for product automation (see Table 1).

Moreover, how could we, as members of our society, sustain lifestyle disruption, pervasive anxiety, and public uncertainty caused by the COVID-19 pandemic? Various archival data (see Table 3) indicated that many people sustained the pandemic with the help of the smart technology-empowered services (see Table 2) from the governments, healthcare providers, social media, online retailers, and numerous volunteer organizations using the digital infrastructure and integrated applications developed by IT professionals.

Smart Technology Empowered Transitions

The examples of the participants demonstrate the mechanism of smart technology-empowered transition facing COVID-19 outbreaks. They utilized smart technologies to facilitate the transition of their lives during the difficult time of the COVID-19 pandemic. Specifically, while the MIS students were learning for smart technologies in their MIS education, they were also using smart technologies to facilitate their learning. Likewise, while the IT professionals were working on the development and integration of smart technologies, they were also using smart technologies to facilitate their work.

In our observations, we found that the participants tend to motivate their transitions in a difficult time with two different paths. Some participants expressed that COVID-19 outbreaks make them think about the transition of role. IT professionals facing COVID-19 outbreaks are similar to the medical doctors and nurses combatting COVID-19, who need not only confidence and satisfaction but also volition and reflection to go on. Smart technologies are utilized to facilitate continuous learning in this regard. The other participants emphasized the transition of practice and experience by exploiting smart technologies in pandemic situations. One needs to exercise system thinking, become a problem solver, and deliver workable solutions in unexpected pandemic scenarios.

After the observed results were obtained, this study presented the preliminary outcome to experts in academics and the IT industry. For further discussion (listed as informal dialog in Table 3). The experts offered their views and confirmed these applicable transition paths for the participants from academic and practitioner perspectives, respectively. The transition can be realized with the motivation model of learning (Keller, 2016). The motivation model of learning contains a synthesis of motivational and volitional concepts and theories that provide a foundation for a motivational design process that has been validated in various contexts (Chang *et al.*, 2020; Keller, 2016). In this study, we broaden the scope of learning in the motivation model from education to include practice and experience. Figure 3 shows the observed road map of motivating transitions linking smart technologies with COVID-19 confrontation.

DISCUSSION AND CONCLUSIONS

Implications

The observations lead us to the reflection about how to learn, work, adapt, and sustain facing COVID-19 outbreaks through the utilization of smart technologies. The above discussion illustrated that the real power of smart technologies lies in their hidden yet profound role in facilitating the transition of lives facing uncertain situations.

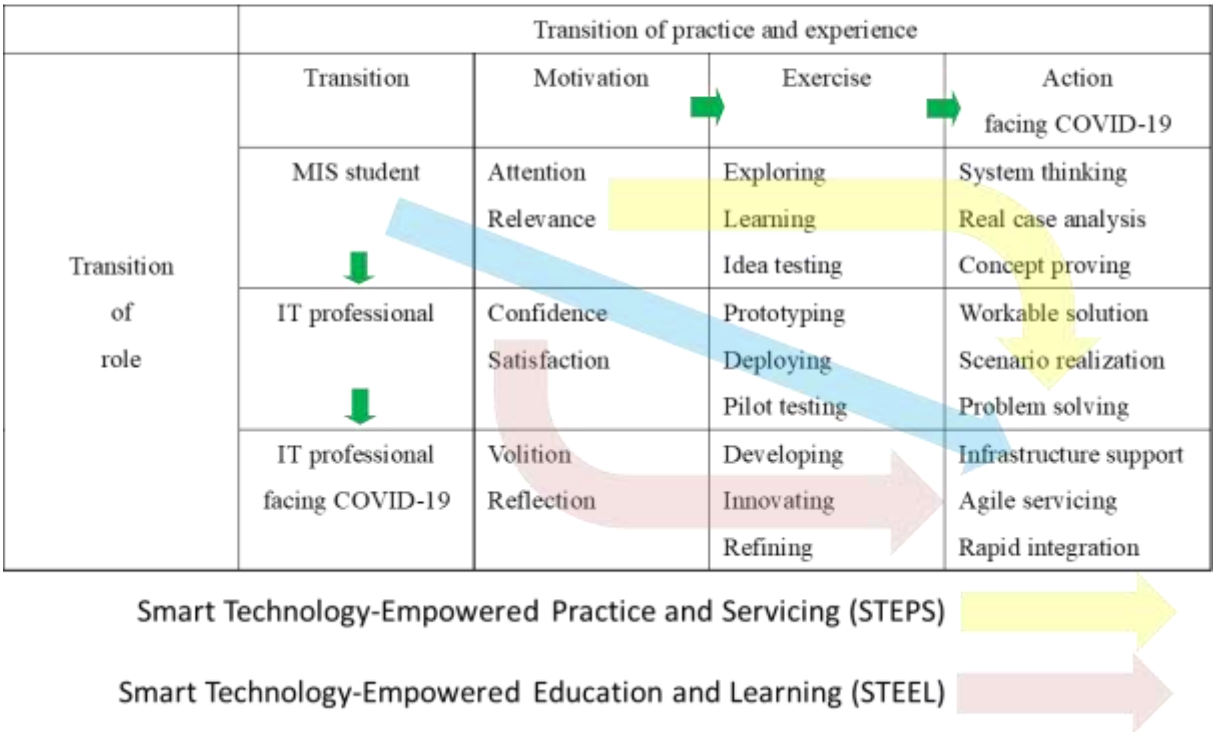
To summarize, the learning in MIS education and the practice of IT professionals can contribute to the realization of smart technology-empowered transition. Furthermore, the smart technology-empowered transition can mitigate the impacts of COVID-19 outbreaks and stimulate the cultivation of sustainable societies.

All of the participants expressed positive experiences about distance education and digital library, despite some of them being forced to use these technologies because of the COVID-19 outbreak. Learning in the clouds is a popular trend of continuous learning. Smart technology-empowered learning enables the generation of adaptable content of education (Marinova *et al.*, 2017). Therefore, learning and education using smart technologies are critical for MIS education since these topics highlight the two equally important facets of MIS education: learning for smart technologies and learning by smart technologies.

Furthermore, as the other industries are using smart technologies and integrated solutions provided by IT professionals to upgrade and evolve, the industry of IT professionals itself will also need to keep up and take the lead. By following the advocacy of Industry 4.0 for the manufacturing industry, the information service industry can also think of the vision and action plan of "Information Service 4.0" with the empowerment of smart technologies. "Smart technology-empowered information service" and "information service for smart applications" are thus a legitimate ambidextrous development strategy for IT professionals. With a substantial MIS education as a foundation and sustained progress with smart technologies, IT professionals can continue to play the indispensable supportive role for the world.

Recommendations

This study reported meaningful implications regarding MIS students' perceptions of MIS education, IT professionals, and the COVID-19 outbreak. However, the validity of an argument cannot be firmly established on the basis of a single qualitative study. Further studies on this topic with various research methods and participants are recommended. Such research will help accumulate more empirical evidence for assessing and validating the propositions of this study.



Source: This study.

Figure 3: Facilitating the transition.

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