Teachers' Perceptions of the Potential Use of Educational Robotics in Management Education

Anne L. L. TANG[a]*, Vincent Wing Sun TUNG[b] and Tiffany O. CHENG[c]

[a*] Anne L. L. Tang
School of Hotel and Tourism Management, The Hong Kong Polytechnic University
17 Science Museum Road, Tsimshatsui East, Kowloon, Hong Kong
E-mail Address: anne.tang@polyu.edu.hk
Phone Number: (852) 3400-2253
**Corresponding Author*

Anne Tang is Instructor at School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong. Her research interests include teacher care, Vygotsky's social constructivism, and pedagogy in higher education.

[b*] Vincent Tung
School of Hotel and Tourism Management, The Hong Kong Polytechnic University
17 Science Museum Road, Tsimshatsui East, Kowloon, Hong Kong
E-mail Address: vincent.tung@polyu.edu.hk
Phone Number: (852) 3400-2183

Vincent Tung is Associate Professor at School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong. His research interests include educational robotics and emerging technologies in higher education.

[c] Tiffany Cheng
School of Hotel and Tourism Management, The Hong Kong Polytechnic University
17 Science Museum Road, Tsimshatsui East, Kowloon, Hong Kong
E-mail Address: tiffany.cheng@polyu.edu.hk
Phone Number: (852) 3400-2235

Tiffany Cheng is Instructor at School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong. Her research interests include assessment strategies and experiential learning in higher education.

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Abstract

There is increasing interest in the potential use of educational robotics (ER) in higher education. Few studies to date have considered teachers' perceptions of using ER outside science and engineering. This qualitative research aims to investigate university teachers' perceived opportunities and challenges of using ER in management education from three interconnected dimensions, curriculum, pedagogy, and technological domain, by means of narrative analysis. The findings suggest the potential of using ER to help develop discipline-specific knowledge and technological and transferable skills for management students. From a conceptual perspective, this research contributes by enriching the current discussions predicated upon teachers' perceptions as determinants of technology adoption, as well as ER's role in engaging students in the learning process premised on Vygotskian social constructivism. Pedagogically and practically, this paper provides insights into exploring the possibilities and obstacles of adopting ER in management education.

Keywords

Educational robotics; Management education; Curriculum; Pedagogy; Technological domain

1. Introduction

Advancements in computer technologies have provided new pedagogical tools for teachers in all educational levels and disciplines (Frude & Jandric, 2015; Jung & Won, 2018). From computer-aided instructions and e-learning technologies to interactive teaching systems, technological-oriented pedagogical approaches can potentially engage students in deep learning and facilitate the development of technological and transferable skills (Cheng et al., 2018). The use of educational robotics (ER) is garnering interest among teachers of different disciplines from STEM education in schools to engineering and computer science education in universities (Mubin et al., 2013; Yuen et al., 2014). As a subset of educational technology, ER refers to the use of robotic technology, such as robotics kits and social robots, to motivate students for learning facilitation and development (Jung & Won, 2018). ER provides a tangible interface that could

enhance the learning process by creating an enjoyable and engaging context (Jung & Won, 2018; Serholt et al., 2014). ER have been employed as pedagogical approaches in demonstrations and experiments (Cristoforis et al., 2013), and in medical emergency training and assessments (Tanzawa et al., 2013). Collaborative robotic projects could encourage students to solve simulated problems and to reflect on their experiences together (Nagchaudhuri, 2004). The development of knowledge and skills through Kolb's experiential learning cycle may be facilitated through the use of ER (Mikropoulos & Bellou, 2013).

Few current studies have investigated teachers' perceptions of using ER outside technology-oriented fields. Although teachers in management education may not feel the urge to use ER in their courses due to lack of connection to the content, using robots to enhance service management, promote operational efficiency and reduce operating cost has become a trend in many industries (reference?). For example, robots are used to greet guests in hotels, provide information to tourists, and to coordinate operations in the logistics sector. Robots are becoming more common in different work environments, and are no longer remote from reality. There could be advantages for management students in terms of career and employment opportunities should they start familiarizing with robotics during university study. ER could also potentially contribute to developing students' subject knowledge, technological competences, and transferable skills (Mikropoulos & Bellou, 2013; Nagchaudhuri, 2004; Tanzawa et al., 2013). Transferable skills refer to those acquired abilities that could be applied across different contexts with little or no adaptation (Gardner & Barefoot, 2017; OECD, 2012). Examples of transferable skills include interpersonal skills, critical thinking skills, and problem-solving skills (Gardner & Barefoot, 2017; OECD, 2012). These skills were considered important for developing students' abilities, enhancing employability, and coping with the rapid integration of advanced technologies into their daily lives (Frude & Jandric, 2015). University students who grew up in an era of technology are considered open-minded, tech-savvy, techno-centric, and are known to prefer learning-by-doing (Churcher et al., 2014; Feiertag & Berge, 2008). ER could be utilized as a pedagogical means to effectively engage students in tech-centric and group-oriented learning processes, enabling them to better achieve subject learning outcomes and prospective career goals (Tang et al., 2019).

There is a growing trend of technology integrated pedagogy. Given teachers' perceptions, attitudes and technological competences are considered as primary determinants of technology adoption in curriculum and pedagogy, it is necessary to understand their perceived views of ER's utility and acceptance in management education (Baskin & Williams, 2006; Chevalier et al., 2016; Schoonenboom, 2014). This qualitative research aims to investigate university teachers' perceived opportunities and challenges of using ER in management education from the interconnected dimensions of curriculum, pedagogy and technological, by means of a narrative analysis. From a conceptual perspective, this study contributes by enriching the current discussions predicated upon teachers' perceptions as determinants of technology adoption, as well as ER's role in engaging students in the learning process premised on Vygotskian social constructivism. Pedagogically and practically, this research is expected to provide insights into exploring the possibilities and overcoming the obstacles of adopting ER in management education, beyond the scopes of science-oriented fields.

2. **Literature Review**

Curriculum refer to the subjects taught within a body of disciplined knowledge (Franklin, 2008). ER could be utilized for developing discipline-specific knowledge (Chevalier et al., 2016). For example, Gabriele et al. (2012) used ER in a cognitive psychology course and allowed students to manipulate and programme LEGO robots. Students recorded their progress, reflected on their learning experiences, and reported higher levels of discipline and robotic knowledge (Gabriele et al., 2012). The adoption of ER into a management curriculum, however, would be conditional on subject content, and the lack of well-planned integration of ER into a curriculum could cause confuse regarding learning outcomes (Mubin et al., 2013; Serholt et al., 2014).

Pedagogy refers to "the general principles of effective teaching, entailing a complex blend of theoretical understanding, practical skills, and competences" (O'Neill, 2008, p. 429). Premised on Vygotsky's (1978) social constructivism, learning require dialectical interactions between students and a more capable other, such as a more experienced person or an intelligent system. The relational dynamics stimulated by ER's versatile interactive functions could facilitate students' dialectical interactions, leading to cognitive modeling, knowledge construction, creativity stimulation, independent problem-solving, and skill and metacognitive development, and hence,

closing the Zone of Proximal Development (ZPD) (Churcher et al., 2014; Ravenscroft, 2001; Vygotsky, 1978). ZPD is "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving with more capable others" (Vygotsky, 1978, p.86). ER could serve as a stimulus for facilitating the necessary dialogic and collaborative discourses to enhance student interactions with teacher and peers, resulting in construction of discipline-specific knowledge and development of technological competences and transferable skills, as compared to other traditional teaching modes (Churcher et al., 2014; Mubin et al., 2013; Serholt et al., 2014).

ER could be used as teaching aid in various pedagogical approaches, including collaborative learning, project-based learning and experiential learning (Martinez-Tenor et al., 2019; Tanzawa et al., 2013; Van Den Berghe et al., 2019). Although conclusive results are yet to be found, current researches into ER have shown that robots could be used to motivate students to achieve higher learning outcomes (Van Den Berghe et al., 2019). ER projects, using LEGO Mindstorms, were found to contribute to increasing students' motivation, collaborative problem-solving skills, communication, and robotics knowledge (Martinez-Tenor et al., 2019; Taylor & Baek, 2018). The beneficial effects were nevertheless conditional on the involvement of team members in interdependent roles and interrelated tasks (Taylor & Baek, 2018). Well-structured collaborative ER projects could support students' construction of knowledge, development of transferable skills, while addressing their weaknesses (Eguchi, 2014; Taylor & Baek, 2018; Yuen et al., 2014).

Integration of ER into pedagogy should consider students' backgrounds, learning needs and prior experiences (Churcher et al., 2014; Feiertag & Berge, 2008; Gabriele et al., 2012). Given current students' preferences for technology and for learning-by-doing, openness to new ideas, and belongingness to group learning (Churcher et al., 2014; Feiertag & Berge, 2008), ER demonstrations could allow for interactive, hands-on experiences, and offer immediacy and support for experiential learning (Cristoforis et al., 2013). Robotic patients, for instance, were used as an interactive model for dental students to practice emergency-coping skills (Tanzawa et al., 2013). ER in this example served as an effective stimulus for promoting students' deep learning and their ability to address real-world challenges (Eguchi, 2014). ER's novelty could also stimulate enthusiasm in students, so that students will be motivated to achieve learning outcomes (Jung &

Won, 2018; Serholt et al., 2014; Van Den Berghe et al., 2019). However, the element of novelty may wear-off over time as students become used to working with robots (Van Den Berghe et al., 2019).

Technological challenges could be a major hurdle in implementing ER in a management curriculum and pedagogy (Schoonenboom, 2014). Teachers outside of technology-oriented fields may not have the technological competences to use ER (Chevalier et al. 2016; Nath, 2019). A lack of technological infrastructure, resources and support, such as IT support staff and training, could prevent faculty from using new technology (Nath, 2019). Other barriers to adoption could be related to teachers' biased attitudes towards new technology, such as their perceived utility, and ease of use (Baskin & Williams, 2006; Schoonenboom, 2014). Technological hurdles could be aggravated by teachers' perceived costs, including acquisition cost, and time cost required to learn and implement the new technology (Serholt et al., 2014). Negative experiences in the past could prevent teachers from using ER in management education. Teachers' perceptions, attitudes and technological competences are regarded as key determinants of technology adoption in curriculum and pedagogy. Investigating teachers' perspectives towards ER would be important for gaining insights into the opportunities, drawbacks and obstacles of applying ER in management education (Baskin & Williams, 2006; Chevalier et al., 2016; Schoonenboom, 2014). This would allow researchers, teachers, and administrators to explore the possibilities and benefits of using ER as a pedagogical tool to effectively engage students in the learning process.

Overall, this study argue that the integration of ER into management education should be based on the three interconnected dimensions described: curriculum, pedagogy, and technological. These domains are critical for exploring opportunities and addressing challenges of ER in management education.

3. Methods

3.1. Research Design

This exploratory study aims to gain insights into university teachers' perceived opportunities and challenges in using ER in management education across three dimensions (i.e., curriculum,

pedagogical, and technological). This study was framed within a qualitative approach via pre- and post-semester open-ended interviews for data collection (Riessman, 2008; Seidman, 1998). The triangulation of empirical data collected at two timeframes sought to strengthen the trustworthiness of the research results (Lincoln & Guba, 1985). The pre-semester interviews aimed to gain an understanding of participants' conceptions and perceived prospects of integrating ER into management education. The post-semester interviews expected to obtain further insights and more concrete ideas of incorporating ER into their teaching context. This allowed participants a second chance to reflect more deeply on ER's potential applications to management education given ER as an emergent phenomenon.

3.2. Participants

The interviews were conducted with academics at a large university. The potential interviewees were more than 50 academics within the management-related department, which has been well-recognized for using innovative approaches to teaching. Based on students' and faculty members' recommendations on the teachers who has used and experimented with a wide variety of highly-interactive, technology-oriented teaching methods, the authors invited seven participants from the potential interviewees. By purposive sampling through authors' personal invitations (Babbie, 2016; Leedy et al., 2019), these seven interviewees ranged from Instructor to Associate Professor level, with considerable expertise in management education and more than seven years of teaching experiences. Please refer to Table 1 for detail of participants' profiles.

Insert < Table 1 >

3.3. Research Instruments

Two open-ended interview guides were developed for capturing participants' views on the curricular, pedagogical and technological considerations of applying ER, and examples of questions are:

Examples of Pre-semester Interview Questions

1) What are the opportunities for using ER in management education?
2) What are the major obstacle for using ER in management education?

3) Summarize your views of using ER from curricular, pedagogical and technological aspects within management education.

Examples of Post-semester Interview Questions

1) Which subjects would be most suitable for using ER in management education?
2) How would you see ER in contributing to students' learning in management education?
3) What are the obstacles that you would find most difficult in overcoming for using ER in management education?

3.4. Procedure

Both of the open-ended pre- and post-semester interviews were conducted either in the interviewees' or the authors' offices. Before beginning the pre-semester interviews, the authors as interviewers had brief conversations on the various aspects of ER in higher education. The interviewer and interviewee discussed ER as building and programming small robots; ER as teaching aids; and ER as general robotic technology to facilitate students' learning and development. As such, a conceptual perspective of ER in management education was built on mutual discussion to avoid misunderstanding, ambiguity, or narrow views. Participants were asked to envision and elaborate, with examples, some of the technological opportunities and challenges to using ER. The technological aspect was considered an appropriate point-of-entry for the interviews as participants could readily describe the challenges they would face given their non-technological backgrounds. This served as a warm-up before moving on to the other dimensions of applying ER.

In the post-semester interviews, participants were asked to reiterate the perceived roles of ER in management education, as well as their perceived personal fulfillment, career-oriented motivations and benefits of using ER. After the first interview and over the course of the academic semester, participants would be more familiar with the concept of ER, and have had a chance to reconsider its adoption. It was expected that participants would be able to convey stronger opinions regarding the use of ER in their teaching context. Each of the pre- and post-semester interviews lasted for around 30 minutes, and was audio-recorded with permission.

3.5. Data Analysis

Narrative analysis was applied to analyzing participants' rich narrations along with researchers' detailed notes, to identify the perceived opportunities and challenges in using ER across the three-interrelated curricular, pedagogical and technological dimensions (Cortazzi, 1993; Miles & Huberman, 1994; Riessman, 2008; Strauss & Corbin, 1990). The pre- and post-semester interviews were first coded and analyzed separately to generate initial open codes and preliminary insights in the form of research notes. Next, the codes were analyzed together, complemented by the preliminary notes, which resulted in a two-tiered data analysis process framed within a narrative analysis. In total, more than 130 open codes were generated by scrutinizing the repeated and salient words, phrases and sentences together. The open codes were subject to an exhaustive examination process to discover the manifested and hidden relationships among all the codes to generate 15 axial codes. All the axial codes were subject to a thorough scrutinizing process to discern the underlying patterns and conceptual meanings among all the codes to generate seven selective codes. Table 2 presents a summary of open codes (highlighted), axial codes and selective codes generated from the narrative analysis framed within the curricular, pedagogical and technological domains. This aimed to demonstrate the interconnections among all the codes and the hierarchical levels of the potential and challenges in applying ER to management education (Cortazzi, 1993; Miles & Huberman, 1994; Riessman, 2008; Strauss & Corbin, 1990). Data collection and analysis procedures, including use of purposive sampling, triangulation of empirical data and analysts, iterative analysis procedures, and achievement of theoretical saturation in data analysis, contributed to strengthening the reliability and credibility of research findings and ensuring the trustworthiness of the research (Lincoln & Guba, 1985).

Insert < Table 2 >

4. Results

4.1. Curriculum for Developing Discipline-specific Knowledge and Transferable Skills

Participants had doubts at first about the plausibility of incorporating ER into the management curriculum. This was attributed to the perceived lack of connection between ER and management education. Later on, however, participants gradually saw the possibilities of

integrating ER, which was largely prompted by the growing trend of using robotics in workplaces. For example, robotic butlers were used in hotels in greeting and providing information to guests, while robotic servers were found in restaurants. Robots could no longer be considered remote from reality.

Opinions on "how" to integrate ER into the management curriculum were divided. Some participants saw the potential use of ER in teaching discipline-specific knowledge and practical skills. For example, ER would be useful for setting different scenarios for students to practice relevant job-related skills, like how to serve a customer, in order to prepare them for future careers related to customer services. Participants acknowledged limitations on applying ER to teach management theories and business ethics. Given the current limitations of artificial intelligence (AI) technology in ER, participants suggested that robotics applications would not be able to explain abstract concepts to students as well as human teachers. Some participants indicated that ER would be better incorporated into general education subjects for developing students' transferable skills rather than in management education. This approach would capitalize on the synergistic effects of cross-disciplinary collaboration, by means of drawing students' strengths from different disciplines while addressing their weaknesses.

Participants noted that the implementation of ER by teachers would require strategic support from administrators. Students' learning needs and prior experiences would need to be taken into consideration. Given that management students might not have many prior experience of learning by means of ER, participants suggested using a "progressive programme design from fundamental to advanced level" to gradually equip students with foundational technological skills in freshman year before progressing to more advanced discipline-specific ER skills in the senior year. Teachers should play a major role in all aspects of curriculum and subject design, while closely supervising students' learning processes and experiences. This would enable teachers to "own" and assume primary responsibilities for the whole design of the curriculum with their well thought out volitional choices of how to best integrate ER for students' learning facilitation. ER's role thus could only be supplementary, and not as a replacement to teachers.

> Participant explained, "[We] still assume the responsibilities for creating, designing, and implementing the curriculum, and must clearly explain to students what the assessment criteria are. Otherwise, [ER] may not get the kind of responses, let alone assess students themselves."

4.2. Robotics as Pedagogical Aids but not a Substitute for Human Teachers

ER was conceptualized as pedagogical aids for learning facilitation and teaching enhancement, but not a replacement for human teachers. Participants were open-minded towards the pedagogical integration of ER and saw the opportunities of utilizing it for teaching and learning improvement. They suggested many innovative ideas of using ER, especially in the context of experiential learning. For example, ER could be applied to demonstrate service skills in a restaurant management class, so that students could learn the standardized procedures. ER could also be programmed as a customer to interact with students in different service scenarios for them to practice handling complaints and emergencies. Given students' preference for instant feedback, ER's interactive functions could provide timely responses for learning facilitation. Participants also recognized that ER use in cross-disciplinary robotics projects was compatible with collaborative learning experiences that could facilitate students' acquisition of transferable skills. Additionally, robotic teaching assistants were envisioned as potential pedagogical applications. Although ER could be effective pedagogical aids, the possibilities would be dependent on the availability of AI technology.

Participants believed that ER had the potential to arouse students' interest and motivate them to learn. Considering students are tech-savvy and quick learners, teachers could capitalize on ER's novel and fun features to draw students' attention. ER would itself be a topic of interest to students to arouse their curiosity and engage them in class activities and the overall learning processes. But, participants were worried that ER could be "seen as a gimmick".

> Participant replied, "[Robot] is something interesting that gets people's attention …… it's very cute, people take photos. That's the interesting part. But after that I don't know how effective it is. Will it really add something unique, memorable with that?"

Participants hesitated to draw a concluding remark on ER's effectiveness in engaging students, because they foresaw misusing or over-relying on robots as a gimmick, without fully integrating it into the overall pedagogical strategies, would backfire. Students might not see the direct connection between ER and specific learning outcomes, which might render ER as a distraction in class, instead of serving as a purposeful aid to promote teaching and learning.

Participants recognized ER's opportunities to provide teaching support. For example, ER could help take attendance and input grades while teachers could focus more on providing customized learning support to individual students. Teachers would have the flexibility and responsibility for integrating ER into pedagogy, so that teachers could manage their time better on essential tasks. ER enhance teachers' overall effectiveness as a teacher. Participants emphasized that ER could only be pedagogical aids and could not be a substitute for human teachers.

> Participant explained, "The robot should not be seen as a replacement, it should be seen as a supplement. The honours, the responsibilities still lie with the instructor in creating in designing, implementing, rolling out all these scenarios, and more important is assessment."

Participants seemed to feel ambivalent about the impacts of ER on pedagogies and on their jobs. A note of uneasiness was sensed about their scepticism about whether or not ER would replace their roles as a teacher sometime in the future. On the other hand, they saw the increasing integration of technologies in pedagogies was the trend. Harbouring such mixed feelings, they appeared to choose to cope with ER in a positive and proactive way. This was reflected in their sharing about how ER could be integrated into a holistic pedagogical strategy, and served as platforms for them to add value to their teaching and students' learning facilitation. Despite an undertone of uncertainty, teachers were open-minded about integrating ER into management pedagogy overall.

4.3. Opportunities or Obstacles Created within the Technological Domain

Participants' sharing of opportunities and constraints in the technological domain covered other pertinent technological concerns in implementing ER in management education. The

availability of robotics and AI technologies was a genuine obstacle to the use of ER. Participants explained that students could constantly synthesize old knowledge with new ones, and come up with complex questions that the current ER technology might not be able to cope with. There was a lack of sophisticated ER with integrated AI technology that could address students' modes of thinking, cognitive learning, and meta-learning. This would pose a serious hindrance to adopting ER in management education.

Teachers' lack of ER skills posed a literal constraint on its integration into the curriculum or pedagogy. This was conflated by the lack of time to learn how to use and implement ER in teaching, because of the difficulties faced in managing the overwhelming work demands on research, teaching, service and administrative duties.

> Participant explained, "Because I need to spend most of my time in research, services, and so forth. My schedule is already fully packed, that's the difficulty to try new things. If it requires my time a lot, then I don't like."

The perceived positive effects of ER on teaching and learning were considered to be worthwhile as compared to the time needed to gain the skills for using ER. Participants acknowledged that if they did not keep up with technologies, they "will not be able to connect with the students". ER would allow them to "to interact with the students and teach their lessons effectively" because students were tech-savvy and techno-centric and would become more responsive to technologies in this era. Considering this, participants recognized that being "open to using new technology" and proactively riding on the wave of technology integration would benefit their career prospects.

Participants believed that the predicament faced in time constraints could probably be overcome by the advancement of robotic technology. They shared that their intention to use ER in class would increase if ER was easy to learn and operate, and with add-on functions. For example, ER would provide ubiquitous 24-hour access anytime and anywhere, resulting in convenient interactive learning opportunities for students without the bound of time and geographical location.

Participants also conceptualized ER as performing other important analytical and monitoring functions for students' learning enhancement.

> Participant envisioned, "We can [utilize ER's] record function to analyze what areas we need to pay attention more to teach students. What areas are most difficult part of students to understand? Based on their interaction, we can analyze what their learning and teaching efficiency or effectiveness."

Participants took a proactive stance to contemplate the multipurpose functions of ER, and explore how it could be innovatively integrated into achieving different pedagogical purposes. As illustrated, ER could be utilized for monitoring students' performances, keeping track of learning progresses, analyzing their overall learning, and customizing learning plans for students. ER had an added advantage of maintaining repetitive teaching quality with standardized programming. Human teachers would focus on high-touch and personalized responses to students.

Finally, participants indicated that a university's commitment to providing financial and technological resources would incentivize their use of ER. University administrators' roles in establishing overall strategic plans and their decisions on selecting the particular types of technologies and offering the kinds of support would facilitate or impede the adoption of ER in management education. Overall, the potential of integrating ER into management education would be expedited once ER technology advanced and more institutional support was offered.

5. Discussion

This study explored university teachers' perceived opportunities and challenges in using ER in management education. The findings were conceptualized from three interrelated dimensions: curriculum, pedagogy and technological. Teachers were open-minded towards the integration of ER into management curriculum and pedagogy, but were concerned about its implementation based on current technology. They were open to opportunities for expediting the utilization of ER in management education once ER technology matures.

There are opportunities for integrating ER into a management curriculum to develop students' subject knowledge and competences for enhancing their career prospects (Cheng et al., 2018; Frude & Jandric, 2015; Mubin et al., 2013). The prime concerns about the integration of ER into management education were the management students' learning needs and prior experiences (Churcher et al., 2014; Feiertag & Berge, 2008; Gabriele et al., 2012). Given that there are growing integration of robots and robotic applications in the workplace, preparing and familiarizing students by means of integrating ER into management curriculum and pedagogical practices, would give students pre-empted advantages. The emphasis should be placed on the importance of subject-content alignment with ER, and articulation with the overall management programme (Gabriele et al., 2012). With clear focuses on the development of career-oriented robotic applications, and acquisition of transferable skills congenial to working in an environment of human-human and human-robot interactions. Despite management students being tech-savvy and have techno-centric preferences (Churcher et al., 2014; Feiertag & Berge, 2008), they still lack specific prior experiences of learning by ER. Therefore, reviewing and revising the management curriculum as a whole to incorporate robotic knowledge by progressing from foundational technological competences in freshman year to more advanced know-how in senior year could be a possible way forward. To avoid distracting students from the learning outcomes, students' needs and interests must be carefully considered before the integration of ER into the curriculum. It is necessary to avoid falling into the trap of confusing ER's novel and fun features with the intended learning outcomes (Mubin et al., 2013; Serholt et al., 2014; Van Den Berghe et al., 2019).

Consistent with Vygotskian social constructivism, ER was conceptualized as a stimulus for facilitating students' construction of discipline-specific knowledge, and development of subject-based practical skills and transferable skills (Churcher et al., 2014; Ravenscroft, 2001; Vygotsky, 1978). Predicated upon the Vygotskian framework, ER could be the suitable pedagogical aids for facilitating interactions for learning and knowledge construction. AI development and its integration into ER could result in practical pedagogical applications in management education for learning empowerment and achievement of learning outcomes. ER, for example, could be utilized in experiential learning by means of demonstrations, such as applying ER to service management, setting different scenarios for practical training, and integrating ER into crisis management to practise handling different emergency situations (Cristoforis et al., 2013; Tanzawa et al., 2013).

ER could be used for interactive tutoring activities, monitoring individual skill levels, assessing performances and providing instant feedback. These examples highlight the potential of utilizing ER as an interactive pedagogical tool, rather than viewing ER as a didactic means for one-way lecturing.

ER could serve as versatile tools for teaching and administrative support (such as grading students' multiple-choice quizzes), so that teachers could utilize their time on improving the teaching and learning experience for students. This would contribute to enhancing teaching effectiveness and efficiency. This study cautions against the indiscriminate use of ER, which could become a distraction (Mubin et al., 2013; Taylor & Baek, 2018; Yuen et al., 2014). ER use is not a panacea for ineffective and poorly-designed teaching methods (Taylor & Baek, 2018; Van Den Berghe et al., 2019; Yuen et al., 2014). Integrating ER into management curriculum and pedagogy comes with the caveat that the novelty effects on learning might fade out over time as students become accustomed to working with robots, resulting in its failure to motivate or stimulate students to achieve the learning outcomes as intended (Van Den Berghe et al., 2019).

Opportunities and obstacles were mainly contingent on the advancement of technology and the availability of institutional support. Teachers' perceived lack of technological competence could be a major hurdle to incorporating ER in management education (Baskin & Williams, 2006; Chevalier et al. 2016; Nath, 2019). This might result in teachers' restricting ER use to one-way lecturing or administrative support, rather than fully utilizing its' versatile pedagogical functions for students' learning facilitation. University-level support, including financial, technological and other resources, would be critical to incentivize the implementation of ER into management education (Baskin & Williams, 2006; Nath, 2019).

Beneath teachers' positive attitudes and open-mindedness to utilizing ER into their teaching, they are sceptical about being replaced by robots in the future. Although they consider the integration of more technology, including ER, into teaching and learning as a prevalent trend, this appears to create a threat to them who harbour doubts and suspicions about being substituted by or losing control to robots. This is a crucial issue that must be addressed by university administrators.

Overall, teachers expressed optimistic attitudes and envisioned the possibilities of integrating ER into management curriculum and pedagogy to develop students' discipline-specific knowledge, technological competences and transferable skills for coping with future challenges. Resources have to be devoted to developing the technology behind ER, redesigning the relevant subjects to articulate with the curriculum, and providing the supporting teaching materials for learning facilitation (Mubin et al., 2013). University administrators' all-rounded support, including training in change management and technologies (Baskin & Williams, 2006; Nath, 2019), and their strategic visions of enhancing teachers' teaching effectiveness and efficiency without marginalizing their overall teaching roles, would incentivize teachers to adopt ER in teaching and learning. Holistic integration of ER may need to be considered at the university-level rather than at the subject-level, as expediting its use in one subject could hamper students' learning in another subject (Baskin & Williams, 2006). The merits of using ER could warrant the additional financial and time investments required as it could be used to engage students further (Baskin & Williams, 2006; Nath, 2019; Serholt et al., 2014). ER should only be considered as complementary, rather than a substitute, to human teachers.

6. **Conclusion**

This study investigated university teachers' perceived opportunities and challenges in using ER in management education from three interconnected dimensions: curriculum, pedagogy and technological, by means of narrative analysis. The findings showed teachers' positive attitudes towards incorporating ER into the curriculum via a progressive approach by accounting for its subject-content alignment and articulation with the overall management programme. ER could be utilized in various pedagogical means, such as demonstrations and practical training, by considering students' backgrounds and learning preferences. Holistic integration of ER with engaged students, supportive teachers, and committed university administrators is crucial.

Based on the empirical results, a strategic and supportive approach engaging administrators, teachers and technological staff in their respective duties and roles and for supporting one another is recommended to facilitate the integration of ER in management curriculum and pedagogy. For example, administrators could provide financial support for robotics equipment and follow-up services, arrange appropriate training workshops and sharing sessions, as well as to provide timely

relief for teachers to engage in the progressive integration of ER into the curriculum. Since teachers are the frontline stakeholder in the actual integration of ER into the overall pedagogical design, they should be actively consulted and involved in the strategic process of planning and implementation. Moreover, technological support, in terms of having technological staff being readily available, and provision of hardware and software, could be arranged. In the curricular domain, ER could be integrated into introductory courses in the freshman year, operations and applied courses in sophomore and junior years, and strategic management and advanced operational courses in the senior year. Pedagogically, ER could be utilized in experiential learning and practical training. Furthermore, ER could be applied to collaborative learning projects to engage students across different management areas, such as service management, operations, and logistics management. This would develop students' transferable skills, consolidate their area-specific knowledge, and promote a holistic approach to integrating ER into management education.

A limitation of this study is the generalizability of the findings to other contexts given the limited sample size. Although the authors highlighted several aspects of ER to participants at the beginning of the interview, the depth (or lack) of knowledge in the subject matter could influence their perspectives. Future studies could examine the integration of AI into ER for learning empowerment and teaching enhancement. Another research direction could investigate the perceptions of different stakeholders, including students and university administrators, towards the adoption of ER, and the ways to explore opportunities while addressing challenges. On the conceptual plane, this research contribute to enriching the current discussions predicated upon teachers' perceptions as determinants of technology adoption, as well as ER's role in engaging students in the learning process premised on Vygotskian social constructivism. Pedagogically and practically, this study is expected to provide insights into exploring the possibilities and overcoming the obstacles of adopting ER in management education.

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Table 1. Participants' Profiles

Name (Pseudonym)	Gender	Ethnicity	Position	Areas of Teaching Expertise
Sally	Female	Taiwanese	Associate Professor	Research Methods; Service Quality
David	Male	Russian	Assistant Professor	Attractions and Visitor Management; Ethics and Social Responsibility
Sonia	Female	Korean	Assistant Professor	Financial and Managerial Accounting; Financial Management
Aimee	Female	Hong Kong Chinese	Instructor	Convention and Events Management; Tourism Management
Ava	Female	Hong Kong Chinese	Instructor	Hospitality Management; Leisure and Society
Darren	Male	Singaporean	Instructor	Customer Relationship Management; Destination Management
Jay	Male	Hong Kong Chinese	Instructor	Cruise Operations and Management; Principles of Tourism

Table 2. Summary of Open Codes, Axial Codes and Selective Codes within the Curriculum, Pedagogy and Technological Domain of ER Applications to Management Education

Curriculum		
Open Codes (Highlighted)	**Axial Codes**	**Selective Codes**
Robots Used in Industry; Discipline-specific Practical Class; General Education Subjects	Practical and Skill-based Class Required by Industry	Curriculum for Developing Discipline-specific Knowledge and Transferable Skills
Discipline-specific Subject Content; Learning Outcomes; Connection between Robotics and Discipline-specific Learning Purposes; Assessment Criteria	Discipline-specific Learning Outcomes	
Transferable Skills; Creativity; Teamwork	Transferable Skills	
Pedagogy		
Open Codes (Highlighted)	**Axial Codes**	**Selective Codes**
Teachers as Facilitator; Focus on Highly-valued Teaching Work; Greater Teaching Outcomes	Teachers as Facilitator	Robotics is NOT a Substitute for Human Teachers
Robotics cannot Substitute for Teachers; Robotics as Secondary Tools; Robotics as Supplement	Robotics is NOT a Substitute	
Robotics as Teaching and Learning Aids; Robots as Teaching Assistant; Robotics as Tutor	Robotics as Teaching and Learning Aids	Robotics as Teaching and Learning Aids for Learning Facilitation and Student Motivation
Facilitate Learning; Interaction; Responses	Robotics for Learning Facilitation	
Motivate Students; Interesting; Get Students' Attention; Tech-savvy	Robotics for Student Motivation	
Technological Domain		
Open Codes (Highlighted)	**Axial Codes**	**Selective Codes**
Investment by University and Department; University and Department Levels; University as Final Decision Maker	Institutions	Opportunities or Obstacles created by Institutions
Lack of IT Resources; Lack of Lab, Equipment and Space; IT Support	Technological support	Opportunities or Obstacles created by Technology
Limitation by Availability of Technology;	Availability of Technology to Address Students' Learning Modes	

Lack Sophisticated and Complex Programming in Robotics; Lack of Technology to Address Students' Sophisticated and Complex Learning Modes		
User-friendly Technology; NOT Too Technological; Easy and Quick to Learn	User-friendly Technology	
Students' Convenience in Accessing Robotics Anytime and Anywhere; Monitor Students' Learning Progresses and Performances; Robotics' Ability in Guaranteeing Quality of Delivery	Advantages of Robotics	
Teachers Lack Technological Competences; Teachers Face Limited Time; Teachers Invest Time and Efforts	Teachers' Technological and Time Constraints	Opportunities or Obstacles created by Teachers
Teachers Have to Master New Technology; Teachers' Creativity in Utilizing Robotics; Open-minded	Teachers' Attitudes toward New Technology and Learning	