

Dual Roles of Educational Robotics in Management Education: Pedagogical Means and Learning Outcomes

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Abstract

This conceptual paper explores the pedagogical implications of educational robotics (ER) in management education. Premised on Vygotsky's social constructivism, this paper conceptualizes ER as a stimulus for serving dual roles, as a pedagogical means and as a learning outcome, by presenting a number of justifications and viable approaches. This paper suggests that ER presents a number of opportunities for facilitating learner-centred, experiential, and collaborative pedagogical approaches to address different learning needs and knowledge levels. Based on a critical analysis of current literature with examples of ER in different fields, ER could be conceptualized as a tool to be integrated into a holistic pedagogical strategy to equip management students with management knowledge and skills, technical competences, and transferable skills for their benefits of learning facilitation.

Keywords

Educational robotics; Social constructivism; Pedagogy; Learning outcomes; Management education; Higher education

1. Introduction

1.1. Research Background

Educational robotics (ER) refers to the use of robotic technology to facilitate student learning and development with the aim of improving their performances (Mubin et al., 2013). Current research in ER seeks to connect ER with pedagogical considerations across a wide range of fields, such as engineering, sciences, biology, medical education, cognitive psychology and liberal arts (Cheng et al., 2018; Li et al., 2009). This connection is predicated upon knowledge construction where learners are actively engaged in creating and building something meaningful together (Billing, 2007). In this regard, previous studies have highlighted the positive effects of using ER as a pedagogical tool by means of cognitive stimulus for engaging students in the process of

knowledge construction, thereby developing their management knowledge and skills, technical competences, and transferable skills (Atmatzidou et al., 2018; Frude & Jandric 2015).

ER can be regarded as a pedagogical agent for students. For instance, while management students may not have extensive prior knowledge and practical skills in ER, acquiring the know-how and competences of using robotics could be considered as a learning outcome in itself. Although using ER in management education may sound remote, it is important to avoid the parochial view of confining the application of ER to computer or engineering-related fields. Management students may benefit from inter-disciplinary robotic projects for developing technical competences, transferable skills, and all-rounded development, which are considered as important learning outcomes of higher education that are valued by employers (Gardner & Barefoot, 2017). Educators could also conceptualize ER as a viable cognitive tool in management education by preparing students to cope with the trends of rapid integration of advanced technologies into their daily and work lives.

1.2. Research Objectives

This conceptual paper aims to contribute to the literature on ER by considering the dual roles of ER within management education, embodying its role as a pedagogical means while serving as a learning outcome premised on the theoretical framework of Vygotsky's (1978) social constructivism. Predicated upon this theoretical frame, the specific objectives of this conceptual paper are:

- To explore the learning outcomes of management education, in terms of acquiring technical competences in ER, as well as management knowledge and transferable skills;
- To discuss the applications of ER to management education as a viable pedagogical means to achieve the pertinent learning outcomes during the process of knowledge construction between students and teachers; and
- To explore different viable approaches to integrating ER into management education by connecting Vygotsky's social constructivism to the use of ER in pedagogy for achieving the learning outcomes.

1.3. Research Problem

In this conceptual paper, we argue that exploring different viable approaches to integrating ER into management education is a relevant and timely concern. Yet, the significant implications of ER for management education remain an under-researched area, despite increasing interest in the subject area across higher education. Furthermore, there is a lack of conceptual work on the role of ER as a pedagogical means while serving as a learning outcome. We thus seek to fill this gap by addressing two key themes: ER as a means and an ends in management education.

1.4. Practical Contributions to Teachers and Learners

This conceptual paper is based on a critical analysis of the literature on Vygotsky's (1978) social constructivism, as well as the current studies and practical applications of ER in different field. This paper seeks to make practical contributions to learners and teachers in management education, summarized as below:

- Students could be better equipped with technical competences, management knowledge and transferable skills;
- Students' learning outcomes could be achieved by the integration of ER into pedagogical means;
- Teachers could utilize ER for facilitating learner-centred, experiential, and collaborative pedagogical approaches to address different learning needs and knowledge levels of students; and
- Teachers could better plan for the strategic integration of ER into overall learning and teaching to achieve the intended learning outcomes.

2. Literature Review

2.1. Definitions of Pedagogy and Learning Outcomes

Pedagogy is the intent of creating learning experiences that will construct and re-construct a broad spectrum of conceptualizations and understandings of the natural and social worlds (Giroux & Simon, 1989). ER, in this conceptual paper concerning formal education, is considered as a viable pedagogical means, encompassing feasible and action-oriented ways for organizing and re-

organizing the cognitive schema, as well as for creating and interpreting the meanings during the process of knowledge construction to achieve learning outcomes (Giroux & Simon, 1989). The considerations for using ER as a pedagogical means is its potential for better developing deeper management knowledge, technical competences, and transferable skills for students, as compared to the purely software-based learning or traditional teaching modes (Serholt et al., 2014). By defining pedagogy from social and relational viewpoints (Giroux & Simon, 1989), this paper conceptualizes ER's broad spectrum of interactive attributes in serving as a pedagogical means for learning facilitation (Churcher et al., 2014; Vygotsky, 1978).

In alignment with the relational construct of pedagogy, learning is conceptualized as comprising 'both an external social process of interaction and an internal process of elaboration and acquisition of the impulses that are created in the interaction' (Illeris, 2008, p.348). Learning outcomes, encompasses both cognitive and non-cognitive learning (Nemeth & Long, 2012). Cognitive learning primarily focuses on knowledge and skill development at the subject or general level (Nemeth & Long, 2012). Intended learning outcomes for a subject should reflect the elements of preparing students for a successful career upon graduation (Swanger & Gursoy, 2007). This implies the importance of understanding subject knowledge, facts and theories by students (Swanger & Gursoy, 2007). Skill development has a procedural orientation and is concerned with proper methods of execution and practical applications (Nemeth & Long, 2012; Swanger & Gursoy, 2007). Management students' understanding of accounting principles and ability to prepare financial statements are examples of achieving subject learning outcomes.

Management students are also expected to acquire transferable skills, which are considered important for coping with challenges, enhancing employability, and benefitting their career (Gardner & Barefoot, 2017; OECD, 2012). Transferable skills are referred to those general abilities acquired through training or work experience, and that can be applied across different social contexts and deployed with little or no adaptation in a variety of social settings (Gardner & Barefoot, 2017). Examples of transferable skills in management education are communication skills, interpersonal skills, organization skills, critical thinking skills, problem-solving skills, and negotiation skills (Swanger & Gursoy, 2007).

On the other hand, non-cognitive learning refers to the development of certain values, beliefs and attitudes, for example psycho-social development, social responsibility and inter-cultural understanding (Nemeth & Long, 2012). Non-cognitive outcomes can require extended personal reflections and development, and are less demonstrable through traditional testing methods (Nemeth & Long, 2012). Learning outcomes, in this conceptual paper, are thus referred specifically to management knowledge and skill development, as well as technical competence and transferable skill acquisition, rather than considering non-cognitive learning.

2.2. Theoretical Framework of Vygotsky's Social Constructivism

Framed within the above definitions of pedagogy and learning outcomes, Vygotsky's social constructivism (1978), with its attention on the relational dynamics between learners and teachers within a learning context, provides a theoretical work to explore the dual roles of ER as a pedagogical means and a learning outcome. Vygotskian theory (1978) illustrates the nature of interpersonal transactions and their effects on intrapersonal learning and developmental processes. Learning is a continuous process of qualitative transformation and internalization of knowledge resulting from the dialectical and intertwined influences of affect and cognition within a learning context (Vygotsky, 1978). It requires dialectical interactions between students and a more capable other, where the latter may be a more experienced teacher or peer, or an intelligent computer system. The interactions elicit an emotional-motivational drive for learning facilitation and cognitive construction (Ravenscroft, 2001; Vygotsky, 1978). This underlines the significance of interconnecting affect and cognition in students' learning facilitation by means of stimuli, including those signs and dialogues created by human facilitators or computer technologies (Churcher et al., 2014).

Previous studies have suggested innovative uses of various computer technologies (e.g., e-learning and social media) for facilitating students' dialectical interactions with teachers and/or peers (Churcher et al., 2014). This has prompted us to re-conceptualize ER as the potential stimuli in fostering positive relational dynamics between learners and the more experienced other. ER could be conceptualized as a stimulus to promote guided participation that could result in cognitive modelling, knowledge and meaning construction, creativity, independent problem-solving, technical and transferable skill development, and metacognitive development, and hence closing

the Zone of Proximal Development (ZPD) (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 under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p.86). From the Vygotskian social constructivist view (1978), ER’s versatile interactive attributes could be considered as a stimulus for facilitating students’ discourses with teachers and/or peers, where knowledge is constructed within a learning context (Churcher et al., 2014).

Vygotskian social constructivism (1978) however has not yet fully applied to exploring the effects of human and non-human (robotics) interactions on promoting university students’ dialectical interactions with teachers and/or peers, and the intertwined effects with cognition on facilitating their achievement of learning outcomes. Previous studies found that having approachable faculty members and establishing positive relationships with them contributed to an effective learning context for university students (Donahue, 2004; Yazedjian et al., 2007). This has substantiated the centrality of affect as established by positive relational dynamics between students and teachers, and its interconnected effects with cognition on learning facilitation. The existing literature has not yet completely addressed the rapid advancement of computer technologies and the prevalent trends of integrating these technologies into stimulating dialectical interactions between students and the more capable others, and its effects on learning and development. We seek to fill this research gap by applying Vygotskian theoretical framework (1978) to critically analyze the potential use of ER as stimuli for facilitating the necessary dialogic and collaborative discourses between learners and the more experienced others like teachers and peers (Churcher et al., 2014). Vygotskian social constructivist approach to learning (1978) thus has formed the theoretical basis of our arguments for constructing the model of ER in serving the dual role of pedagogical means and learning outcomes in this conceptual paper.

3. Dual Roles of ER in Serving as Pedagogical Means and Learning Outcomes in Management Education

Pedagogy represents learning experiences that will construct and re-construct knowledge of the natural and social world with specific meanings and interpretations (Giroux & Simon, 1989). This implies that teacher and students’ relational dynamics play a part in determining the

experiential quality of knowledge construction during their dialectical interactions (Vygotsky, 1978). The basic tenet of knowledge construction lies in that learners actively create cognitive meanings as opposed to uni-directionally receiving information (Cristoforis et al., 2013; Wellington, 2008). Premised on Vygotskian social constructivism (1978), the relational dynamics between students and teachers exert profound impacts on the learners' knowledge construction through stimuli within a learning context (Wellington, 2008). For teachers, their pedagogical roles and views on the perceived utility of certain stimuli, ER for instance, could facilitate or restrain the occurrence of learning and knowledge construction (Chevalier et al., 2016).

ER could serve as a stimulus for learning facilitation. Previous studies showed that integrating ER into learning experiences could create a collaborative environment for engaging learners, resulting in the construction of new interpretations and meanings (Cristoforis et al., 2013; Wellington, 2008). Students are tech-savvy, digital natives, and open to new ideas, and their relationship with technology could enhance pedagogical practices (Anderson, 2004; Churcher et al., 2014; Feiertag & Berge, 2008). As a result, it is necessary for teachers to carefully leverage the possibilities of ER for knowledge construction in tandem with the benefits of class instruction. This may present opportunities to utilize the versatile pedagogical functions of ER to create desirable study experiences for learning facilitation and knowledge construction in management education (Frude & Jandric, 2015; Papert, 1980).

In this view, the use of ER in management education could facilitate students' learning through dialogues and interactions with teachers, which results in knowledge construction (Churcher et al., 2014). An interactive process, such as building and applying robotics in the classroom, could encourage learners to construct knowledge with their teachers and peers, and thus, provide them with new opportunities to internalize conceptual understanding and intellectual concepts, reasoning, reflective capabilities, and behavioural competences (Churcher et al., 2014). Vygotskian social constructivism (1978) serves to substantiate our conceptualization of ER as a pedagogical means to engage both learners and teachers during a dialectical process of knowledge construction and holistic development (Ravenscroft, 2001). This premise is germane to the thesis of this conceptual paper, which serves to explore the relational dynamics between students and teachers, by means of which ER serves as a pedagogical agent for students' knowledge construction.

Figure 1 illustrates the dual roles of ER in serving as a pedagogical means and a learning outcome in management education.

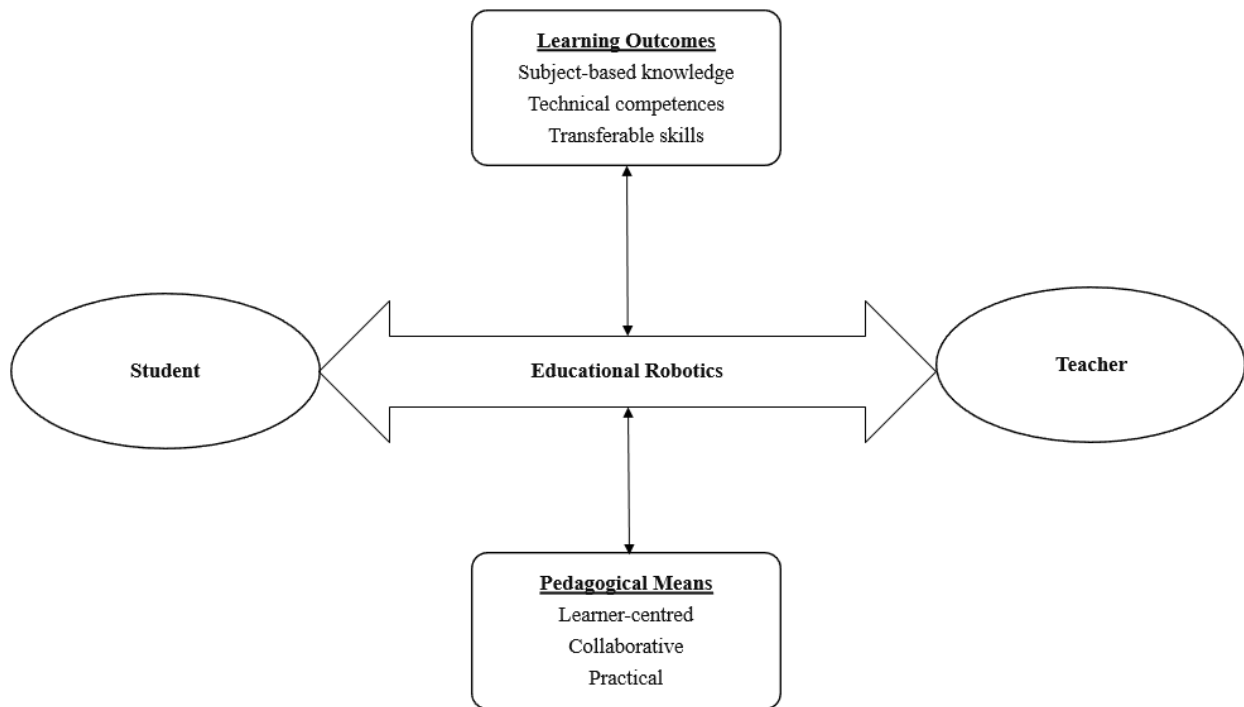


Figure 1. Dual Roles of ER in Serving as Pedagogical Means and Learning Outcomes in Management Education

3.1. ER as Learning Outcomes

Equipping students with technical know-how and competences, management knowledge, and transferable skills are some of the primary aims of management education. To equip management students with technical knowledge and skills, a holistic approach to integrating ER into the management curriculum is a pressing concern. Organizations are increasingly incorporating more advanced computer technologies into their daily management and operations, and consequently, management students need to equip themselves with a certain extent of technical know-how to stay relevant in the workplace (Frude & Jandric, 2015).

Considering that management students may not have the specific know-how in completing highly technical operational tasks, developing their technical competences is important. For example, similar to management students, students in psychology may not have advanced technical background at the onset, but this skill is deemed important nevertheless (Frude & Jandric, 2015). Previous work has shown that ER projects that required psychology students to build robots could act as a successful stimulus for helping them acquire certain technical know-how (Gabriele et al., 2012). In this regard, this conceptual paper suggests a progressive set of learning outcomes with gradually-advancing technical knowledge in the management curriculum to accommodate students' progression from foundational technical competences learned at freshman year to advanced know-how acquired at senior year. This curriculum design is expected to influence students' gradual development of management knowledge and transferable skills through continuous knowledge construction process during their university study.

Equipping management students' technical competences is in tandem with developing their management knowledge. While the technical aspect may appear to be distinct on its own, it is instead interacting with the domains of management knowledge acquisition and transferable skills development during the process of knowledge construction (Eguchi, 2014). The same is relevant for the holistic integration of ER into the management curriculum and pedagogy. For instance, the integration of ER into management curriculum as learning outcomes could be built on existing courses. This would encourage ER to support the teaching of non-robotic topics (Spolaor & Benitti, 2017). For example, an operations management class could incorporate ER into its subject content to cope with the demands of the rapidly changing service industries that are incorporating robotics as a means of reducing operational costs and labour costs.

Another core aspect of management education is to equip students with the capability to establish operational strategies, standard operating procedures (SOPs), and crisis management (Slack & Brandon-Jones, 2018). The aim is to develop students' ability to control quality standards for achieving organizational goals, such as to organize operational staff to follow SOPs for service delivery. Through ER scenario-design, students could practice and assess the merits of different approaches with the aid of robotics for handling simulated emergencies. Students would become

more confident in handling emergencies and in coping with the unexpected and unforeseen circumstances.

Transferable skills could complement the enrichment of management students' knowledge, critical minds and holistic growth (Gardner & Barefoot, 2017). It could be beneficial for their all-rounded development if both management knowledge and transferrable skills are developed to complement and reinforce one another, in tandem with the technical competences. ER projects that require the application or building of robotics to solve real-world problems are highly-interactive and challenging; within this context, ER could be applied to projects in the management curriculum to foster transferable skills, within and beyond the management area in interdisciplinary teams.

Overall, the various examples above serve to emphasize the role of ER in facilitating learning outcomes. This includes developing management knowledge, technical competences and transferable skills within a whole-person approach for students. The next section presents ER as a pedagogical means.

3.2. *ER as Pedagogical Means*

Vygotsky's (1978) social constructivism emphasizes learning as being a socially-mediated process facilitated by the dialectical interactions between the learners and the more experienced (e.g. teachers and peers) within a learning context. This implies that teacher and students' relational dynamics affects the experiential quality of learning, and hence facilitates or restrains the occurrence of learning, as well as the resultant knowledge construction and meanings (Vygotsky, 1978). In this view, ER in-and-of itself is not the 'source' for students' knowledge acquisition. Instead, ER is a pedagogical tool to stimulate or attenuate the social mediation process, while the relational dynamics between students and teachers determines the outcomes of knowledge construction. ER merely assists in fostering the relational dynamics between students and teachers, and enables a collaborative learning context to help students acquire conceptual knowledge, technical know-how, and transferable skills.

Premised on social constructivism, learners are not passive social agents receiving information from teachers unilaterally (Vygotsky, 1978). Their learning process is affected by their

dynamic interactions with teachers within a learning context (Wellington, 2008). ER could potentially stimulate students' and teachers' dialogic and collaborative discourses within the learning context through its highly-interactive and customizable functions, integrated into a variety of pedagogical approaches including learner-centred, experiential and collaborative learning.

ER as a pedagogical means presents opportunities for enabling a learner-centred pedagogy. The versatile pedagogical roles of ER with customized functionality could be employed to address individual student's learning needs, progress and competence level during the learning process (Grimes & Seng, 2008). With the continuous advancement in ER, more user-friendly, lower cost, and interactive ER and robotics kits will be available for use in management fields.

Experiential learning is another pedagogical approach to capitalize on ER's versatility and customized functions for developing management students' hands-on, practical skills directly related to management knowledge and competences (Tanzawa et al., 2013). For instance, ER could accommodate different students' learning progresses through all four phases of Kolb's Experiential Learning Cycle, involving 'Concrete Experience', 'Reflective Observations', 'Abstract Conceptualization' and 'Active Experimentation' (Nagchaudhuri, 2004). For example, in Japan, a robot was used in a scenario design to replicate an emergency situation (Tanzawa et al., 2013). Undergraduate students were required to handle the situation, and practice hands-on procedural tasks. This developed students' subject knowledge and efficacy in handling emergency situations, promoted positive learning behaviors and study motivation, and developed transferable skills. Positive feedback was received from students, and to avoid confusion, students were reminded of the differences between the real-world setting and the simulation-based training. Nevertheless, this example serves to stress the potential of ER as a surrogate and stimulus to engage students and enable them to acquire subject knowledge and skills through hands-on, practical training.

ER as a viable pedagogical tool in management education could also draw from the experiences in other non-engineering fields. In an ER project at a university in Italy, psychology students collaborated to design, build, programme, and test small robots using LEGO (Gabriele et al., 2012). ER served as a stimulus to engage students to create positive group ethos through the highly interactive process of collaboration. This resulted in positive study behaviours, including

improved learning efficiency, study engagement and workgroup retention. ER positively mediated group dynamics and contributed to constructing and retaining knowledge, developing cognition and mental modelling, acquiring technical know-how and competences, and developing transferable skills (Gabriele et al., 2012). This example serves to show that ER as a stimulus could help create a fun learning experience beyond the limits of engineering or science education; there is potential to apply ER in management education to facilitate learning and promote positive study behaviours.

While the above examples highlight the potential of ER within a field, ER could also be utilized for harnessing the beneficial effects of collaborative learning across fields. There is potential for applying inter-disciplinary robotics projects to facilitate management students' development of technical competences and transferable skills through collaborative learning. For example, engineering students could be invited to participate in inter-disciplinary robotics projects with management students. These inter-disciplinary robotics projects would not only provide students with hands-on experiences of robotics and an understanding of the interconnections and applications to management, but also serve as the catalyst for students to leverage expertise from outside their field of study in order to complete the projects. For instance, management students could connect their decision-making and management mindsets with engineering students' technical know-how and competences. By harnessing the benefits of collaborative learning, competences and strengths of different disciplines could be synergized while weaknesses could be coped with by having one team helped out by another team. Inter-disciplinary ER projects as a pedagogical means could help address management students' potential lack of technical competences in robotics.

Nevertheless, it is important to acknowledge some of the potential pitfalls of inter-disciplinary collaborations. For examples, students from different disciplines may separate into autonomous sub-teams responsible for their own tasks without engaging in authentic interactions, mutual support, and affective and emotional engagement at the cross-disciplinary level (Doerry et al., 2004). To address this, it is necessary to develop intellectually-challenging, meaningful and relevant inter-disciplinary ER projects, involving not only students from various disciplines, but also comprising interlocking components throughout different stages, so that students concerned

see the authentic connection of subject knowledge and robotics (Beagon et al., 2015; Doerry et al., 2004; Kibler et al., 2011). This could prevent management students from seeing these inter-disciplinary projects as a fad, but as an authentic cognitive tool to engage and stimulate project team members during the process of knowledge construction. This could also avoid management students' confusion over the learning purposes of robotics if they fail to see the connection between the holistic benefits of technical competences, management knowledge, and transferrable skills. Previous studies have suggested that the teams could benefit from well-devised inter-disciplinary ER projects for developing mutual appreciation for their respective contributions (Grimes & Seng, 2008; Kibler et al., 2011).

Overall, collaborative learning within inter-disciplinary project teams could result in a dialectical and multilateral process of knowledge construction. Inter-disciplinary ER projects present a viable pedagogical means for management education. The versatile functions of ER as a pedagogical means could facilitate dynamic interpersonal interactions between students and teachers, as well as students and other students, to stimulate collaborative learning.

4. Critical Reflection on Dual-role Model of ER

Predicated our conceptual proposition of the dual-role model of ER upon Vygotskian social constructivism (1978), it is cautioned against ER's possibilities of distracting management students from the learning outcomes or during the learning process. The distraction may be attributable to the situations that teachers fail to harness ER's potential for serving as stimuli as intended. This would result in abating, rather than promoting, the positive relational dynamics between students and teachers required to elicit the affect and hence the intertwined effects with cognition in stimulating the emotional-motivational drive and scaffolding for learning facilitation (Churcher et al., 2014).

As far as the management curriculum is concerned, it is necessary to avoid the trap of confusing ER's novel and fun features with the subject learning outcomes, like developing students into an ethical leader in management fields (Theil et al., 2018). The expedient integration of robotic knowledge into a stand-alone subject may result in fragmented approaches and dissonant course materials. Stress is laid on the importance of subject-content alignment with ER, and articulation

with the overall management programme. Reviewing and revising the management curriculum from a holistic approach to incorporate robotic knowledge by progressing from foundational technical competences in freshman year to more advanced know-how in senior year could be a possible way forward.

The indiscriminate use of ER could become a distraction, rather than utilizing it as an effective pedagogical means (Taylor & Baek, 2018). It is essential to caution against using ER for the sake of using new technology. Importance is placed to avoid the pitfall of reducing ER to a didactic, teacher-led lecture or restricting it to administrative support only. To make ER a successful pedagogical strategy, it is vital for teachers to embrace an open-minded attitude towards exploring ER's versatile and interactive functions in order to innovatively integrate it into the overall teaching tactics for learning empowerment and better achievement of learning outcomes in management education. According to Vygotskian social constructivism (1978), ER is conceptualized as stimuli for promoting students' dialogical and collaborative discourses with teachers and/or peers, where knowledge is constructed within a learning context (Churcher et al., 2014). ER for example could be potentially utilized in experiential learning by means of demonstrations, role-plays and setting different scenarios for practical training in management fields. This would facilitate students' construction of management knowledge and transferable skills. ER however is not be a panacea for ineffective teaching or poorly designed collaborative projects.

While re-conceptualizing the potential of utilizing ER innovatively in management education, it is essential to keep in mind that teachers should assume the primary roles and overall responsibilities for all aspects of programme and pedagogical design. Incorporating computer technologies into management studies will become the prevalent trend (Frude & Jandric, 2015), ER's role however could only be supplementary and not be seen as replacement to human teachers. Teachers themselves would be the one responsible for how ER is integrate into supplementing the overall teaching and complementing students' learning.

5. Conclusion

This conceptual paper explored different viable approaches to integrating ER into management education. It connected Vygotsky's social constructivism to the use of ER in pedagogy, and presented a number of arguments and examples for the dual roles of ER as a pedagogical means and learning outcome in management education. ER also presents a number of opportunities for facilitating learner-centred, experiential, and collaborative pedagogical approaches to address different learning needs and knowledge levels. This paper however cautions against the perceiving ER as the 'core' focus of learning. It is necessary to avoid falling into the trap of confusing the use of ER with the purpose of ER. ER should not be thought of as a panacea for unsound teaching methods, but be conceptualized as a tool that could be integrated into a holistic pedagogical strategy for the benefits of students' learning and development. With the advancement of computer technologies, ER would become an effective pedagogical aid, but could not be a substitute for human teachers.

There are several limitations and areas of future research. Considering that this paper focused on the co-construction of knowledge between teachers and students by means of using ER as stimuli, it did not explore the possibilities of using ER in stimulating student's self-exploration during the learning process. Students could construct their own understandings of the cognitive and social worlds through the use of ER in the process of assimilation and accommodation, as well as develop their intellectual and problem-solving capacities through self-exploration of real-world situations. This paper did not address the feasibility of ER's pedagogical applications in these areas. Future researchers are recommended to conduct empirical studies to investigate these opportunities and obstacles, as well as the benefits and drawbacks of applying ER in a broad spectrum of management education. This will uncover potential opportunities for teachers, researchers and administrators to harness ER for the benefits of enhancing teaching and learning experiences for students.

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