PRELIMINARY SURVEY OF EDUCATIONAL SIMULATIONS TOWARDS EDUCATIONAL CONTEXT

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Abstract

In accordance with the rapid technological emergence, new educational methods have been implemented such as simulations, educational games (serious game), virtual reality, intelligent tutoring systems, flipped and blended learning, telepresence, cloud computing and so forth. These new era of learning tools are most beneficial to educational process especially in teaching and learning process, class management, teaching practice, personal and specific skills development, administration and others. Educational simulations are one of the most debatable, yet still have brought major impacts towards educational field. The main objective is to study on the implementation of mostly applied educational simulations specifically in higher education and teaching practice. The considerations are on the characteristics, strengths and drawbacks along with special features of each. Findings indicate that educational simulations are worth to be integrated; leading to positive effect on motivation, ease understanding, decrease digital gap, as well as enhance communication, collaboration, practical and professional skills development. Future recommendations highlight on a more complicated real-life scenarios, more additional intelligent avatars, import additional features, expand the graphical user interface, create a database for future references of user's actions and automatic update to increase the level of difficulty.

Keywords: Educational simulations, higher learning, teaching practice

1.0 INTRODUCTION

It is undeniable that both technology and education are relatively connected each other in order to enhance the performance of educational process [1]. The relation between education and technology is defined as technology education or familiarly referred as educational technology. It represents the study of technological sectors that contribute to solve the human problems through the manipulation of deep knowledge about technology fields and the role of technology in educational process to enhance and develop its methods respectively [2].

The utilization is mainly to solve many problems occurred within the traditional classroom instruction that likely has its own strengths and drawbacks. The arguments are focused on the limitation of real-world learning experiences inclusion in the traditional classroom setting [3], the disconnection between content presented in the classroom from the real world context [4], the conversion of classroom knowledge which is strictly stacked or stitched to the classroom or school context only despite the context in which the knowledge was created [5]. Thus, this has negatively impact the learning process, adversely influencing learner motivation in particular. Educational technology highlights on overcoming problems especially in the literacy skills such as thinking, listening, speaking, writing, and reading yet also the sensory problems as for blind students or visually impaired [6]. There are also significant connection between writing skills and other problems such as grammer, syntax, spelling, and punctuating.

Radio technology was the pioneer of educational technology which later being upgraded with audio visual telecommunication such as television and being replaced by remoteness education when networks are widely used. Interactive multimedia emerges from the advances of multimedia technology. Internet and World Wide Web are common terms being used every day and information is just a click away. Virtual learning environment, virtual reality, simulation and educational simulation (ES), educational game (serious game), blended and flipped learning, telepresence, cloud computing and so forth are part of educational technology emergence. These evolutions contribute widely to facilitate the process of farness education, ease the educational materials execution anytime and anywhere, and increase knowledge.

Due to the complicatedness of other tools, the consideration is backward to simulations. Simulations as learning environment have a long history of implementation both in education and training, and have gain popularity in creating realistic digital environments that closely imitate real life situations [7]. Tremendous growth of technology and advances in virtual reality, visualization, haptic technologies and simulation engines have evolved some of the popular

simulation games such as the Sim series comprises of SimEarth, SimCity, and the Sims [7]. Simulation also assist in gaining understanding on the impact of classroom discourse on student learning by analyzing research data on how exemplar teachers facilitate learning and behavior management within classroom settings, especially during the teaching of reading, writing and spelling [8].

This paper highlights on a preliminary survey from multiple resources regarding to the characteristics, strengths and drawbacks, including special features of education simulations towards educational context especially for higher education and teaching practice. The remainder of this paper is organized as follows. In section 2, types and main objectives of ES are presented generally. Real applications of ES are briefly discussed in Section 3 comprises of mostly-applied ES within educational context. Section 4 concludes this paper.

2.0 BACKGROUND

As an indispensable problem-solving methodology for the solution of many real-world problems, instructional simulation or educational oriented simulation or generally referred as ES have been one of the gaining attention approaches to overcome these problems. Since ES is classified as somewhat like training simulation, it is typically come in one of these three categories namely (1) **live simulation** where real people use simulated or dummy equipment in the real world, (2) **virtual simulation** where real people use simulated equipments in a simulated world, or virtual environment and (3) **constructive simulation** where simulated people use simulated equipment in a simulated environment. Both existing and conceptual systems can be modeled with ES.

The key features of an ES is the representation of a model to represent a process, event or phenomena that has some learning significance towards its' learners [7]. This technology represents a powerful set of tools that can change the way instructional designers create experiences as well as the way instructors facilitate those experiences [9]. The implementation of real world learning situated in real world contexts also leads to positive impacts on learning and learner motivation [3]. Effective simulations, foremost, have to be accurate to the real world which clearly defined learning objectives.

It is also one of the technological approaches available to education to facilitate the building of skills such as critical thinking. Simulations development and of the even more innovative serious game is a very useful and realistic way of dealing with the expectations and needs that students face in current progressive societies. According to [10], there are four (4) general objectives of ES as summarized in Table 1as follows.

As stated by [4], ES is directed by an internal model of real world system of phenomena in which some elements have been simplified or omitted due to facilitate learning. There are mainly three general types of models in which ES are built namely continuous, discrete and logical [4].

Table 1 The summarization of ES general objectives

To teach students how to learn The published body of knowledge can be accessed, thus students do not accept things "as they are".	**To think creatively** The determination of choices (what-if approaches require thought as to what the "what" are) and the estimation of problem scale and benefits and the general desirability of proceeding (model size should be determined by parsimonious necessity not potential contract increases) can be achieved – use or create models that spark debate.
To problem solve The requirement of abandonment of the model – develop an understanding towards the complexity of the problems.	**To be professional** The need to understand something of ethics and morality – recognizes biases and prejudices in oneself and others.

Types of Models	Description	Fields
Continuous models	Constructed using calculus as the representation of system with infinite number of states.	▪ Scientific simulations. ▪ Engineering simulations.
Discrete models	Employs statistics and queuing theory as the representation of systems with quantitatively discrete states.	▪ Scientific simulations. ▪ Engineering simulations.
Logical models	Constructed using a set of heuristic implemented through a high-level computer programming language.	▪ ES

Table 2 The summarization of ES general types of model

3.0 REAL APPLICATIONS

ES learning is based on a simple premise where "it is only effective full-cycle". The cycle starts with an initial understanding, moves towards testing the knowledge and ends at building a more refined understanding [11].

The discussion of ES is mainly based on these four categorization namely (1) physical simulations, (2) iterative simulations, (3) procedural simulations and (4) situational simulations.

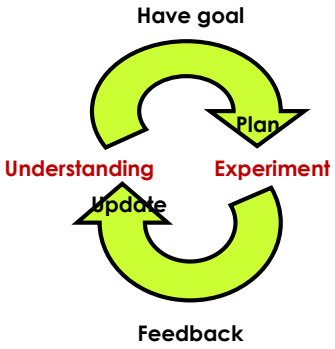

Figure 1 Full-cycle learning of ES

Applications	Features	Advantages
simSchool  **Figure 2 Snapshot of simSchool Modules**	▪ simSchool is a classroom simulation, targeted for pre and in-service teachers which acts as a platform that enables transformational experiences. ▪ simSchool supports the rapid accumulation of a teacher's experience in: - analyzing student differences, - adapting instruction to individual learner needs, - gathering data about the impacts of instruction, - seeing the results of their teaching ▪ simSchool generalizes real-time reports - present a to-the-minute snapshot of how instruction and communication selection impact the performance and emotions of diverse learners.  **Figure 3 Snapshot of simSchool Analysis**	▪ Enhances/improves the general teaching skills – ability to make a difference in a child's life. ▪ Explores instructional strategies to suit diverse learning styles and behaviours. ▪ Examines classroom management techniques – increases task design, implementation and confidence level of technology integration. ▪ Practises building relationships with students inclusion of special needs students. ▪ Boosts up significant positive impact on the mastery of deeper learning capacities that consists of the readiness to teach. ▪ Improves "staying power" on the path to the field of teaching acquired through rapid development of strong self-efficacy and resilience. ▪ Enhances analyzing skills through student information and data. ▪ Allows freedom to its users - can create any type of learners, task, classroom, or module based on their own selections (model over one (1) billion learner profiles on demand).  **Figure 4** Snapshot of simSchool Criteria Selection ▪ Capability to share to the Open Library or visit the Library and use items created by other members of the community in a real time manner.  **Figure 5** Snapshot of simSchool Sharing Capability

simAULA	▪ simAULA is an open source virtual practicum medium guided by European Lifelong Learning Programme. ▪ simAULA acts as an initial and lifelong teacher training comprises of a realistic, 3 dimensional (3D), simulated world mimicking an authentic school context as closely as possible. ▪ Avatar is the core elements of simAULA (teachers' and students' avatars). ▪ Main features of simAULA: - customizing learning scenarios. - reducing the need for physical presence in classrooms. - interoperability with other virtual training systems. - introducing different types of teaching content and goals. - increasing the complexity of behaviour, the student model and so forth. - new teaching strategies with the enhancement of artificial intelligence. - multiplayer mode, collaborative platform, exchange of best practises.	▪ Offers an environment for acquisition of role models supporting the value transmission in the classroom. ▪ Enhances skills by practising in various learning contexts, while avoiding the consequences of making inappropriate decisions that can lead in a physical environment. ▪ Experiments on various approaches for the formation of values. ▪ Facilitates the development of skills in future teachers: - provides an appropriate selection of educational content and good examples of core human values. - presents the design of the physical parameters of the classroom environment and providing students with different choices – bearers of different values. - provides wide selection of behavioural role models through personal examples and role models by the teachers. - enhances students' communication skills through mediation of students' communication by the selection of appropriate learning activities and also collaborative work. - provides the reflection of the sequence and consistency of the selections of the teaching and learning elements, as well as the success or failure evaluation of these selections through the virtual environment.
simCity	▪ simCity is a computer-based real life simulation game within virtual learning environment [12] that postulates social skills development.	▪ Enhances collaborative communication between students to discuss assignments, suggest solutions and find results. ▪ Identifies objectives and fulfilling them by building and planning skills through the creation of students' own city in virtual reality [13]. ▪ Manipulates cognitive thinking by experiencing new objects and methods by using the students' physical behaviours [1].
Second Life	▪ Second Life is a 3D virtual learning software that provides self-learning capabilities, develops critical thinking skills and enhances self-motivation.	▪ Reaches online courses that facilitates the online learning process through enjoyable experiences [14]. ▪ Promotes cooperation among students to investigate the problem, acquiring the required data and suggesting solutions. ▪ Stimulates learners' imagination and learning strategies under the supervision of teachers [1].
Serious Game  **Figure 6 Snapshot of SG Module [18]**	▪ Serious Game is an educational game basis/concept using a mental contest in accordance with specific rules and uses avatars to replace interactive representation of human figure (human characteristics including speech and facial expressions). ▪ It promotes diversity of scenarios, the competition elements that some of the scenarios offer, the rapid feedback capability, as well as the integration of rich multimedia learning environment recreated in the context of the game [15]. ▪ Example: The Roma Nova Project, The Racing Academy, Quest Atlantis (QA), and US-Nexus.  **Figure 7 Snapshot of Serious Game Operational Process**	▪ Easy to use - the dialogues used are very informative, easy to read and to select. ▪ Guides learners to focus on key aspects of the learning context - unintentionally difficult experiences such as designing and simulating. ▪ Individualization of learning experience based on the needs of each learner which lead to promoting social interactive learning and active engagement (becoming co-author of the learning content with the learning process [15]. ▪ Develops specific, practical and professional skills in the process of participation in various learning environments and situations displayed in the simulation [19]. ▪ Provokes learners' cognitive thinking and emotional activity - through discussion, evaluation, and problem solving which enhance the students' attitudes [1]. ▪ Enhances learners' professional and personal development in consistent way to suit the modern information society demands [15]. ▪ Big impact in self-motivation and personification, hence making them as a good tool for learning [16]. ▪ Increases the readiness to enter the classroom and also stimulate their development due to the explosion of much greater variety of situations compared to regular face-to-face internship [17].

Virtual Practicum	• Virtual classroom acts as a classroom simulation which involves three main elements namely teacher, students and classroom environment. ▪ It is an alternative to experience the real class environment, class monitoring and assessment and handle all the obstacles and possibilities roused between it.	▪ Supports professional developmental skills and competencies. ▪ Promotes the ability to create supportive learning environment and implement collaborative work in classroom. ▪ Allows repetition in various simulated settings. - supplements and further develop interns' knowledge and skills [1]. - personal and professional knowledge and qualities development – teaching and learning process and techniques, awareness of the existing varieties of techniques, approaches, and strategies aiming to support learners. - enriches interns' knowledge about the school regulations and professional requirements. - enhances further learning on the knowledge of content, lesson planning procedures and curriculum development requirements. - readiness of teacher-student connection in general. - content and technology readiness and terminological mastery. - identify pupils' achievements and problems and ways to support them.
Classroom Simulation	▪ Classroom simulation is an important feature of virtual learning environment that reflects the process of internal form of conventional classroom to imitate the real life scenarios. ▪ It is based on three major domains namely coaching, scaffolding, and feedback [1].	▪ Depends mainly on the settings of traditional classroom such as solving problems, hypothesis testing, and models development [1]. ▪ Promotes practical experiences for students by testing hypothesis and finding their results by themselves [1]. ▪ Enhances the development of professional knowledge, skills, and competencies. ▪ Increases the ability to supplement and further develop interns' knowledge acquired in the conventional face-to-face settings [1].
Diagnosis Simulation	▪ Diagnosis simulation falls under procedural simulations which mainly targeted for medical students, physicians, nurses, and paramedics. ▪ It is an avatar based clinical case simulations – to make medicine fun. ▪ Example: Patient diagnosis simulations, task training simulation, manikin-based simulation, standardized patient simulation, virtual reality simulation.	▪ The learner is presented with a problem to solve. ▪ Performs various diagnostic studies – allows repetitions, thus reducing mistakes. ▪ Manages patient history and performance. ▪ Well secured compared to real diagnosis.
Virtual Lab/ Laboratory Simulation	▪ Virtual lab/laboratory simulation also falls under procedural simulations. ▪ Example: BioLab Frog, A.D.A.M Interactive Anatomy	▪ Contains simulated physical objects to meet procedural requirements. ▪ Allows engagement in the procedure.

4.0 CONCLUSION

Learning in simulated environments have lead to a positive effect on motivation in the learning process, as well as on the development of practical and professional skills. It is important to select it correctly, understand "why", explore possibilities, diagnose problems, identify constraints, develop understanding, build consensus, and prepare to any changes.

With or without critics or debates, ES has somewhat aids in teaching and learning process, improves motivation and acquired skills, eases understanding towards learning content, decreases the digital gap and enhances communication and collaboration amongst learners. The best part is ES can postulates hidden, creative and continuous learning skills where learners can freely think out of the box, beyond their imagination. ES is basically intended to present simulation as being part of a larger field concerning techniques relevant to decision making as part of other courses ranging from operational research to management science. Indeed, it is good to bear in mind that ES is not an isolated discipline and have strong links to other fields that providing a look into the future.

Future recommendations have been suggested which include a more complicated real-life scenarios, more additional student avatars with different artificial intelligence for each one, import additional features for each student such as psychological profiles and confidence, expand the graphical user interface of the game to include face avatars and information selection, create a database for future references of user's actions and automatic update to increase the level of difficulty.

The formation of groups such as the Immersive Education Initiative are working together to define and develop open standards, best practices, platforms, and communities of support for virtual reality, game-based learning and training systems. In addition, the tremendous growth of technology in computer advancement, visualization, and haptic technologies also lead to rapid development of

computer-based simulation for training and education.

Acknowledgement

We are grateful for the SLAB/SLAI scholarship to Author 1.

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