1. DEFINITION

Integration of technology refers to the strategic use of online resources to enhance a simulation's ability to meet its learning objectives. Technology can help make simulations more realistic, more interactive, and help to overcome spatial or temporal constraints (Jones, 2015).

2. BEST PRACTICES

a. Instructors should carefully consider which type of simulation is most appropriate given their learning objectives. Options include the traditional in-person approach (i.e. face-to-face), computer-based approaches (i.e. online or virtual), or a blended approach (i.e. a combination of face-to-face and virtual activities). In each case, the instructor should evaluate whether and how a given technology can deepen or enhance student engagement or learning.

   1. **In-person Simulations.** This remains the most conventional approach a traditional face-to-face university course. Integrating technology can help to create more realistic and convincing scenarios. Technology can also aid training on complex and critical problems, better error management and error prevention, and provide additional scope of repetitive practice for risky or sophisticated procedures (Jones, 2015). For example, patient simulators used in medical education can reproduce all the classic components of a disease, which student's may not be able to experience otherwise.

   2. **Computer-based Simulations.** An online approach is useful for overcoming spatial or temporal boundaries, or for teaching topics that are less tangible like molecular reactions or astrophysics (Moore et al., 2014). In a social science classroom, online technologies can be useful for replicating the dynamism of real-world political processes (Gehlbach et al., 2008).

   3. **Blended Simulations.** A blended learning approach can be useful for extending or enhancing an in-class simulation beyond the physical limits of the classroom. Online tools have been used to recreate the frenetic and nuanced character of international negotiations (Schnurr et al., 2015). An additional benefit of pairing online interactions alongside in-person ones is that they open up alternative venues for participation, which can help overcome gendered, cultural or linguistic barriers that tend to exclude certain students within face-to-face interactions (Schnurr et al., 2013).

b. **Social Media.** Students are digitally connected and active on multiple emerging forms of technology and media from an early age (Selwyn, 2012). Social media platforms are becoming powerful tools that can be integrated into simulation to enhance student

learning by offering communication tools that students are already familiar with and offering the possibility of continuous feedback (Everson et al., 2013). Social media can also help instructor's replicate real-world scenarios. For example, disaster management simulations have used Twitter and SMS to help students learn how to gather and process information during a crisis (Anderson et al., 2014)

3. DISCIPLINES

Health Sciences

A combination of different high-fidelity and low-fidelity simulators are used for teaching technical and non-technical skills to healthcare professionals. Khan et al. (2012) describes the use of such multimodal simulation programs for the training of urologists. Virtual reality simulators, robotic simulators and bench-top synthetic models are used for the training of technical skills of surgery, where the trainees had the scope of practicing surgery repetitively on the simulators. Interactive human patient mannequins are used to run different scenarios to train urologists on non-technical skills (decision-making, communication and team-working skills).

Social Sciences

Technology can aid to run simulations which require a longer time frame, and continuous connectivity among the participants. Gehlbach et al. (2008) introduces a five-week long web-based simulation where the students negotiated treaties on current world issues. During the simulation, students interacted through synchronous ''live chat'' conferences and through asynchronous email correspondences. SIMCON, a simulation controller, moderated all the communications, monitored the civility of the student interactions and ensured that no premature agreements were made.

Natural Sciences

Computer-based simulations in chemistry courses allow students to explore complex chemical phenomena, visualize particles at molecular level, perform chemical experiments in a virtual chemistry lab, and troubleshoot with complex chemical processes. Moore et al. (2014), examines the use of PhET, an interactive computer-based simulation for teaching molecule polarity. PhET allowed students play around with atomic structures to learn about molecule polarity and geometry. A guided inquiry activity in PhET was shown to increase active participation and interactive discussion.

4. RESOURCES

Anderson, B., Swenson, R., & Kinsella, J. (2014). Responding in Real Time: Creating a Social Media Crisis Simulator for the Classroom. *Communication Teacher, 28*(2), 85-95.

Everson, M., Gundlach, E. & Miller, J. (2013). Social media and the introductory statistics course. *Computers in human behaviour*, *29*, 69-81.

Gehlbach, H., Brown, S.W., Ioannou, A., Boyer, M.A., Hudson, N., Niv-Solomon, A., Maneggia, D., Janik, L. (2008). Increasing interest in social studies: Social perspective taking and self-efficacy in stimulating simulations. *Contemporary Educational Psychology, 33*, 894–914.

Jones, F., Passos-Neto, C.E, Braghiroli, O. F.M. (2015). Simulation in medical education: Brief history and methodology. *Principles and Practice of Clinical Research, 2(1),* 56-63.

Khan, M. S., Ahmed, K., Gavazzi, A., Rishma, G., Thomas, L., Poulsen, J., Ahmed, M., Jaye, P., & Dasgupta, P. (2012). Development and implementation of centralized simulation training: evaluation of feasibility, acceptability and construct validity. *BJU International, 11,* 518–523.

Moore, E. B. Moore, Julia M. Chamberlain, J.M., Parson, R., and Perkins, K.K. (2014). PhET Interactive Simulations: Transformative Tools for Teaching Chemistry. *Journal of Chemical Education, 91*, 1191−1197.

Schnurr, M., Santo, E., & Craig, R. (2013). Using a Blended Learning Approach to Simulate the Negotiation of a Multilateral Environmental Agreement. *International Studies Perspectives, 14*(2), 109-120.

Schnurr, M.A., De Santo, E.M., Green, A.D., & Taylor, A. (2015). Investigating Student Perceptions of Knowledge Acquisition within a Role-Play Simulation of the Convention on Biological Diversity. *Journal of Geography*, *114*(3), 94-107.

Selwyn, N. (2012). Social media in higher education. The Europa world of learning.