Use of simulation technology in teaching nursing clinical skills

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Abstract: Nursing education has evolved from being descriptive and more conventional to using state-of-the-art equipment such as simulators and/or computer software. Educational institutions invest in costly technology in order to prepare students for clinical practice while not worrying for patient's safety and confidentiality. On the other hand, educators need to be able not only to use modern technology, but also to prepare appropriate and active learning courses transforming students from passive receptors of knowledge to critical thinkers who can apply their theoretical knowledge in the actual clinical or community setting. The goal of high-fidelity technologies integration into education is to achieve high level and cost-effective care and ultimate patient outcomes.

Keywords: education; nursing; simulation.

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1 Introduction

Nowadays, a lot of educational institutions invest in simulation technology for providing state-of-the-art teaching. According to Merriam-Webster's Dictionary (2018), simulation is defined as "the imitative representation of the functioning of one system or process by means of the functioning of another." Another definition of the word, also included in the same dictionary, states that simulation is the "examination of a problem often not subject to direct experimentation by means of simulating device."

The first use of the simulation process has been recorded to be in World War II during pilot training (Ward-Smith, 2008). The process is still used to train pilots in very sophisticated simulators using scenarios of poor weather conditions, loss of power and engine failures aiming at achieving higher safety both for commercial and military flights. Furthermore, the aviation industry is using flight simulators to imitate exact weather and flight conditions after plane accidents to determine the reasons and to try to prevent other accidents. Another major user of such technologies is the motor industry. Car manufacturers and research institutes are using simulation in order to set standards for passenger safety, testing seatbelts and car breaks, as well as the whole car's response to various weather conditions or coalition situations.

In everyday life, simulation is a very popular form of entertainment since the first video games, in the mid-1980s, were released. They were designed to simulate real-world activities, such as farming, driving, doing a sport or business, planning strategies and military operations (Wolf and Baer, 2001). Modern simulation games are using sophisticated and high-fidelity graphics that are very life-like. In addition, virtual reality equipment can be connected to home cinemas, TVs or computers giving the player the ability to be a part of the game.

As science and technology progressed, simulation has been adopted by education as sophisticated and innovative learning and teaching approach, as well as an assessment practice (Edgecombe et al., 2013; Zendejas et al., 2013). In healthcare education, in particular, the USA Institute of Medicine, in 2004, has adapted simulation as a pedagogical method and proposed the use of it by healthcare schools (Sanford, 2010). The use of sophisticated advanced technological devices, such as simulator rooms and/or computerised mannequins that perform human functions realistically, are allowing students, as well as professionals that want to update their knowledge, to practice skills and interventions in a more 'artificial' and less threatening environment of a lab to provide accurate and safe care to patients/clients (Sanford, 2010; Arthur et al., 2012). With simulation real situations can be mirrored, anticipated or amplified with guided experiences in a completely interactive way. Within this context "simulation is a technique to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion" (Gaba, 2007). Simulation can be of high or low cost, depending on the technology, fidelity, and methods used (Maloney and Haines, 2016). During the simulation process professional actors or mannequins can be used in live or 'virtual' environments presenting any signs, symptoms, and feelings an actual patient would feel (Maloney and Haines, 2016).

In Greece, mainly due to financial constraints and reduced budgets, the majority of nursing schools are not fully equipped with high-fidelity simulation technology. Clinical skills are practiced mainly on models or mannequins with the use of clinical scenarios and care plans and afterward in the actual clinical environment. Having that in mind, the

present review is the first part of a research study on the impact and effectiveness of high-fidelity simulation technology into nursing education and clinical skill teaching.

A literature review was conducted in the last five year's publications in PubMed and CINAHL, in order to find studies on the use and effectiveness of simulation in nursing education and the impact on student learning. Keywords used in the search were *nursing education and simulation*, *clinical skill teaching and simulation*, *learning in clinical environment*, *undergraduate nursing studies and simulation*. More than 300 papers were found and from those 100 matched the search criteria.

2 Nursing education and simulation technology

Nursing teaching process within nursing curricula integrates theoretical knowledge and practical skills aiming at preparing students to develop their problem-solving skills and implement them in real-time situations during their clinical placement and/or their career (Norman, 2012).

Organised nursing education has started with classroom lectures by an experienced nurse, teaching, mainly empirically, nursing interventions and implementing them directly to patients/clients. It proceeded to more theoretical courses but still, procedural skills had to be learned with the use of learning equipment such as oranges to practice intramuscular and subcutaneous injections. Life-size mannequins and task trainers (part or region of the body) were introduced in nursing education in the early 1910s, in the USA and Canada, and became more popular worldwide in the 1950s (Hyland and Hawking, 2009). The outer layer became more sophisticated, but it was still rubber and gave no actual human skin feeling making difficult for students to visualise this dummy model as a real person with health problems (Issenberg et al., 2001; Seropian et al., 2004; Medley and Horne, 2005).

Since the late 1990s and the early 2000s, various simulation educational methods, useful pedagogical approaches, were used according to education level and learning outcomes without compromising the patient's safety or well-being (Toserud et al., 2013; Kim et al., 2016). Up-to-date nursing education uses devices, equipment and computer software specially designed to imitate patient's signs, symptoms and reactions looking like life-sized human mannequins but with extremely realistic anatomical structure and high response fidelity (Issenberg et al., 2005; Kiernan, 2018). The 'patient' can have a pulse and heartbeat, signs of bleeding or fluid overload and the healthcare student can perform auscultation of heart, lung and bowel sounds. Low-fidelity basic simulators, such as wound sites, model 'arm' for practicing IV insertion, Foley insertion pelvic models, are also used in a lot of training settings (Hyland and Hawkins, 2009; Sanford, 2010). Furthermore, lifelike virtual clinical environments (emergency room, operating theatre, hospital ward and community settings) and/or emergency situations are used to help nursing students to develop a variety of skills that are going to be needed during their career (Moule et al., 2008; MacLean et al., 2018). In addition, with the use of computers students can develop not only clinical skills, but also procedures that are used in everyday clinical practice like patient handoffs, phone assessment and provision of guidelines or teaching self-management to a patient aiming at improving patients' outcomes (Kraft et al., 2013; Kiernan, 2018).

An in-depth literature review by Paige and Morin (2013) described simulation as a matrix of three dimensions: physical, psychological and conceptual. Physical dimension is associated with equipment (mannequin technology) and environment (appearance and layout of the simulated setting). Psychological dimension is about students' perceptions about the believable representation and authenticity of the experience of caring for a 'real' patient. The conceptual dimension refers to the way that theoretical knowledge is connected to the clinical situation encountered during the simulation process.

In the evolving of nursing education, members of the faculty are teaching students to become critical thinkers who can apply their evidence-based theoretical knowledge and clinical skills in complex healthcare situations (Decker et al., 2008; Welman and Spies, 2016). A US national survey (Clapper and Kardong-Edgren, 2012) has demonstrated that 69% of nursing teachers' time is consumed by observing students demonstrating clinical skills. Worldwide, and in Greece in particular, patients' shorter hospitalisation days, larger student numbers and faculty shortage, due to financial cut-outs in universities' budgets, have led to fewer clinical practice hours than a decade ago. Because of the situation described, students are not able to have the appropriate supervised clinical experience (Rhodes and Curran, 2005; Missen et al., 2016). On the other hand, patient numbers are increasing, diseases become chronic and more complex as the world's population is aging, making the demand for better-prepared healthcare students urgent (Nestel and Kneebone, 2010). A solution to the problem could be the use of simulation during graduate studies where faculty can teach and evaluate student clinical skills and then students could have clinical practice without the need for intense supervision by their teachers (McCormick et al., 2010; Nestel and Kneebone, 2010). Alas, only two nursing schools out of nine Greek universities and applied universities have the privilege to have high-fidelity equipment/mannequins and none a simulation classroom or environment.

3 Advantages and disadvantages of simulation as an educational strategy

Training healthcare professionals with simulation, according to DeVita (2009), should be the main educational strategy as it is "measurable, focused, reproducible, mass producible and very memorable." As a teaching process, simulation offers a means through which students participate in clinical decision-making and provision of care in a manner not encouraged by merely reading textbooks or listening to lectures. It includes first self-study or classroom lecture, secondly the simulation session and finally an evaluation session. In the last phase of simulation teaching, evaluation, students review their performance and discuss the theoretical framework that was applied into the nursing practice scenario (Fowler Durham and Alden, 2008). The most important part of the whole process is the feedback that the instructor/teacher is giving at the end of the evaluation session.

Scholars have been looking into the use of sophisticated technology combined with traditional ways of teaching nursing science and skills. In the mid-1990s, the beginning of the high-fidelity simulation, Fletcher (1995) argued about its positive effects: realistic clinical settings, no threat to the patient, active learning, errors that could be corrected and discussed, and consistent experience offered to all the students. In other words,

simulation is a mixture of technical and non-technical experiences and skills that are offered to all students (Medley and Horne, 2005; Nestel and Kneebone, 2010).

Since the beginning of the 2010s, it is well established that the advantages of simulation-based education include the ability to repeat the nursing skills taught, to provide feedback, to adjust the difficulty level, to individualise learning, to improve communication skills and collaboration and enhance self-efficacy (Kim and Choi, 2011; Cook et al., 2011; Kim et al., 2011; Norman, 2012; Kraft et al., 2013). Furthermore, students have been found to be more active in the classroom, more satisfied by their ability to implement knowledge into practice, keener to the learning process and faster learners than those who were trained with traditional education practices (Garrett et al., 2010; Norman, 2012; Shin et al., 2015). Kim et al. (2016) argue that simulation-based nursing education has a positive educational effect, especially in students' psychomotor domain.

In addition, as it has been documented that nursing students and new graduate nurses with less than a year of clinical experience are involved in 49%–53% of patient falls, medication administration errors and failure-to-rescue incidents simulation training can prevent these situations (Saintsing et al., 2011; Beroz and Hallmark, 2017; Kenward and Zhong, 2006). Repetitive supervised practice with critique and feedback from faculty embedded into virtual reality simulator helps students to become more competent in clinical skills and enhance their performance (Oermann et al., 2011; Chiniara et al., 2013).

On the other hand, it could be argued that technology has an uneven effect on teachers and students, based on their familiarity, comfort, and expertise with technology, and their intent of how to use technology. It is well established that every new generation can understand and use technology better than the previous one (Canas-Bajo et al., 2016). So, it not uncommon that nursing students can use sophisticated devices easier and more efficient than faculty members. McKnight et al. (2016) stated that current learners expect their faculty to use technology in education and to incorporate the modern technologies needed for their profession. In addition to that, science textbooks tend to be outdated by the time they reach students and the combined use of other resources can provide richer and more useful information (McKnight et al., 2016).

In order to keep up with training needs and trends in education, a lot of nursing schools have purchased extremely costly interactive computerised models and/or setup simulation training classrooms. However, it is not uncommon that the teaching process is still unchanged, and the equipment misused or underused mainly due to faculty's difficulty in dealing with such equipment and the resistance to change (Medley and Horne, 2005). In addition, this enormous emphasis on having state-of-the-art equipment and surroundings, might negatively affect the learning outcomes (Dieckmann et al., 2009), as students could be more interested and keen on practicing in the safety of the simulation lab than in actual clinical settings.

With more innovation in nursing education, and with appropriately trained personnel, knowledge and skills offered to reach a higher level aiming at providing a better quality of care for patients/clients. Nurse educators through simulation technology, as well as other new teaching procedures, can bring transformational leadership to the profession and achieve the goal of a high level and cost-effective care and ultimate patient outcomes.

4 Conclusions

Today, simulation technology is more mainstream than ever; but is it worth the financial cost? In our opinion, it is a value for money investment. Learners can have up-to-date scientific knowledge and clinical skills, interprofessional collaboration with fewer educators, in a safe, but also accurate, clinical and/or community environment where confidentiality and safety concerns cannot interfere with the teaching process.

For nursing students, and other healthcare professionals, to be clinically competent and confident it is required of them to spent adequate time practicing in the lab and get sufficient feedback on techniques and performance. Simulation training can enhance a student's confidence, critical thinking, knowledge, and skills leading to the creation of a better healthcare professional.

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