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REVIEW PAPER

High-Fidelity Simulation in the Nursing Degree: gains perceived by students

Simulação de Alta-Fidelidade no Curso de Enfermagem: ganhos percebidos pelos estudantes

Simulación de alta fidelidad en la carrera de enfermería: beneficios percibidos por los estudiantes

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Abstract

Nursing is facing a new reality with the inclusion of new strategies in the teaching/learning process. With high-fidelity simulation, the student acquires skills in a controlled and risk-free environment.
A systematic literature review was conducted from December 2010 to February 2011 to identify the best scientific evidence on the gains perceived by the Nursing students in relation to high-fidelity simulation practice using specific inclusion criteria, descriptors and databases. Nine papers of high methodological quality were selected, which had been published between 2005 and 2011. The following themes emerged: satisfaction, learning and motivation, realism, self-confidence, technical skills, reflection on action, and transfer of skills. High-fidelity simulation is valued by students for increasing their cognitive and psychomotor perception of the clinical reality that awaits them and raises a lot of apprehension.

Keywords: patient simulation; teaching; nursing student; nursing education.

Resumo

A enfermagem está a vivenciar uma nova realidade com a inclusão de novas estratégias no seu processo de ensino/aprendizagem. Com a simulação de alta-fidelidade o estudante adquire competência num ambiente controlado e isento de riscos.
Com o objetivo de identificar a melhor evidência científica sobre os ganhos percebidos pelos estudantes de Enfermagem, em relação à prática com simuladores de alta-fidelidade, foi realizada uma pesquisa sistematizada da literatura desde dezembro de 2010 a fevereiro de 2011, com critérios de inclusão, descritores e bases de dados definidas. Foram selecionados 9 artigos de alta qualidade metodológica, publicados entre 2005 e 2011, dos quais emergiram os temas: satisfação; aprendizagem e sua motivação; realismo; autoconfiança; habilidades técnicas; reflexão sobre a ação e transferência de competências. A simulação de alta-fidelidade é valorizada pelos estudantes por aumentar a sua percepção cognitiva e psicomotora para a realidade de prática clínica que os espera e que lhes suscita muita apreensão.

Palavras-chave: simulação de paciente; ensino; estudante de enfermagem; educação em enfermagem.

Resumen

La enfermería vive una nueva realidad, con la inclusión de nuevas estrategias en el proceso de enseñanza/aprendizaje. Con la simulación de alta fidelidad, el estudiante adquiere competencias en un entorno controlado y sin riesgos. Con el objetivo de identificar la mejor evidencia científica sobre los beneficios percibidos por los estudiantes de Enfermería, en relación con la práctica simulada con simuladores de alta fidelidad, se realizó una revisión sistemática de la literatura desde diciembre de 2010 hasta febrero de 2011, con los criterios de inclusión, descriptores y bases de datos definidos. Se seleccionaron nueve artículos de alta calidad metodológica, publicados entre 2005 y 2011, de los cuales surgieron los temas: la satisfacción, el aprendizaje y la motivación, el realismo, la confianza en sí mismos, las habilidades técnicas, la reflexión sobre la acción y la transferencia de competencias. La simulación de alta fidelidad es valorada por los estudiantes porque aumenta su percepción cognitiva y psicomotriz sobre la realidad de la práctica clínica que les espera y que les preocupa mucho.

Palabras clave: simulación de paciente; enseñanza; estudiante de enfermeira; educación en enfermería.

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Introduction

Nursing has a long history using simulation as an important teaching/learning strategy for acquiring skills and preparing students for professional practice (Sanford, 2010). However, as a result of the evolution of science and technology itself, other resources have been developed to meet the growing demands of today's society, both in terms of the innovation in teaching processes and the needs for enhancing students' mandatory skills. Therefore, more pressure was put on nursing schools and their faculty to produce more and better prepared professionals (Leigh, 2008).

Nowadays, we aim at placing the student at the centre of learning, which makes traditional teaching methods less appropriate (Hawkins, Todd, & Manz, 2008).

Within health in general and Nursing in particular, the use of High-Fidelity Simulation (HFS) has increased exponentially. Several Nursing schools have gradually adopted this new teaching method as an integral part of their curricula.

Simulation is an attempt to replicate the essential aspects of a given clinical situation so that it is more readily understood and managed in clinical practice. This technique uses an artificial environment, by recreating a real situation for the purpose of practicing, learning, evaluating, testing or gaining understanding of systems or human actions. Thus, HFS provides the student with a high degree of interactivity and realism. In teaching, HFS increases and promotes significant learning experiences and may reach its maximum potential if participants perceive it as legitimate, authentic and realistic (Leigh, 2008).

HFS has demonstrated its efficacy in cognitive and behavioural education. With this teaching strategy, students show high levels of self-esteem and self-confidence when performing procedures, an increased internalisation of information and greater satisfaction in the learning process (Hoadley, 2009).

Several authors mention that HFS enables students to experience the practice of caring, without having yet been exposed to a clinical environment, as well as care for patients in life-threatening situations, thus preventing errors in the future (Leigh, 2008).

The results obtained from research on the use of HFS in Nursing education are limited (Sanford, 2010). There are many unanswered questions within this domain, and there is an urgent need for diversifying effective methodological approaches of HFS in Nursing teaching/learning (Sanford, 2010; Hoadley, 2009).

Given our lack of knowledge regarding the existence of a study on this topic, the purpose of this review is to identify the best scientific evidence on the gains perceived by Nursing students in relation to simulated practice using high-fidelity simulators.

According to Santos, Pimenta, and Nobre (2007), the PICO criteria (Population, Intervention, Comparison, Outcomes) were used in the review to identify and select articles that enabled systematisation of knowledge. This has resulted in the following research question: "How do nursing students perceive the gains acquired through high-fidelity simulation practice?".

Systematic Review Method

Inclusion and exclusion criteria were established for the search. Studies meeting the following criteria were included: 1) carried out with bachelor/undergraduate students in Nursing; 2) whose interventions had used simulated practice using high-fidelity simulators; 3) that addressed the gains perceived by students in a simulated practice context; 4) with qualitative and/or quantitative approaches, which contributed to understanding the phenomenon under study. Comparative studies between HFS and other teaching strategies were also included, provided that they would objectively present the gains perceived by students.

Secondary and non-scientific studies were excluded, as were those that were not written in English, Portuguese, French or Spanish and those without full-text access.

Strategies to identify relevant studies

The electronic databases made available by EBSCOhost (CINAHL Plus with Full Text; MEDLINE with Full Text; PMC; DARE; Cochrane Central Register of Controlled Trials; Nursing & Allied Health Collection: Comprehensive; British Nursing Index; MedicLatina; Elsevier – Science Direct (Freedom collection); Academic Search Complete and ERIC) and the Google scholar in Portuguese, English, French and Spanish were used.

The search was conducted between December 4th, 2010, and February 10th, 2011, with no restrictions of timeframe, type of presentation or publication, using the descriptors "simulation", "nursing", "students", "perceptions" and "education", and the keywords "high-fidelity" and "experiences". In the first search, the terms high-fidelity simulation AND nursing AND students OR experiences OR perceptions OR education" were associated using Boolean full-text operators (TX All Text). This resulted in 1119 articles, which had been published between 1999 and 2011.

Aiming at analysing the most recent scientific evidence, the timeframe was restricted to the period between 2005 and 2011. This resulted in 1086 articles, which indicates that most scientific production in this area is still very recent. Therefore, for the purpose of including the reports which focused on the object of study, a search was conducted using the expression "high-fidelity simulation" in the title (TI Title) and the remaining expressions in text (TX All Text). This resulted in 72 articles: CINAHL Plus with Full Text – 25 articles; MEDLINE with Full Text – 27 articles; Nursing & Allied Health Collection: Comprehensive – 9 articles; British Nursing Index – 2 articles and Academic Search Complete – 9 articles.

Five articles were found in Google scholar that met the established inclusion criteria. However, they were duplicates and were therefore not included. Hence, only the articles selected from the EBSCOhost platform in the English language were considered, given that no results were found in the other languages.

Following the title analysis, 40 articles were selected for a preliminary review.

From this stage onwards, another reviewer was involved for greater reliability of the selection process. Following the abstract analysis, 15 articles were independently selected for a comprehensive analysis. The differences of opinion among reviewers were discussed until consensus was reached.

The grounds for the exclusion of studies related to the facts that they were in duplicate, the sample did not represent nursing students, and their goals differed from the proposed research question.

Following the full analysis of the articles selected, six were excluded for not analysing how students perceived the gains obtained. Thus, nine articles remained eligible for analysis in this review. In this stage, no differences of opinion were found among reviewers.

Assessing the methodological quality of the studies

For greater reliability of the selection process, the reviewers assessed the methodological quality of each article independently based upon the methodological coherence and consistency of the studies, depth of analysis, reliability of the results, and relevance of data regarding the area under study. For that purpose, reviewers adapted an instrument that had been used by Vilelas (2009).

Despite the use of standard instruments in the methodological assessment of the published studies, there is no consensus regarding the use of a generic instrument which is simultaneously suitable for different types of studies. This explains why the instrument used was adapted to the characteristics of the studies included in this review. As such, the quality of each article was assessed according to the following criteria: clear definition of the problem; correlation between study aims and systematic literature review (SLR); description of the methodology (description of goals, specification of the type of study, correct definition of variables, correct definition of the sample, and specification of the instruments used and the assessment items, which can be found in the results); an appropriate methodology; feasible results; and results that contribute to the nursing practice.

With regard to assessment, each article was assigned a score of 1 point when the item was present and 0 points when doubtful or absent. With a maximum score of 11 points and a minimum score of 0 points, the methodological quality of each article was classified as either low (0 – 3 points), moderate (4 – 7 points) or high (8 – 11 points).

Data Extraction

The nine selected articles were subject to a descriptive analysis by the reviewers. Data were withdrawn and transcribed into a table that was set up (Table 1) to meet the objectives of this review and characterise the searches that were at its origin.

Data synthesis

Systematic literature review with narrative summary (Joanna Briggs Institute, 2011), performed by two reviewers, whose summary of results encompassed

the inductive analysis of each study to extract and synthesise data which answered the question posed by this review, as well as the main conclusions mentioned by the authors (Table 2).

Results

After applying all procedures to refine the search results (Figure 1) and performing an analysis of each report, it was found that the nine studies used convenience samples with students enrolled in different years of the bachelor/undergraduate degree in nursing. Samples varied between 24 and 68 participants, with an average of 48 and a total of 432 nursing students participating in studies. Three of the nine studies did not provide information on the participants' gender and age. However, those which provided such information had always a higher number of female participants: between 72.9% and 94.1%.

Seven of the nine selected studies were conducted in the United States of America, one in Canada and one in Australia.

With regard to methodology, three articles were descriptive quantitative studies, two quasi-experimental studies with pre- and post-tests, one experimental, one qualitative and two used mixed methods.

All studies used high-fidelity simulators either individually or together with other teaching strategies (low and medium fidelity simulators, traditional teaching method). Three studies did not mention the type of simulator used, one used the PediaSIM®, two used the VitalSim® and three the SimMan®. One study also used an actor in one scenario, and compared this method with other teaching strategies.

The core themes or areas observed following the simulated practice with high-fidelity manikins and analysis of the hierarchy of evidence according to Vilelas (2009) were identified in each article. The studies were classified between levels II and VI.

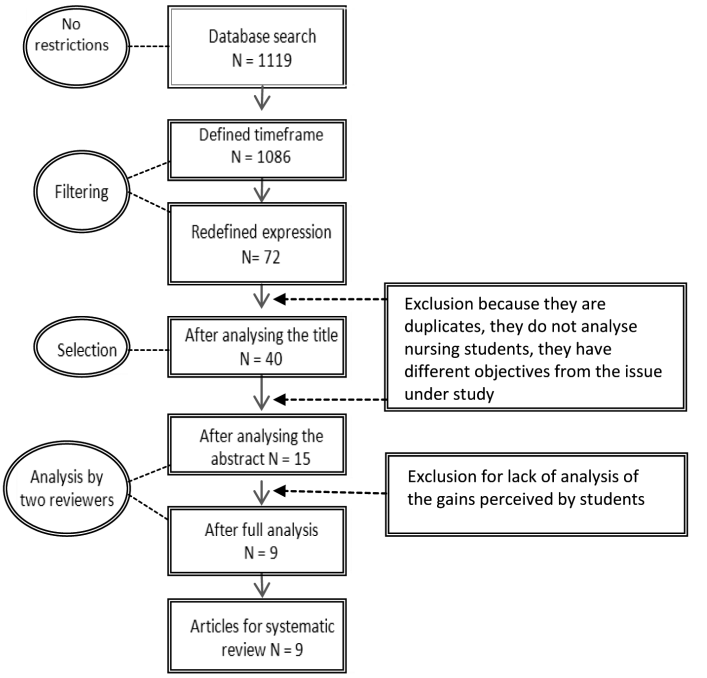

FIGURE 1 – Flowchart of article selection process

The methodological quality of the studies was assessed by the reviewers as high, with one article scoring 9 points, three articles scoring 10 points and five scoring the maximum points. The correct definition of the variables and the sample were the least scored items.

TABLE 1 – Script to extract data from articles

Study	Author(s)/Year	Type of Study/Participants	Objectives/interventions	Instruments
E1	Kuznar (2007)	- Descriptive quantitative study - 37 students	- To increase knowledge on HFS in nursing teaching - To determine the perception of students after HFS	- Feingold's 21-item survey (as cited in Kuznar, 2007); - Socio-demographic questionnaire
E2	Smith and Roehrs (2009)	- Descriptive correlational quantitative study - 68 students	- To assess the level of satisfaction and self-confidence of students after HFS when caring for a patient with respiratory disorder - To analyse the correlation between socio-demographic characteristics and simulated practice	- The Student Satisfaction and Self-Confidence in Learning Scale of Jeffries and Rizzolo (as cited in Smith & Rogers, 2009); - The Simulation Design Scale of Jeffries and Rizzolo (as cited in Smith & Roehrs, 2009); - Socio-demographic questionnaire
E3	Blum, Borglund, and Parcells (2010)	- Quasi-experimental study - 53 students	- To determine the nursing students' self-confidence and their clinical competence following traditional simulation and HFS	- Lasater Clinical Judgment Rubric of Lasater (as cited in Blum, Borglund, & Parcells, 2010)
E4	Butler, Veltre, and Brady (2009)	- Experimental study - 31 students	- To know if there is a difference in perception regarding educational processes between students using low- and high-fidelity simulators	- The Student Satisfaction and Self-Confidence in Learning of Jeffries and Rizzolo (as cited in Blutter, Veltre, & Brady, 2009); - The Simulation Design Scale of Jeffries and Rizzolo (as cited in Blutter, Veltre, & Brady, 2009); - The Educational Practices in Simulation Scale Scale of Jeffries and Rizzolo (as cited in Blutter, Veltre, & Brady, 2009)
E5	Baxter *et al.* (2009)	- Descriptive Q-methodological study - 24 students	- To explore the perceptions of students on simulation and identify common ground	- Content analysis
E6	Swenty and Eggleston (2010)	- Descriptive quantitative study - 79 students	- To assess the perception of students on learning following simulated practices in 4 scenarios (perioperative, oncology, haemorrhage and death)	- The Student Satisfaction and Self-Confidence in Learning Scale of Jeffries and Rizzolo (as cited in Swenty & Eggleston, 2010); - The Simulation Design Scale of Jeffries and Rizzolo (as cited in Swenty & Eggleston, 2010); - The Educational Practices in Simulation Scale of Jeffries and Rizzolo (as cited in Swenty & Eggleston, 2010)
E7	Reilly and Spratt (2007)	- Qualitative study - 41 students	- To explore students' perceptions of the HFS	- Interview (focus group)
E8	Bye (2008)	- Quasi-experimental study with pre- and post-tests - 51 students	- To explore the impact of HFS on the acquisition of knowledge and levels of self-confidence of nursing students	- Prior knowledge test (multiple choice); - Self-confidence scale of Ravert (as cited in Bye, 2008)
E9	Lasater (2005)	- Exploratory descriptive study with mixed methods (quantitative and qualitative) - 48 students	- To analyse the contribution of high-fidelity simulation to critical thinking in nursing students	- Lasater Clinical Judgment in Practice Survey of Lasater (as cited in Lasater, 2005); - Lasater Clinical Judgment in Simulation Rubric of Lasater (as cited in Lasater, 2005); - California Critical Thinking Disposition Inventory of Facione et al.(as cited in Lasater, 2005); - Focus Group

TABLE 2 – Summary of results/conclusions of the studies

Study	Results/conclusions
E1	- High levels of satisfaction - Practice with HFS was very close to reality - More confidence in real context situations - Increase in dexterity and motivation - More competence to assess and collect patient data - Improved critical thinking and decision making - Age and previous experiences did not interfere with HFS assessment - For females, the HFS contributed more to establish priorities
E2	- Students were satisfied with this teaching method with a mean score of 4.5 - Self-confidence with a mean score of 4.2 - Participants expressed positive feelings regarding the characteristics of this simulation model with mean scores ranging between 4.4 and 4.8 - Moderate correlation between simulation objectives and levels of satisfaction and self-confidence - Debriefing corresponded to the lowest correlation with satisfaction and reliability to the lowest correlation with self-confidence.
E3	- There were significant increases in self-confidence levels and clinical competence after mid-term and final evaluations - Comparing both simulation techniques, there were no statistically significant differences between them, despite the fact that traditional simulation presented a higher increase in self-confidence from mid-term to final evaluations.
E4	- Both groups valued an active learning with simulation - The group with HFS considered that this practice impacted more on the ability to solve problems, bared more resemblance to real life situations and allowed for a more active and productive learning than Low-Fidelity Simulation (LFS) - The cost and time involved in HFS training was beneficial given the experiences offered to students and the possibility to standardise such experiences.
E5	- Simulation increased the awareness of actual skills, but did not replace the actual patient - It was difficult to develop interpersonal relationships because they were only manikins - Scenarios were very stressful but they allowed for a greater contact with real life situations - Students would like to set up their own scenarios and apply them to each other - Simulation strengthened organisation.
E6	- By offering students more realistic scenarios and the perception of a more active learning, the scenario of death showed higher levels of satisfaction and self-confidence than the other scenarios - Students assigned a high importance to scenario reliability - Self-confidence increased across scenarios - Students were more involved in nursing activities when the SimMan was used, but more introverted students had more difficulties communicating with the manikin.
E7	- Simulated practice increased confidence levels and students felt more prepared for clinical practice - HFS provided an active and realistic learning - Safe practice that developed confidence.
E8	- There was a difference in knowledge between the traditional method (classroom) and the use of a patient (actor), the traditional method showing greater knowledge. There was no difference between the traditional method and the method using HFS. - There was no significant difference in knowledge retention between the three teaching methods 1 month after the completion of the test. - There was no significant difference in levels of confidence between the three groups from the pre- to first post-test. In the second post-test, the VitalSim students presented significantly higher levels of self-confidence than the other students.
E9	- HFS had a strong impact on the development of students' clinical judgment - Simulation allowed developing skills that affected the levels of confidence, attitudes, competences and experience - Students considered that the HFS allowed for the integration of knowledge in low-risk environments in different areas (reading, laboratory skills and provision of care to the patient). Debriefing allowed reflecting on the action and was a facilitator of learning.

Discussion

The core themes or areas that were identified following the simulated practice with high-fidelity manikins were: Satisfaction; Learning and motivation; Realism; Self-Confidence; Technical skills; Reflection on action; and Transfer of skills.

The main limitations related to the sample size and limited ability to generalise results and the fact that there were various teachers involved in the studies,

which could have biased the results. With regard to suggestions, the authors mentioned the need for carrying out the same studies in other educational levels, with different and multicentre scenarios. Despite these observations and taking into account the attention paid to the methodological processes and analyses conducted, the studies allow for the transferability of results.

Satisfaction

Satisfaction with the laboratory practice was mentioned in five studies. In three of these, students expressed high satisfaction with the HFS learning process, with mean scores ranging between 4.1 and 4.6 on a 5-point Likert-type scale (Kuznar, 2007; Smith & Roehrs, 2009; Swenty & Eggleston, 2010). Despite the fact that some participants had mentioned prior clinical teaching experience, which could affect the levels of satisfaction, they still presented a score of 4.5. This was statistically insignificant compared to those who had no prior experience, who presented a mean score of 4.6 (Smith & Roehrs, 2009). Jeffries, Rew, and Cramer (2002), based on a sample composed of 70 nursing students, showed that the students' levels of satisfaction were significantly higher with high-fidelity than low-fidelity simulators. Similar findings were reported in the multicentre study of Jeffries and Rizzolo (2006), with 403 students, which concluded that students expressed greater satisfaction with interactive learning than other learning approaches. This was found following the application of a learning satisfaction scale to compare three different teaching methodologies (analysis of a case study in the classroom, use of LFS and use of HFS).

In paediatric laboratory practice, students also expressed higher levels of satisfaction with the use of the high-fidelity simulator PediaSIM®, with a mean score of 61.86, compared to the mean score of 55.33 obtained with the low-fidelity static manikin (Butler et al., 2009). These results were corroborated by the study of Baptista, Coutinho, and Martins (2010a), which analysed a sample composed of 181 nursing students using a 17-item satisfaction scale built for that purpose. The authors observed a mean satisfaction level of 85% (SD = 7%), ranging between 64% and 100%. In this study, students reported that the relation between the use of scenarios and theory (44.8%) and the quality of the simulators used for simulated practice (44.2%) were the aspects that satisfied them the most. They assigned the maximum score (10) to these parameters.

Students' satisfaction is also associated with objective responses given to HFS-related interventions. This is because these manikins, besides enabling the perception of the learning process and its progress, also contribute to making students more active in clinical practice, recognising and acting appropriately in real life or potential situations (Reilly & Spratt, 2007).

Learning and motivation

Nursing students in this age group are very receptive to new technologies in general and teaching/learning technologies in particular, also because of stimuli by the society. The traditional pencils and pens no longer make sense, given that they do little to encourage new knowledge and drive students away from an educational model which seeks a more constructivist approach.

In this review, students from six studies mentioned interactivity with manikins as a reason for learning, with a mean score of 4.22, and considered that their learning had improved by participating in HFS scenarios (mean score of 4.28).

In the study of Butler et al. (2009), which compared two groups of students who participated in high- and low-fidelity scenarios, the authors found a significant difference in the total mean scale used to assess the educational practices (LFS = 70.44; HFS = 77.27). Participants considered HFS as an active and diversified learning, which contributes to teamwork and provides high expectations for the future. In the same study, all students (15) who participated in HFS assigned the maximum score (5 points) to this active learning process as being more productive, while 10 students (63%) who participated in LFS considered the method as more productive for their learning process. This view was reinforced in the study of Swenty and Eggleston (2010), which revealed all scenarios performed by students as active learning, with mean scores ranging between 4.32 and 4.57. In this way, in addition to strengthening the theoretical knowledge acquired in the classroom and being authentic by reflecting reality, simulated practice contributes to students' participation in their own learning, making them more aware of their actual skills, allowing for the perception of both positive

and negative aspects and contributing to having the student say "I know" rather than "I think" (Baxter et al., 2009).

In addition to being inclusive of learning as it combines theoretical foundations and psychomotor skills, thus developing critical thinking on the practices (Lasater, 2005; Reilly & Spratt, 2007), simulation is also motivating given that it enables students to discover in the manikins what is described in the books and covered in the classroom.

Realism

The resemblance of simulated practices with reality was addressed in six review articles, with mean scores ranging between 3.53 and 4.19, in which students felt laboratory practice as if it were a real clinical experience (Kuznar, 2007). This is similar to the opinion of 13 (87%) participants of the HFS group who strongly agreed that the simulated experience was realistic compared to the 5 (31.3%) participants of the LFS group (Butler et al., 2009).

The students' perception of the levels of realism with the simulated practice has been addressed by various authors and, in general, levels are high. However, high-fidelity simulation is much more than simply having a simulator that reacts like a person. It is necessary to equip the laboratory with an array of materials and equipment that are able to recreate a similar environment to the clinical practice. This attempt to resemble reality leads to high levels of stress and adrenaline, despite remaining positive for students since it represents what may happen to them in clinical practice (Reilly & Spratt, 2007). In one of the scenarios carried out for the student to deal with a patient's death, the students' scores ranged between 4.50 and 4.68 with respect to the importance of fidelity in the simulation, though this situation is not desired and is often even avoided by professionals (Swenty & Eggleston, 2010).

Although the scenario bears great resemblance to reality, students are aware that they are in the presence of a manikin. Moreover, despite all their potential, simulators do not communicate nonverbally (smiles, eye contact avoidance, postures), which may hinder the learning of interpersonal skills (Baxter et al., 2009), and do not exhibit skin changes or oedemas. Furthermore, it is impossible to assess reflexes in neurological exams using simulators (Lasater, 2005).

Self-confidence

A feeling of security and confidence in one's own abilities were the most addressed aspects in the articles included in this review. All studies referred that participants had shown high levels of self-confidence, which is in line with the various authors who have already analysed this domain (Smith & Roehrs, 2009; Blum et al., 2010; Baptista, Coutinho, & Martins, 2010b; Jeffries & Rizzolo, 2006).

In the analysed studies that used Likert-type scales, with scores ranging between level 1 (not confident at all) and level 5 (very confident), students had higher levels of self-confidence which ranged between the mean scores of 3.81 and 4.5.

When comparing pre- and post-simulated practice results, the levels of self-confidence also evolved favourably, as referred to by 27 students who rated their self-confidence levels as "exemplary" at the end of the study, compared to only 16 in the mid-term evaluation (Blum et al., 2010). However, when comparing pre- and post-tests in practices using the VitalSim®, a real patient (actor) and a traditional class, there was no significant difference between the three groups, although one month after the practice, the group who used the VitalSim® showed significantly higher levels of self-confidence than the others (Bye, 2008).

An HFS experience increases the levels of confidence and preparation of its participants if the situation experienced in the laboratory occurred in real life (Kuznar, 2007; Reilly & Spratt, 2007). This confidence results greatly from the way scenarios are set out and the goals intended to achieve, because when a simulation experience is not well planned and/or negative results appear unexpectedly, the levels of confidence in the provision of care and the nursing practice may be affected (Lasater, 2005).

The environment in which the simulated practice occurs and the fact that students are aware that they are working with a manikin make them more comfortable, for they can make mistakes without the risk of the "patient" dying (*Idem*). Therefore, they can practice as often as necessary, until they feel confident and excel. This is not the case in clinical practice as learning opportunities are not always taken advantage of for fear of making mistakes and/or harming the patient (Reilly & Spratt, 2007).

Technical Skills

Simulation occupies a major part of the history of nursing teaching, as an important strategy for teaching/learning technical skills, such as intravenous therapy, wound care or different catheterisations, among others. All these and other types of simulated practice share common characteristics as they are artificial situations taking place in controlled environments where students can develop skills to provide safer care in a clinical setting (Sanford, 2010). These skills were mentioned and analysed in only two studies, in which students considered that the HFS had improved their technical skills, with a mean score of 3.92, and that their levels of confidence in these skills had increased by practicing with simulators (mean score of 3.69) (Kuznar, 2007). On the other hand, they also considered that this teaching/learning strategy had provided them with additional skills that could be used in clinical practice, including the ability to work and be part of a multidisciplinary team (Baxter *et al.*, 2009).

Reflection on Action

Reference was made in three studies to the reflection on practices and the observation of how such conscious analysis was important for students' learning.

Students mentioned that by reflecting on action they acknowledged that they had done something positive and became more aware of their difficulties and limitations, what they had done and how they had done it, and the consequences for the patient resulting from appropriate or inappropriate decisions (Lasater, 2005; Reilly & Spratt, 2007). Even while observing the peers' practices, reflection continues to be highly valued and considered by students as a potential learning situation (Jeffries & Rizzolo, 2006). Reflecting on practices allows for an increase in the students' levels of confidence in their performance, improves their ability to make the right decision the next time, stimulates critical thinking on what it means to be a nurse, and develops cognitive skills from practical experiences.

Transfer of skills

Of the four studies that mentioned the capacity of HFS to recreate events in a realistic way and transferring them into clinical practice, three mention the progresses in caring for the patient and one mentions nursing care in general.

According to Leigh (2008), the main objective of HFS is to foster in students a sense of connection with clinical practice based on simulation, thus providing an opportunity for students and teachers to learn through the transfer of knowledge into practice.

Students reported that they were able to perform a better clinical history of the patient (mean score of 3.72), had improved their evaluation (mean score of 4.16) and HFS had helped them to provide more efficient care, particularly in urgent and emergency situations (mean score of 4.03) (Kuznar, 2007). Others reported that caring for the patient had become less traumatic because they had already experienced a similar situation in the laboratory (Reilly & Spratt, 2007). Some students considered that, despite the fact that scenarios were often exaggerated, HFS helped think about and anticipate what might happen to the patient, as well as the importance of including the family in the care process (Lasater, 2005).

This view is reinforced by the emphasis of health on providing appropriate and safe care to patients and, within this domain, both simulators and simulations allow for the development of professional practices in less threatening environments, thus contributing to accomplish this important objective (Sanford, 2010).

The capacity of high-fidelity simulation to replicate real life situations, as well as the possibility of audio and video recording of the students' interventions in the scenario for the final debriefing may increase knowledge retention and its transfer into practice (Hoadley, 2009). This contributes to building prior experiences that may facilitate the transfer process and improve clinical expertise (Leigh, 2008).

Conclusion

Students have expressed great satisfaction with the use of HFS, not only because it is a recent teaching/learning strategy, but also because they are able to obtain objective data regarding their performance. HFS allows increasing the awareness of actual skills and perception of positive and negative aspects, thus contributing for students to have a proactive attitude in their learning process.

Students strongly agreed that the simulated clinical experience was realistic and caused similar levels of stress and anxiety to those experienced in clinical practice, though they were aware that they were

using a manikin and that it was difficult to simulate everything that could happen to a patient.

Self-confidence was the most addressed theme in the articles included in this review given that students can train as often as necessary until they feel confident and without fear of making mistakes, which does not happen with a real patient.

Technical skills were the least referenced theme in this review, perhaps because they are often practiced using low fidelity manikins, which was not the aim of this review. However, students still refer to improvements in this dimension after performing some procedures using high-fidelity simulators.

Reflection on action was considered as very positive as it allowed them to become aware of their difficulties and limitations.

Further scientific evidence is needed on high-fidelity simulation. It brings about positive outcomes for students, trainers and especially patients, who are the main focus of nursing.

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