ORIGINAL RESEARCH

IMPROVING PERFORMANCE AMONGST NURSING STUDENTS THROUGH THE DISCOVERY OF DISCREPANCIES DURING SIMULATION

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Abstract

Discrepancy creation is a form of self-regulated learning which can be used to improve individual performance. Discrepancy can be created as a result of comparison against an occupational standard or when an individual strives to achieve higher personal goals. This study explores the process of discrepancy discovery and reduction following simulation sessions. Second year under-graduate nursing students undertook three simulation sessions over a one year period. After each session the participants completed a series of visual analogue scales to rate their own performance and the perceived performance of peers, final year student and a newly registered nurse. Once discrepancy had been identified, participants were asked to produce a short written action plan on how the discrepancy could be addressed and to work on this action plan between sessions.

A total of 70 students completed discrepancy scores for all three scenarios. The most common areas of discrepancy were understanding physiology, understanding medicines and pharmacology, patient assessment and handover (hand off). Wilcoxon Signed Ranks suggested a statistically significant difference between student scores in all areas with the exception of team-work. All of the participants used peers as their comparator when identifying discrepancy. There was also a statistically significant difference in the scores following each simulation session suggesting improved performance.

Key words: simulation, goals, discrepancy, performance improvement, feedback

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Introduction / Background

Discrepancy creation is a concept articulated by Organizational Psychologists to describe how employees strive to improve their individual performance. Phillips et al (1996) describe how discrepancy creation involves either the measurement of current performance against a standard (negative discrepancy creation) or by driving achievement when an individual sets higher personal goals (positive discrepancy creation). Phillips et al (1996) argue that until an individual has achieved the level of an occupational standard they will not engage in positive discrepancy creation but rather they will direct their efforts at achieving the occupational standard. Nursing students by virtue of their role are engaged in negative discrepancy creation as they are seeking to achieve the occupational standard by becoming a registered nurse. Once discrepancy has been created, the individual works towards discrepancy reduction by directing cognitive and behavioral efforts towards reducing the level of discrepancy identified (Carver and Scheier, 2000).

While discrepancy creation and reduction has been used to study human motivation, goal setting, performance of employees, school children and athletes the concept has not been widely applied to nursing or health professional's education. Discrepancy creation is a form of self-regulated learning. Zimmerman and Schunk (1989) described how self-regulated learning involves targeting thoughts, feelings and actions towards the achievement of the student's own goals. Self-regulated learning involves a number of processes but of particular interest in terms of simulation, are the importance of feedback and de-brief in activation of interest, identifying goals and monitoring progress (Pintrich, 2005; 452).

Within nurse education there has been some concern that self-directed learning is often used inappropriately and occasionally lacks the structure necessary to achieve particular outcomes (Timmins, 2008). Additionally, it appears that this approach is sometimes unpopular amongst nursing students (Walsh, 2004) and that self-directed ability may be confined to those students who are high achievers (McCauley and McClelland, 2004). Timmins (2008) argues that for self-directed learning to be successful there needs to be

investment in the students in terms of facilitating the development of their own learning needs, goals setting and action planning. This approach appears to fit with the creation and subsequent addressing of discrepancy.

Discrepancy creation is based on social constructivist learning theory where the learner constructs through a process of reflection and analysis of their own performance discrepancy between their current performance and that of a comparator they aspire to. It is unclear whether students base this discrepancy on peers, on students at a more advanced stage of their course or on the ultimate outcome of the course becoming a registered nurse. Donovan (2009) sets out a number of pre-requisites for discrepancy creation including appropriate levels of self-efficacy, positive task interest and a learning goal orientation. Self-efficacy is perceived as important as individuals with low self-efficacy are likely to set less challenging goals than those with higher levels. Less challenging goals will be easier to achieve and, as a result, the individual may lose interest in developing and may fail to maximise their potential. Donnovan (2009) describes how individuals are more likely to monitor and regulate their performance where they see the task as attractive or important to their role. In addition, individuals who are focused on learning new things and seeking out new challenges are thought to have a strong learning goal orientation and are, therefore, more likely to create and address discrepancy.

Hesketh and Ivanac (2002) outlined the essential requirements for the self-regulation of performance including performance indicators which were capable of being controlled and achieved by the individual without the need to manipulate external factors. Feedback was identified as an essential requirement both in terms of identifying discrepancy but also in judging performance improvements. Feedback needs to be acceptable and specific. A systematic review undertaken by Neubert (1998) identified that adding feedback to goal setting almost doubled the impact in terms of performance improvement over goal setting alone. The results of the meta-analysis indicated that there was little or no difference between feedback presented personally and that which was presented impersonally to a

group of people. Irrespective of the method of feedback, it must be relevant and accurate (Archer, 2010).

Feedback to individuals, to develop their knowledge of their own performance, has been described as the single most important feature of simulation based education (Issebberg et al, 2005). Within simulation feedback usually takes the form of a structured de-brief or guided reflection on action. Fanning and Gaba (2007; p116) have described how de-brief is seen as a key component of simulation based education because 'not everyone is naturally capable of analyzing, making sense, and assimilating learning experiences on their own'. Despite the importance of feedback it remains largely unclear how students then use the feedback to structure future learning. However, within nursing education student self-assessment has been developed alongside simulation based education as a way of promoting and enhancing student self-directed learning (Cato et al, 2009). It has been suggested that student self–assessment can enable students to set goals and then subsequently monitor progress towards these goals (Nicol and Macfarlane-Dick, 2006). This suggests that a structured approach to self-assessment alongside faculty feedback and structured reflection may be a useful approach to structure future self-regulated learning amongst student nurses.

Finally, Hesketh and Ivanac (2002) also outline how goal setting is an essential requirement for the self-regulation of performance. Goals need to be acceptable to the individual and should be attainable and prioritized when a number of different areas require attention. Kirschenbaum (1985) suggests that individual's given freedom to set their own goals accrue more positive benefits than those assigned goals by an external agent. Whether an individual is able to set their own goals or would prefer goals to be set for them will depend upon the individual's locus of control. Gymnasts with an internal locus of control have been shown to achieve more performance improvement when they are able to set their own goals than when goals were set by a coach (Lambert et al, 1999).

In this study a discrepancy was defined as a deficit in the student's practical performance,

knowledge, care management or team working ability. It can be argued that performance discrepancy is not created by discovered. Creation involves bringing something into existence and it is likely that the discrepancy in the student's performance already existed. Therefore, while the psychological term is discrepancy creation the term discrepancy discovery is preferred in this study.

The aim of the study was to explore the discovery of discrepancy between the student's current and perceived optimal performance following participation in simulation exercises. The researchers were interested to ascertain whether discrepancy discovery was a useful way of assisting nursing students to plan their own learning and development.

This study aimed to answer the following research questions:

1. Does structured de-brief as part of simulation exercises allow for the discovery of performance discrepancy by students?
2. Which comparator group (e.g. peers, students at a different point in the program or registered nurses) is the most effective at assisting students to identify discrepancy?

Research Design

The study used a quasi-experimental case study design. The case studies involved groups of under-graduate nursing students undertaking simulation sessions in groups of 4-6 students. Yin (2003) describes how a case study is a research strategy that seeks to answer how and why questions and accommodates situations where the researcher has minimal control over real life events. Nurse educators conducting evaluation research find case studies particularly useful as they allow for the explanation of presumed causal relationships in real life situations which may be too complex for experimental strategies (Amerson, 2011). Cohen et al (2007) describe how single case research designs have become increasingly popular in educational research. Characteristically, such designs involve:

- Continuous assessment of performance over a period of time with multiple measures

being recorded at different points

- Multiple interventions which are replicated over time with the same group of students

This methodology was selected because it was the least intrusive given that the simulation sessions were a key element of the program and, therefore, it was not possible to randomly assign students to an intervention and to a control group.

Simulation delivery

One cohort of second year under-graduate nursing students (n=210) undertook three simulation scenarios during the course of the year. Students participated in simulation exercises in groups of 4-6 with an academic facilitator and a technician both drawn from Faculty staff. Students participated in at least three of the following scenarios:

1. Hypovolemic shock
2. Exacerbation of asthma
3. Chest pain (angina)
4. Urinary tract infection leading to sepsis
5. Chest pain leading to cardiac arrest
6. Anaphylactic shock

Scenarios are run together in pairs with students participating in one scenario then observing other students participating in a different scenario. This enables Faculty staff to operationally manage simulation for larger student cohorts rather than reflecting options or student choice. Session one consists of either participation in hypovolemic shock or an exacerbation of asthma. Session two consists of either participation in chest pain (angina) or urinary tract infection. Finally, session three consists of either participation in chest pain leading to cardiac arrest or anaphylactic shock.

The scenarios were all designed to develop and review the student's knowledge and skills around the recognition and rescue of the deteriorating patient. In addition, both technical in

terms of taking and recording observations, patient assessment and drug administration and non-technical skills such as situational awareness, communication, team working and problem solving were reviewed as part of a structured de-brief. During the year the simulations become more complicated by virtue of moving away from students simply recognizing patient deterioration towards using evidence and treatment algorithms to make clinical decisions about patient management. At the same time the level of support from the academic facilitator is reduced with the facilitator acting as a member of the health care team rather than guiding and prompting the students.

All sessions used SimMan™ mannequins and had video capture with live feed and bookmarking functions. Bookmarking allows for various parts of the video recording to be marked. During video review the academic facilitator can then jump forward and back between bookmarks using short pieces of video to illustrate key areas of performance. All of the sessions delivered involved three stages:

Stage 1 - Preparation: this stage involved the preparation of the student for the simulation exercise. Preparation included linked lectures, seminars related to the simulation exercise as well as immediate preparation just prior to starting the simulation where all students are introduced to the features of the mannequin and the purpose of the session prior to the scenario commencing. This stage is repeated prior to every simulation session.

Stage 2: Delivery: this stage involved the running of the scenario, the provision of student support and preparation for the final stage. Students were provided with a written overview of the scenario and were then prompted to take action, assess the patient and implement action designed to address areas of concern. During this period the academic facilitator either role plays other members of the healthcare team or provides direct support through prompting or by posing questions to the students.

Stage 3: De-brief: this stage involved the academic facilitator and the students reflecting and analyzing what happened during the simulation exercise. The academic facilitator bases the de-brief on the framework articulated by Steinwachs (1992) which involves focusing

discussions around reflection on what happened and why, analyzing how things were done and could be done differently and finally identifying areas for improvement. The stages outlined by Steinwach's (1992) are similar to the defining attributes of de-brief outlined by Dreifuerst (2009) in that they involve reflection with an element of emotional release, integration by analyzing the process of how care was provided and finally exploring the transference of learning to other scenarios to improve performance.

Ethics and sample

Ethical approval for the study was granted by the School Research Ethics Committee. All 210 adult nursing under-graduate students were eligible to be included in the research. Consent was sought for participation in the study and a total of 70 students provided consent and subsequently participated in all elements of the data collection process. As this was a research project completion of the discrepancy discovery tool and action plans was not mandatory and students were able to withdraw from the project at any time. Participation in the research may have been affected by the fact that it was optional and that completion of the data collection tools involved staying behind at the end of sessions.

Data collection

A Discrepancy Discovery (DD) data collection tool was developed. The tool consists of a series of performance criteria derived from an analysis of the common elements of all of the scenarios (Figure 1), together with a series of 50mm (5 cm) visual analogue scales (VAS). The performance criteria were identified and validated by the authors following analysis of video footage of the scenarios and by relating these to the learning objectives of each session.

Participants were asked to indicate on each VAS where they perceive their performance was, where the performance of a student at the same point in their course should be, where the performance of a final year student and a newly qualified nurse should be. Each VAS

ranged from *novice* at point 0 to *expert* at point 5. This is based on the competency development continuum developed by Dreyfus and Dreyfus (1980) and subsequently developed further by Benner (1984) in her seminal work *From novice to expert.*

Once participants had identified discrepancies they were asked to select up to three aspects of their performance which they wished to develop between this session and the next one. Participants were then asked to produce a brief action plan of how they intended to develop their skills and knowledge to address the identified discrepancy. Both the DD tool and the action plan pro-forma were pre-carbonated, allowing the student to retain a copy in their personal development portfolio.

DD tools and action plans were completed after each of the three scenarios during the year. At the commencement of each new simulation session students were asked to highlight areas they had decided to work on so that these could be discussed in detail during any subsequent de-brief.

Data analysis

Each rating on the VAS was measured in millimeters and assigned a value from 0 to 50 mm for each of the performance criteria and for the student and the three comparators (peer, final year student and newly qualified registered nurse). This data was then entered into the Statistical Package for the Social Sciences (SPSS version 19). Each of the performance criteria were then analyzed using a Wilcoxon Signed Ranks test to identify if there was a statistical difference between the score the student had given to themselves and for each of the comparators. In addition, Wilcoxon Signed Ranks tests were performed on the student's self-reported performance against each of the performance criteria for each scenario to identify if there had been a statistically significant improvement in performance over the year.

Controversy exists over whether VAS data is normally distributed (Waltz, Strickland and Lenz, 2010) and whether it represents ratio or ordinal data (Myles et al, 1999). Some authors (Myles et al, 1999) argue that the data is normally distributed as individuals are able to mark at any point on the VAS as opposed to Likert type scales which restrict the rating. To what

extent self-reported performance marked is a two on a scale is twice the performance marked as a one is open to debate. In addition, Svensson (2000) has suggested that a mark on a VAS has no interpretable meaning. Such a view is likely to be related to the fact that a mark on a visual analogue scale is a subjective response which can only be considered in the context in which the mark was created. In this study the authors are interested in whether there is a difference between self-performance and the perceived optimal performance of comparators and whether this allows for the discovery of discrepancy by students. Therefore, the level of performance assumes less importance in terms of the most appropriate statistical test. Mantha et al (1993) surveyed the literature related to VAS and found that 50% of authors had used parametric tests. Hasson and Arnetz (2005) describe how most researchers regard VAS data as ordinal data and, therefore, use non-parametric tests. Therefore, such methods have been used in this study.

Actions plans produced by participants were analyzed in terms of content by identifying key words and phrases. This allowed descriptive statistics to be produced in order to identify the frequency of action plan topics and a subsequent ranking of the top 5 most frequent topics. While this was not a direct study question it was felt that it would be useful to identify the areas where students had discovered discrepancy and planned to address it. Without the analysis of action plans it would not have been possible to identify which areas of discrepancy the students felt they should address and as a result which was the most useful comparator from the student's perspective.

Results

Participants in the study included 67 female student nurses (average age 24 years range 19 - 48 years) and 3 male student nurses (average age 25 years range 20 – 31 years). A total of 70 participants completed discrepancy discovery tools for all three simulation scenarios. All but one student identified discrepancies in their own performance during the simulation sessions. This data revealed a statistically significant difference between the students' self-

reported performance and that of the comparators at all levels (peer, final year student and registered nurse) in the majority of the performance criteria, with the exception of team-work, measurement of observations and handoff (handover) where the median scores were the same for the student and the peer comparator of a student at the same stage of the program. Table 1 shows the median self-reported performance for each of the performance criteria and the median performance for a student at the same level alongside the statistical analysis

There was also a statistically significant difference in self-reported performance between the first simulation scenario and the final scenario on all of the performance criteria (Table 2). However, for some of the criteria students continued to score their performance below that of their peer comparators (students at the same stage of the program). This suggests that, despite addressing discrepancy during the year, some students still continued to identify discrepancy between their own perceived performance and where they felt they should be. One explanation for this may have been the increasing complexity of the simulation scenarios in terms of the anticipated learning outcomes.

A total of 66 participants (94%) went on to complete action plans after scenario one, this reduced slightly to 62 (88%) after the second scenario and fell to 16 participants (22%) after the final scenario. Around 60% of students (69.6% after scenario one, 59.6% after scenario two and 62.5% after scenario three) created an action plan on the basis of an identified discrepancy between their own self-reported performance and what they would expect their performance to be at this stage in the program. Table 3 shows the top five action plan themes across all three scenarios together with the median student score, median reported student comparator score and the median level of discrepancy from the DC tool data. Table 3 shows that some areas were action planned despite the fact that in scenario 3 the median level of discrepancy had dropped. This could be one explanation for the fall in students producing action plans at the end of scenario 3 as for some students at least the discrepancy in their performance against that of their peer comparator had been addressed.

Discussion

The first research question in this study related to whether the structured de-brief following simulation allowed for the discovery of discrepancies in student performance. The results show that the most frequently identified discrepancies across all of the scenarios based on students selecting areas to action plan were awareness of anatomy and physiology, understanding of pharmacology and patient assessment and hand off (handover). A study by Dunn et al (2012) explored the influence of student attributes for success on self-regulated learning in pathophysiology. They found that where student had self-efficacy in terms of understanding the material they were more likely to succeed in their learning. Self-efficacy in this study appeared to be based on performance and the student's perception of success and failure, positive reinforcement from academic staff and student metacognition in terms of how the student perceived their ability to learn.

While concerns about anatomy and physiology and pharmacology knowledge are common amongst nursing students, issues around patient assessment and hand off (handover) of care appear to be directly related to the simulation scenarios. Both patient assessment and hand off (handover) are key objectives of each of the simulation scenarios and as such students are expected to concentrate on these areas during the simulations. However, the scenarios are likely to have created some discrepancy about normal and abnormal physiology and about common medicines and their effects principally through the de-brief process when students were asked to analyze what they felt was happening to the patient. This illustrates that the structured de-brief has an important role to play in the identification of performance discrepancies. While the processes of reflection during de-brief may also act as a catalyst for student development concern exists about the effectiveness of such approaches as there is a dearth of research in this area. Several studies have indicated that students often tend to deflect feedback which produces discrepancy between their own self-perception of performance and the facilitator's perceptions (Molloy & Boud, 2013) and that

students may interpret feedback to make it conform to their own interpretation of their performance (Carless et al, 2010). This suggests that approaches which assist students to discover discrepancies in their own performance may be useful in term of future development and learning. Sook Yoo et al (2010) conducted a small scale experimental study where the experimental group (n= 20) were asked to evaluate their performance in performing a clinical skill by watching a video recording. When compared with the control group (n = 20) students in the experimental group had a statistically significant improvement in their competence, communication skills and learning motivation when asked to perform the procedure again eight weeks later. This study suggests that the use of video analysis of performance may assist students to identify areas of good and less than optimal performance which they can then work to address.

While discrepancy was discovered in relation to the student's self-reported performance and all of the comparators, the action planning process suggests that students used the student at a similar stage of training as the most appropriate comparator. Identifying the most effective comparator was the second research question in this study. The results reveal that the majority of action plans related to discrepancy between the student's performance and where they believed a student at their stage of education should be. This fits with the work of Lev Vygotsky (Obukhova and Korepanova, 2009) which notes that students have a Zone of Proximal Development. This zone illustrates the extent to which the student believes they are able to develop new skills and knowledge. Skills and knowledge which the student believes are not attainable at this stage are regarded as being outside of their Zone of Proximal Development. This suggests that any discrepancy identified when using a qualified nurse or a final year student may be regarded at this stage as unattainable by students. In addition, students were able to identify areas of discrepancy not covered by the discrepancy discovery tool and a number of students used more generic themes, such as 'to increase confidence' to develop their action plans.

Within the health professions peer teaching has become more common. Peer teaching in nursing is often used in skill development with a more experienced nursing student supervising and guiding a more inexperienced student in the performance of a clinical procedure (Buke and Mancuso, 2012; Roberts, 2007). Peer teaching has also been used in simulated based teaching (Owen and Ward-Smith, 2014). Despite the use of peer teaching what remains unclear is what role comparison takes between the experienced student and the student being taught in terms of promoting further learning and development. This study suggests that peer comparison in terms of discovering discrepancies in performance may be more useful than comparisons against faculty or the performance of a newly qualified registered nurse.

One area which did not show a statistically significant discrepancy was that of team-work. One possible explanation for this is that students did not perceive the simulation scenarios to be realistic in terms of working as a team. A number of things point to this as a possible explanation including the fact that it would be unusual for 6-7 students to be involved in caring for the patient at once. Most hospital nursing and healthcare teams have a variety of experience levels, whereas the scenarios were conducted by a ‘company of equals’ where everyone is at the same level / grade with a similar range of experience. If the situation is regarded as unrealistic, it is unlikely that students will perceive any deficits identified to be real but rather that they are a by-product of having undertaken a simulation based exercise. Given the importance of peer comparison in the discovery of discrepancy it is important that students are given an opportunity to compare their performance with that of colleagues. Nurse education in the United Kingdom has moved away from allowing comparison with grades, degree classifications are now anonymized. Opportunities for comparison between students can be limited and many students shy away from putting themselves forward and answering questions during lectures for fear of being ostracized by others in the class. Simulation therefore provides a useful vehicle for discrepancy discovery in nursing because it represents one of the few opportunities that students have of comparing themselves

against their peers. Most clinical placements do not have the capacity to take large numbers of students. While students may work alongside other students at different stages in the course, they are unlikely to be their direct peers in terms of the stage of the course that they are at. This study identified that students used the perceived discrepancy between their own performance and that of peers as the basis of the development of an action plan. Therefore, the lack of a direct comparator in practice could limit the potential for discrepancy identification during clinical practice placements. During simulation live video feed of student groups and joint participation of observers and participants in a structured de-brief can prove a useful way of allowing for comparison.

While the majority of students developed action plans in which they identified areas of discrepancy and planned how they would address these, it is unclear how useful the students found such action plans. Indeed, it is not clear whether the action plans were referred to at all following their completion. The fact that so few students completed action plans after the final scenario, which was also the end of the research project, suggests that the students viewed the action planning process as simply part of the research data collection. The use of action plans and how students subsequently address the discrepancy identified is a significant area for further research. Discrepancy was still identified by students at the end of the research and, while all of the performance criteria had shown statistically significant improvements since the first scenario the students decided not to action plan for improvement. The fact that there was a statistically significant improvement in performance is interesting especially given the fact that the scenarios progressively get more complex and the level of direct academic facilitator support reduces over the year.

The action plans suggested a wide range of methods of addressing the identified discrepancy in performance. Some students cited that they planned to read around the topic, look up specific information or review previous lecture notes. Others planned to talk to other students and to gain opportunities for experience when out on placement. A small number of students provided clear statements about what they perceived future performance should

look like. These statements specifically related to behaviors such as having a clear leader or delegating tasks more effectively.

Following the research, the team have promoted the notion of discrepancy discovery and reduction to students. The discrepancy discovery tool is not used as there is little time between sessions for students to complete this. Work is underway to identify the resource implications of extending sessions to allow the discrepancy discovery tool to be routinely used and to enable students to develop and work on action plans. In the meantime academic facilitator's use the structured de-brief and video review to highlight possible discrepancies. This, together with the continuation of student peer observation and de-brief participation, allows students to identify possible discrepancies. In addition, academic facilitators point to possible methods of discrepancy reduction, for example self-directed learning, when summarizing the possible areas to be addressed in future scenarios during the application phase of the de-brief.

Conclusion

Discrepancy discovery can act as a catalyst for student learning with students appearing to prefer peer comparators over comparisons with students at a more advanced stage or qualified nurses. Given the limited opportunities for peer comparison within many contemporary nursing education programs, simulation can provide a useful vehicle for discrepancy discovery. While tools incorporating visual analogue scales may be useful in identifying performance and knowledge discrepancies their use outside of research projects may be limited by time constraints. In these circumstances discrepancy identification can be facilitated by using structured methods of de-brief and by incorporating video feedback which illustrates performance and behavior. Academic facilitators are then well placed to highlight good performance and areas for improvement as well as signposting possible methods of addressing discrepancy. Irrespective of the approach adopted, students must be free to

select the areas they wish to address and they are unlikely to select areas which they feel are beyond their reach in terms of their stage within the program.

References

Amerson, R. (2011) Making a case for the case study method. *Journal of Nursing Education,* 50; 427-428

Archer, J. (2010) State of the science in health professions education: effective feedback. *Medical Education,* 44; 101-108

Benner, P. (1984) *From novice to expert: Excellence and power in clinical nursing practice.* Menlo Park CA: Addison Wesley

Carless, D., Salter, D., Yang, M. & Lam, J. (2010) Developing sustainable feedback practices. *Studies in Higher Education,* 36; 1-13

Burke, H & Mancuso, L. (2012) Social cognitive theory, metacognition and simulation learning in nursing education, *Journal of Nursing Education,* 51; 543-548

Carver, C.S. & Scheier, M.E. (2000) On the structure of behavioural self-regulation In *Handbook of self-regulation* (Boekaerts, M., Pintrich, P.R. & Zeidner, M Eds). San Diego CA: Academic Press

Cato, M. L. Lasater, K. & Peeples, A. I. (2009) Nursing students' self-assessment of their simulation experiences. *Nursing Education Perspectives,* 30(2); 105-108

Cohen, L., Manion, L. & Morrison, K. (2007) *Research methods in education* (6th ed.) London: Routledge

Donnovan, J. J. (2009) Antecedents to discrepancy production in an achievement setting. *Journal of Managerial Issues,* 11(3); 402-420

Dreifuerst, K. T. (2009) The essential of debriefing in simulation learning: a concept analysis. *Nursing Education Perspectives,* 30; 109-114

Dreyfus, S.E. & Dreyfus, H.L. (1980) *A five stage model of the mental activities involved in directed skill acquisition.* Washington DC: Storming Media

Dunn, K. E. Osbborne, C. & Link, H. J. (2012) Exploring the influence of students' attributions for success on their self-regulation in pathophysiology. *Journal of Nursing Education,* 51(6); 353-357

Fanning, R. M. & Gaba, D. M. (2007) The role of debriefing in simulation-based learning. *Simulation in Healthcare,* 2(2); 115-125

Hasson, D. & Arnetz, B. B. (2005) Validation and findings comparing VAS v Likert scales for psychosocial measurements. *International Electronic Journal of Health Education,* 8; 178-192

Hesketh, B. & Ivanac, K.. (2002) *Enhancing performance through training*. In *Psychological management of individual performance* (Sabine Sonnentag ed.) Chichester: Wiley and Sons

Issenberg, B, S. McGaghi, W. C. Petrusa, E.R. Gordon, D. L. & Scalese, R. J. (2005) Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Medical Teacher,* 27(1) 10-28

Kirschenbaum, D. (1985) Proximity and specificity of planning: a position paper. *Cognitive Therapy and Research,* 9; 43-54

Lambert, S. M., Moore, D. W, & Dixon, R. S. (1999) Gymnasts in training: The differential effects of self- and coach-set goals as a function of locus of control. *Journal of Applied Sports Psychology,* 11(1); 72-82

Mantha, S., Thisted, R., Foss, J et al (1993) A proposal to use confidence intervals for visual analog scale data for pain measurement to determine clinical significance. *Anaesthesia Analg*, 77; 1041-1047

McCauley, V. & McClelland, G. (2004) Further studies in self-directed learning in physics at the University of Limerick, Ireland. *International Journal of Self-Directed Learning,* 1(2); 26-37

Molloy, E & Boud, D. (2013) Seeking a different angle on feedback in clinical education: the learner as seeker, judge and user of performance information. *Medical Education,* 47; 227-229

Myles, P. S., Troedel, S., Boquest, M. & Reeves, M. (1999) The pain visual analog scale: is it linear or nonlinear? *Anaesthesia Analg,* 89; 1517-1520

Neubert, M. J. (1998) The value of feedback and goal setting over goal setting alone and potential moderators of effect: a meta-analysis. *Human Performance,* 11(4); 321-335

Nichol, D. J. & Macfarlane-Dick, D. (2006) Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education,* 31(2); 199-218

Obukhova, L. F., & Korepanova, I. A. (2009). The Zone of Proximal Development: A Spatiotemporal Model. *Journal of Russian & East European Psychology*, 47(6), 25-47.

Owen, A.M. & Ward-Smith, P. (2014) Collaborative learning in nursing simulation: near-peer teaching using standardized patients. *Journal of Nursing Education,* 53(3); 170-173

Phillips, J. M., Hollenbeck, J.R. & Ilgen, D.R. (1996) Prevalence and Prediction of positive discrepancy creation: examining a discrepancy between two self-regulation theories. *Journal of Applied Psychology,* 81(5); 498-511

Pintrich, P. R. (2005) The role of goal orientation in self-regulated learning In *Handbook of self-regulated learning.* (Monique Boaekaerts, Paul Pintrich, Moshe Zeidner eds) London: The Academic Press

Roberts, D. (2007) Learning in clinical practice: the importance of peers. *Nursing Standard,* 23(12); 35-41

Steinwachs, B. (1992) How to facilitate a debriefing. *Simulation and Gaming,* 23 (2); 186-195

Svensson, E (2000) Comparison of the quality of assessments using continuous and discrete ordinal rating scales. *Biometrical Journal,* 42(4); 417-434

Timmins, F. (2008) Take time to facilitate self-directed learning. *Nurse Education in Practice,* 8; 302-305

Walsh, M. (2004) *Lecturers understanding and experiences' of self-directed learning and its relevance to undergraduate nurse education.* MSc Thesis, University College Dublin

Waltz, C., Strickland, O.L., & Lenz, E. (2010) *Measurement in Nursing and Health Research.* (4th Ed.) New York: Springer

Yin, R. (2003) *Case study research: Design and methods* (3rd ed). Thousand Oaks CA:

Sage

Yoo, M. S. Yoo, I. Y. & Lee, H. (2010) Nursing students' self-evaluation using a video recording of foley catheterization: effects on students' competence, communication skills and learning motivation. *Journal of Nursing Education,* 48(7); 402-405

Zimmerman, B.J. & Schunk, D.H. (1989) *Self-regulated learning and academic achievement: theory, research and practice.* New York: Springer

Conflicts of Interest: none

Table 1

Student self-reported scores and perceived peer comparator scores

Performance criteria		Student self-reported score [a] *(Median and range)*	Peer comparator score [b] *(Median and range)*	Wilcoxon Signed Ranks Test
Ability to work as a team member	(n = 69)	25 (9 – 40)	25 (10 – 40)	Z = -1.27, *p = 0.26*
Prioritising work	(n = 69)	22 (5 – 45)	25 (9 – 40)	Z = -3.1, *p = 0.002*
Delegation of tasks to others	(n = 69)	8 (0 – 45)	20 (3 – 40)	Z = -4.19, *p = >0.000*
Measurement of observations	(n = 69)	25 (0 – 50)	20 (3 – 40)	Z = -2.34, *p = 0.02*
Systematic patient assessment	(n = 69)	20 (0 – 45)	23 (0 – 40)	Z = -2.52, *p = 0.012*
Identification of the patient's problem	(n = 69)	18 (0 – 38)	20 (10-40)	Z = -4.78, *p = >0.000*
Understanding physiology	(n = 69)	18 (0 – 38)	38 (16-50)	Z = , *p = 0.001*
Awareness of medicines	(n = 69)	14 (0 – 40)	20 (0 - 39)	Z = -4.54, *p = >0.000*
Handoff (handover) / call to doctor	(n = 68)	20 (0 – 41)	20 (5 – 37)	Z = -2.6, *p = 0.009*

Note a. from first scenario b. second year student at a similar stage in the program as the student

Table 2

Median student self-reported scores at first and final simulation scenario

Performance criteria		Student first self-reported score (First scenario) *(Median and range)*	Student final self-reported score (Final scenario) *(Median and range)*	Wilcoxon Signed Ranks Test
Ability to work as a team member	(n = 69)	25 (9 – 40)	35 (10 – 50)	Z = -5.95, *p* = *>0.000*
Prioritising work	(n = 69)	22 (5 – 45)	30 (10 – 50)	Z = -5.06, *p* = *>0.000*
Delegation of tasks to others	(n = 69)	18 (0 – 45)	30 (10 – 50)	Z = -5.56, *p* = *>0.000*
Measurement of observations	(n = 69)	25 (0 – 50)	33 (0 – 47)	Z = -4.81, *p* = *>0.000*
Systematic patient assessment	(n = 69)	20 (0 – 45)	30 (10 – 46)	Z = -5.26, *p* = *>0.000*
Identification of the patient's problem	(n = 69)	18 (0 – 38)	30 (10 - 45)	Z = -5.35, *p* = *>0.000*
Understanding physiology	(n = 69)	18 (0 – 38)		
Awareness of medicines	(n = 69)	14 (0 – 40)	25 (0 - 39)	Z = -5.52, *p* = *>0.000*
Handoff (handover) / call to doctor	(n = 68)	20 (0 – 41)	30 (6 – 4.3)	Z = -5.45, *p* = *>0.000*

Table 3

Top five action plan themes across all three simulation scenarios

Rank	Action plan theme	Percentage of students producing an action plan	Numbers of students producing an action plan	Median student self -reported score	Median peer comparator score	Median level of disc'pancy
1	Understanding of medicines					
	Scenario 1	74.2%	n = 49	13	25	12
	Scenario 2	79.0%	n = 49	18	32	12
	Scenario 3	68.7%	n = 11	25	30	5
2	Understanding of physiology					
	Scenario 1	40.9%	n = 27	18	23	5
	Scenario 2	51.6%	n = 32	20	30	10
	Scenario 3	37.5%	n = 6	20	30	10
3	Patient assessment					
	Scenario 1	33.3%	n = 22	20	30	10
	Scenario 2	27.4%	n = 17	20	30	10
	Scenario 3	37.5%	n = 6	20	30	10
4	Confidence during hand off					
	Scenario 1	25.7%	n = 17	10	20	10
	Scenario 2	32.2%	n = 20	16	29	13
	Scenario 3	25.0%	n = 4	20	30	10
5	Delegation to others					
	Scenario 1	16.6%	n = 11	13	25	12
	Scenario 2	22.5%	n = 11	15	25	10
	Scenario 3	25.0%	n = 4	20	30	10

Figure 1 The Discrepancy Discovery tool

*Please indicate which scenario you **participated** in today (tick one box per form ONLY)*

AA0404 / 503	Post Operative Patient	☐	Asthma	☐
	Chest Pain	☐	Urinary Tract Infection	☐
AA0504	Chest Pain	☐	Meningitis	☐

For each of the areas shown below use the Visual Analogue Scale 0-5 (0 = novice and 5 = expert) and rate your performance today, where you think a student at your stage of training should be, where a third year student should be and where a newly qualified staff nurse should be

Please rate each area by placing a cross somewhere on each 5cm (50mm) line |✖——|

	Your performance today	*A student nurse at your stage*	*A third year student nurse*	*A newly qualified staff nurse*
Ability to work as a member of a team	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert
Prioritising work	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert
Delegation of tasks to others	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert
Measurement of observations and use of Early Warning Score	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert	0 5 Novice Expert

Systematic patient assessment	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**
Identification of the problem	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**
Understanding of Physiology	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**
Awareness of medicines, their uses and side effects	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**	**5** Novice Expert **0**
Handover (handoff) / Call to Doctor	**5** Novice Expert	**5** Novice Expert	**5** Novice Expert	**5** Novice Expert