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Evaluation of a novel scoring and grading model for VP-based exams in postgraduate nurse education☆

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SUMMARY

For Virtual Patient-based exams, several scoring and grading methods have been proposed, but none have yet been validated. The aim of this study was to evaluate a new scoring and grading model for VP-based exams in postgraduate paediatric nurse education.
The same student group of 19 students performed a VP-based exam in three consecutive courses. When using the scoring and grading assessment model, which contains a deduction system for unnecessary or unwanted actions, a progression was found in the three courses: 53% of the students passed the first exam, 63% the second and 84% passed the final exam. The most common reason for deduction of points was due to students asking too many interview questions or ordering too many laboratory tests.
The results showed that the new scoring model made it possible to judge the students' clinical reasoning process as well as their progress.

Introduction

In nursing education it is important to assess the competencies that are essential for the professional role, such as clinical reasoning and decision-making. Clinical reasoning can be described as a cognitive process of applying knowledge and experience to clinical situations in order to develop solutions. By analysing patient data the nurses get an overall picture of the patient and can plan and perform actions for positive patient outcomes (Fonteyn and Ritter, 2008; Wangensteen et al., 2011; Yanhua and Watson, 2011). To teach and learn clinical reasoning can be difficult because of its complexity. Levett-Jones et al. have described a learning model for the "five rights" of clinical reasoning. Nurse students should adapt "the ability to collect the right cues and take the right action for the right patient at the right time and for the right reason" (Levett-Jones et al., 2010, p.517).

Virtual Patients (VPs) are defined as interactive computer simulations of real-life clinical scenarios for the purpose of healthcare and medical training, education or assessment (Ellaway et al., 2008). Most VP systems have common features including an introduction, patient interview, physical examination and laboratory/imaging tests as well as features for suggesting appropriate diagnosis and treatment, and a feedback section (Bergin and Fors, 2003; Kononowicz et al., 2015; Zary et al., 2006). VPs have been found to enhance learning (Botezatu et al., 2010b) and have also been recommended for the assessment of clinical reasoning (Cook and Triola, 2009). The use of VPs for assessment is based on the fact that VP systems are focused on clinical reasoning and have the potential for tracking in detail every interaction of the user, which can be used for assessment (Botezatu et al., 2010a, 2010b; Forsberg et al., 2011).

Web-SP (Web based Simulation of Patients) is a VP system initially developed at Karolinska Institutet in Sweden (Zary et al., 2006) and used in healthcare education at several universities worldwide. Since 2010 Web-SP has included a semi-automatic assessment module which allows the examiner to define required or recommended patient interview questions, physical examinations and laboratory and imaging tests in order to score student's performance (Forsberg et al., 2011).

In healthcare education, exams are predominantly performed at the end of a course/programme as a summative assessment, to provide a basis for grading students. However, one exam form cannot measure

☆ Authors' contributions
E. FORSBERG, PhD, RNT, at Halmstad University, Halmstad, Sweden. EF participated in the planning of the study and performed all educational activities. EF also analysed the material and wrote a substantial part of the manuscript.
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KZ, HH and UF all participated in the planning of the study and contributed to the writing of the manuscript. All authors have approved the final version of the manuscript.

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everything (Van der Vleuten et al., 2012). To design exams for clinical competence (including clinical reasoning), various taxonomies can be used. A well-known international taxonomy for assessment of clinical expertise is Miller's four-level taxonomy (See Fig. 1). At the base level, *knows*, the student can demonstrate factual knowledge. On the next level, *knows how*, the student should show an ability to use the knowledge in a specific context, for example, as clinical reasoning in solving a patient's issue(s). The third level, *shows how*, describes a student's ability to act appropriately in a simulated environment. To assess clinical competence, *does*, the top of Miller's pyramid (Miller, 1990), the student should demonstrate skills in a real work environment — thus a workplace-based exam needs to be undertaken. A proper VP-based assessment should therefore target the second and third levels of Miller's pyramid.

The Bologna Directives recommend the Structure of the Observed Learning Outcome (SOLO) taxonomy (Biggs and Tang, 2007) as the criterion by which students' knowledge should be assessed. The SOLO-taxonomy consists of five stages and exams for postgraduate nursing should be designed to provide for assessment of the higher levels of this taxonomy, i.e. showing achieved ability to identify, synthesise and apply knowledge in complex clinical situations.

A problem in scoring and grading all kinds of exams is to find a model that differentiates excellent students from those who are not so good. The use of rubrics can improve reliability of the scoring and this also seems to help students improve their performance in an exam (Jonsson and Svingby, 2007). There have been discussions regarding the difficulty of finding an effective way to assess healthcare students' 'clinical reasoning process' in diagnosis and treatment (Cook and Triola, 2009) and VP-based exams have been proposed to solve this issue. However, several scoring and grading methods have been proposed for VP-based exams, but none have yet been verified as reliable (Botezatu et al., 2010a; Fors and Gunning, 2014; Oliven et al., 2011; Perron et al., 2009; Waldmann et al., 2008). However, it is not only important to arrive at an accurate diagnosis, it is also necessary to assess which steps students are taking to get there (for example, which interview questions they have asked or what physical exams they have performed). In a previous study, experienced nurses argued that students should not get a high score if they had asked every possible patient interview question or ordered all available laboratory tests (Forsberg et al., 2014), calling for a model that also controls such issues.

In Sweden, you need a Bachelor's degree in nursing (180 higher education credits [ECTS], 3 years) and most universities also require registered nurse (RN) experience for at least 1 year before applying for postgraduate Diploma in Specialist Nursing Paediatric care (60 ECTS, 1 year). The postgraduate education includes learning goals such as demonstrating clinical reasoning skills and ability in child health- and paediatric care. To measure these skills in a resource- and cost-efficient manner and to follow students' progress over time can be tricky. In Sweden VP-based assessments are not a national model for final examinations, but such a model might facilitate the assessment. But even if VP-based exams might be used to assess these skills, it is still not known how different scoring and grading rubrics should be constructed to best suit assessments of clinical reasoning in nursing.

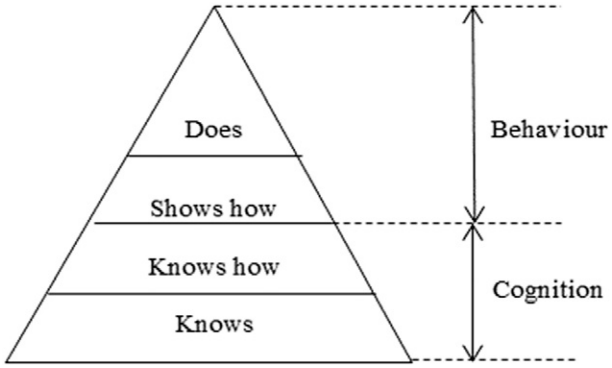

Fig. 1. Miller's pyramid of clinical competence (Miller, 1990).

The aim of this study was therefore to evaluate a novel scoring and grading assessment model for VP-based exams in postgraduate paediatric nurse education.

Method

Design

A study with quantitative descriptive design was set up. The VP system Web-SP was used for assessment of postgraduate paediatric nurse students' clinical reasoning skills. Twelve different VP cases representing different sub-disciplines in paediatrics were created and implemented in Web-SP. All cases were validated by a senior paediatrician. Four cases were used in each of the courses, depending on the course content. For the study, a special scoring and grading assessment model was used.

Sample

In the educational programme for postgraduate paediatric nursing care, 19 students participated in three summative VP-based exams in three consecutive courses. The first course in the educational programme is Health and Ill Health related to Children and Adolescents (15 credits), and the first exam took place after 10 weeks; the second course is Neonatology (7.5 credits) and the students performed the exam at the end of the first semester. In addition, during the first semester the students have a course in Pain Management related to Children and Adolescents (7.5 credits); knowledge from the Pain Management course is assessed in the Neonatology exam and in the exam for the last course at the end of second semester. The last course is Paediatrics and Paediatric Nursing Care (30 credits) and the third VP-based exam takes place at the end of second semester.

Students received oral and written information about Web-SP and the exams. The students also had access to as much training as they wanted before the exams using two to four other cases in Web-SP. They performed the exam on a specific day and time at home or at the university and they had a maximum time of 3 h to solve the four exam VP cases.

Requirements Per Case

Before the exams, a group of experienced teachers agreed on which specific patient interview questions, physical examinations and laboratory/imaging tests in Web-SP should be 'recommended' per case. These 'recommended' actions were not visible to the students during the exam, but used as a base for the scoring and grading rubric (see below). Additionally, each case contained a follow-up question on basic physiological principles or clinical approaches that were reflected in the case. The teachers also decided on correct diagnosis and treatment regimens, including optimal justifications for these decisions.

The Scoring And Grading Model Applied

The scoring rubric applied was based on previous studies (Forsberg et al., 2011, 2014) but also inspired by the model used by Botezatu et al. (2010a). Before applying this new scoring and grading model, a validation process of the model was performed where 18 students in a distance-based course for postgraduate paediatric nursing care received two summative VP-based exams with four VP cases at each time. A preliminary scoring and grading model was applied for the assessment