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Identifying strategies to assist final semester nursing students to develop numeracy skills: A mixed methods study

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SUMMARY

Background: It remains a grave concern that many nursing students within tertiary institutions continue to experience difficulties with achieving medication calculation competency. In addition, universities have a moral responsibility to prepare proficient clinicians for graduate practice. This requires risk management strategies to reduce adverse medication errors post registration.
Aim: To identify strategies and potential predictors that may assist nurse academics to tailor their drug calculation teaching and assessment methods. This project builds on previous experience and explores students' perceptions of newly implemented interventions designed to increase confidence and competence in medication calculation.
Methods: This mixed method study surveyed students ($n = 405$) enrolled in their final semester of study at a large, metropolitan university in Sydney, Australia. Tailored, contextualised interventions included online practice quizzes, simulated medication calculation scenarios developed for clinical practice classes, contextualised 'pen and paper' tests, visually enhanced didactic remediation and 'hands-on' contextualised workshops. Surveys were administered to students to determine their perceptions of interventions and to identify whether these interventions assisted with calculation competence. Test scores were analysed using SPSS v. 20 for correlations between students' perceptions and actual performance. Qualitative open-ended survey questions were analysed manually and thematically.
Results: The study reinforced that nursing students preferred a 'hands-on,' contextualised approach to learning that was 'authentic' and aligned with clinical practice. Our interventions assisted with supporting students' learning and improvement of calculation confidence. Qualitative data provided further insight into students' awareness of their calculation errors and preferred learning styles. Some of the strongest predictors for numeracy skill performance included (1) being an international student, (2) completion of an online practice quiz, scoring 59% or above and (3) students' self-reported confidence.
Conclusion: A paradigm shift from traditional testing methods to the implementation of intensive, contextualised numeracy teaching and assessment within tertiary institutions will enhance learning and promote best teaching practices.

Introduction

It is crucial that nursing students and registered nurses alike are confident and competent in drug calculations as patients' lives depend on the nurse's ability to calculate with accuracy. One mistake can literally lead to significant patient harm. Unfortunately, medication errors remain the leading cause for self-reported errors among nurses, highlighted by the number of preventable medication errors reported through hospital Incident Information Management Systems [IIMS] (NSW Health, 2007). From the point of becoming a registered nurse, the new graduate is legally expected to safely calculate and administer medications; therefore, competence must be achieved in undergraduate learning (Australian Nursing and Midwifery Council, 2006). This reinforces the need for university educators to implement numeracy strategies, in both teaching and assessment, which cater to the differing learning styles of students.

Historically, developing undergraduate nursing students' confidence and competence in medication calculation has been an ongoing challenge for nurse academics within Australia and internationally (Wright, 2007, 2010). Accurate calculation skills has become a component of university teaching, demanding new and innovative approaches to achieve higher levels of competence (Wright, 2008). With this in mind, this project was designed to identify strategies and potential predictors that may

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assist nurse academics internationally to tailor drug calculation teaching and assessments. This should maximise confidence and competence in students and better prepare them for their future responsibilities as a registered nurse.

Background

Although mathematical skills and competency in medication calculation are essential skills for nurses to perform proficiently, evidence shows that practicing nurses and undergraduate students have weak numeracy foundations (Dilles et al., 2011; Dray et al., 2010; Eastwood et al., 2011). Furthermore, many student nurses prior to graduation feel inadequately prepared to administer medications safely (Dilles et al., 2011). Due to the importance of numeracy for undergraduate nurses, some programs require evidence of basic numeracy skills as a prerequisite (Dray et al., 2010). A recent study has identified conceptual, arithmetical, and computational areas as main areas for errors in numeracy (Eastwood et al., 2011). Another study further highlighted that to calculate correctly, students needed to understand decimal numbers before learning procedural rules for calculation (Pierce et al., 2008).

A plethora of research describes varying factors that may relate to nurses' and student nurses' mathematical abilities and performance, and these included prior background knowledge, clinical practice experience, age, school level, and work experience. However, there remains no consensus on this issue (Grandell-Niemi et al., 2003, 2006; McMullan, 2010; McMullan et al., 2010). Moreover, Walsh (2008) highlighted students' confidence levels increased with further exposure to medication calculation practice.

Elliott and Joyce (2005) suggested that when teaching numeracy within the curricula, it is essential to develop students' calculation ability rather than focussing on assessment. Research shows that instructional approaches are important, particularly case-based scenarios that simulate practice. In fact, the literature reiterates that the use of contextualised calculation tests have better results than traditional 'pen and paper' tests (Cartwright, 1996; Hutton et al., 2010; McMullan, 2010; Ramjan, 2011; Wright, 2008). Computerised and multimedia programs are seen to be helpful with acquiring procedural knowledge and, for some students, improved satisfaction (Glaister, 2005, 2007; Maag, 2004). Internationally, the literature reports mandatory numeracy tests, which students need to master, to successfully complete course requirements before registration (Wright, 2005, 2009), whereas Dyjur et al. (2011, p. 210) support the need for numeracy learning, testing and practice to avoid isolation and advocate that educators should focus on the minimisation of 'factors such as inexperience, distractions, interruptions and communication' that can impede safe practice. Indeed, Westbrook et al. (2010) had earlier identified that distractions during the administration of medication increased the risk of error.

Further studies demonstrate that nursing students perform better in their medication calculation skills when taught and tested during or immediately after clinical placement, highlighting the need for contextualised teaching (Adams and Duffield, 1991; McMullan, 2010; Wright, 2009). Students need to practice and develop skills during clinical experience, and the role of educators and clinicians is imperative for ensuring support and guidance (Jukes and Gilchrist, 2006; McMullan et al., 2010). This small-scale educational research project to improve teaching practice reiterates the need for a variety of learning interventions to develop confidence and competence in medication calculation when preparing nursing students for their transition to the workplace.

Methods

At a large Australian multi-campus school of nursing and midwifery faculty, students were offered three separate opportunities during their final session to demonstrate medication calculation competence. To acquire a satisfactory grade, students needed to achieve 100% competency (mastery) in one contextualised 'pen and paper' test. Academic lecturers within the school had an expectation that final semester students would have the ability to transfer previously learnt numeracy skills across the program. However, over the past 3 years, the failure rate for final semester students indicated limited transfer of numeracy acquisition. This was a catalyst for change.

Design

This ethics-approved project investigated predictors of numeracy skills performance, examining nursing students' perceptions of the effects of specific tailored interventions on their learning and perceived confidence, using a mixed methods design. Sampling was purposive. Participants were students enrolled in a third year unit ($n = 628$), 'Transition to Graduate Practice (TGP)' in a Bachelor of Nursing course at the University of Western Sydney (UWS). Of the total cohort, 390 students (62%) consented to participate and agreed to have test scores analysed. The participants included 327 female and 63 male students.

Learning and Teaching Interventions

The following interventions were implemented to improve numeracy outcomes for students (see also Fig. 1):

1. Online practice quizzes available to students with increased accessibility (highly recommended).
2. Simulated medication calculation scenarios incorporated into the first three clinical practice unit (CPU) classes.
3. Contextualised 'pen and paper' test (test 1) in tutorial classes in week 3.
4. A visually enhanced didactic remediation workshop in the CPU (1 hour), with a ratio of two to three lecturers (cross-disciplinary) to 20 students during week 7—offered to those unsatisfactory in test 1.
5. Students unsatisfactory in test 1 re-tested in week 8 and received another contextualised 'pen and paper' test (test 2).
6. A 'hands-on' contextualised workshop in the CPU (1 hour), with a ratio of one to two lecturers (nursing) to 10 students, in week 15—offered to those unsatisfactory in Test 2.
7. A final contextualised 'pen and paper' test (test 3) administered (final teaching week).

Nursing and numeracy lecturers collaborated to facilitate these workshops with increased teacher to student ratios.

Data Collection

Survey 1 was administered during tutorial classes in week 15 (final teaching week) and survey 2 was administered immediately following the 'hands-on' workshop by independent staff. Students were surveyed about their levels of confidence in medication calculation and the perceived value of these interventions. Demographic data were collected, with additional university data to obtain a global perspective of this cohort. Both surveys included Likert rating scales (0–10) and additional space was provided for qualitative comments. All survey data were entered into an SPSS version 20 database by a research assistant (RA).

Ethical approval for conducting this study was granted by the University of Western Sydney Human Research Ethics Committee. Participation was voluntary and students were fully informed of their right to withdraw their consent to participate at any time during the study. None did so. All test scores were linked to individual survey data by the RA.