Surveying the experiences and perceptions of undergraduate nursing students of a flipped classroom approach to increase understanding of drug science and its application to clinical practice

Julie Hanson, PhD RN

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Original research article

Title: SURVEYING THE EXPERIENCES AND PERCEPTIONS OF UNDERGRADUATE NURSING STUDENTS OF A FLIPPED CLASSROOM APPROACH TO INCREASE UNDERSTANDING OF DRUG SCIENCE AND ITS APPLICATION TO CLINICAL PRACTICE

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Correspondence details of authors:

Corresponding Author: Julie Hanson PhD RN
Lecturer of Nursing, University of the Sunshine Coast,
ML 40, Locked bag 4, Maroochydore DC
Queensland 4558, Australia
Email: jhanson@usc.edu.au
Phone: +61 75456 5767
Fax: +61 75456 5940

Contributor
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HIGHLIGHTS

- Flipped learning increased students’ understanding of pharmacology concepts
- Flipped learning improved students’ application of drug science to practice
- Replaying eLectures was beneficial to independent learning
- Time-poor students relied on eLectures alone and did not benefit from workshops
- Some students prefer traditional teaching methods

INTRODUCTION

Patient harm from medication administration error is a significant ethical and public health issue. Medication errors result in poor patient outcomes and increased healthcare costs (Dormann et al., 2013; Handler et al., 2006; Roughead et al., 2013). Medication-related activities in hospital settings account for up to one third of a nurses’ workload (Keers, 2013) and consequently, medication administration is perceived as a “routine task” (Hewitt et al., 2015, p.17). A task-orientated view of medication administration belies the multifaceted nature of medication related activities and the complex processes required to maintain patient safety and promote patient education (Hewitt et al. 2015; Roughead and Semple, 2009). The Nursing and Midwifery Board of Australia Code of Ethics for Nurses acknowledges that nurses’ play a key role in the detection and prevention of errors and adverse events in health care settings and serves to remind the profession of its ethical obligation to “do no harm” (NMBA, 2008).
factor that contributes to medication administration errors by health professionals (Keers et al., 2013), another important issue is knowledge-deficits (Brady et al., 2009; Del Bueno, 2005; Meechan et al., 2011; Nichols et al., 2008). According to Boggs et al. (1998), nurses know dose, indication and adverse effects of medications but often have insufficient knowledge of how drugs work (pharmacodynamics) and interact with the body (pharmacokinetics). Ndosi and Newell (2008) discuss the need for nurse educators to redesign pharmacology courses to meet the challenges nurses face of administering multiple medications for multiple diseases. Hence, understanding the mechanism of action and drug interactions are an essential component of drug knowledge (Ndosi and Newell, 2008). Previously, nurse educators tended to give this type of knowledge little attention (Morrison-Griffiths et al., 2002) but a move towards collaborative, multidisciplinary approaches to medication management focus on developing knowledge, patient education skills and interprofessional communication to enable nurses to deliver safe, high quality care (Leufer and Cleary-Holdforth, 2013; Levett-Jones et al., 2012). The current imperative to provide nurse education via online components is driven by the diverse needs of 21st Century learners. Flipping the classroom means that: (i) what used to be presented in a formal lecture context is now learned using online resources; and (ii) what was previously designated as homework is now worked on in class with the teacher present and involved in dialogue (Salyers, 2007; Bergmann and Sams, 2012; Kim et al., 2014). A flipped classroom approach can offer flexible delivery of technology-enhanced materials (Chen et al., 2014; Entwistle, 2008; Keppel et al., 2010; Johnston et al., 2013; Gedik et al., 2013; Bloomfield and Jones 2013; Kim et al., 2014; Sidebotham et al., 2013; Simpson and Richards, 2015). According to Ferreri and O’Connor (2013) teaching approaches that move beyond traditional instruction are the most effective at engaging students and enhancing their learning.
Reason for change

The pharmacology course is offered in second-year of the Bachelor of Nursing Science Degree. It is a theoretical course with no clinical skills component and is designed for undergraduate nursing students to learn foundational pharmacological concepts and their relevance to clinical practice. A strong focus on pharmacokinetic and pharmacodynamic principles within the course content complies with the Australian Health Practitioner Regulation Agency (AHPRA) accreditation standards, which require that nurses understand drug principles underpinning how drugs work and interact with the body.

Based on course evaluations and anonymous feedback from 2008-2009, it was apparent that many students found the fundamental pharmacological concepts difficult to understand and struggled to see their relevance to clinical practice. The surveys revealed that when using a conventional lecture format, it was the first time that students were exposed to difficult scientific concepts. In 2010-2011, the course coordinator realised that students were interested in learning about drug science and feedback on the lecturer and lecture content in that topic scored between 4.6 and 4.7 on a 5.0 point Likert scale (1 = very poor; 5.0 =Excellent). However, many students struggled to listen, write and make meaning of new and sometimes technical content in the lecture. The coordinator, in conversation with students, discovered that an inability to grasp new concepts was a source of discouragement, disengagement and frustration. These issues prompted a change to a flipped classroom approach in 2012 with the aim of enhancing students’ understanding of pharmacology by inviting them to engage with the scientific concepts on their own, prior to gaining access to the knowledge via the lecturer. The starting point of this study was to gauge the level of understanding that students had been achieving through conventional teaching methods and measure their response to a flipped approach.
Justification for change

This university’s strategic plan for 2011-2015 prioritised blended learning in acknowledgement of its worldwide appeal to students. Recent research on the impact in university teaching has focused on blending digital technologies with face-to-face learning using virtual learning environments (VLEs). Lameras et al. (2012) defined VLEs as the course management systems that support student engagement through the provision of video, audio, weblinks, discussion boards, quizzes and chat rooms.

The literature supports the use of blended teaching approaches in nursing. Web-enhanced learning has benefited clinical skills development in nursing students by providing access to the theoretical principles behind each skill prior to practice sessions in a clinical skills class (Bloomfield and Jones, 2013). Digital lecture recordings have enhanced flexible engagement with anatomy and physiology coursework, proving valuable to students as a way to supplement learning experiences of lecture content, laboratory classes and independent learning (Johnston et al., 2013). Within a Bachelor of Midwifery programme, blending face-to-face workshops with interactive online modules concerned with evidence-based practice and research has resulted in high levels of student satisfaction and success (Sidebotham et al., 2013). This has also been shown by improvements in laboratory psychomotor skills outside the classroom and higher than average exam scores on final assessment (Salyers, 2007). In addition, blending of lectures with simulation has been effective in improving student satisfaction and self-efficacy in clinical skills education (Sinclair and Ferguson, 2009). Other benefits include increased graduate confidence, psychomotor skills and decision-making (Kerrigan, 2008). When teaching population health and health promotion to nursing students using a flipped classroom, Simpson and Richards (2015) found that students were enthusiastic about flexible delivery and self-paced learning, and faculty staff noted an increased understanding of the relevance of studying population health in the nursing program.
AIM

The aim of the study was to elicit undergraduate nursing students’ responses to a flipped classroom approach in pharmacology lectures and evaluate the impact on their understanding of drug science and its application to clinical practice.

FLIPPED CLASSROOM DESIGN

It was proposed that by engaging students in conversations concerning the analysis and synthesis of the lecture content with the lecturer present, it would be possible to focus on knowledge application (Pluta et al., 2013), critical thinking (Simpson and Richards, 2015) and detecting misconceptions (O’Flaherty and Phillips, 2015). Advocates for this approach have recognised that digitally recorded materials alone are not sufficient to benefit learning, rather they represent one component that needs to be integrated into a more holistic approach (Bergman and Sams, 2012; Tucker, 2012; Chen et al., 2014).

In this flipped classroom design in 2013 and 2014, there were six components that remained consistent in the delivery of the lecture content over the two-year period. The study was designed to make comparisons about students’ understanding and measure their responses so the only intentional change in the lecture series was the increased number of students enrolled. The six components were:

1. eLectures: pre-recorded voice-overs of lecture slides were prepared of lecture slides and all eLectures were made available from week one of the semester. The availability enabled students to watch, listen and engage with fundamental concepts at any time before the class;

2. Lecture format: The lectures were prepared such that they clearly stated the learning outcomes for the session; 3-5 quiz questions were written to test student understanding of three main concepts in the eLecture; and a case study was included to generate discussion on
how the scientific concept(s) relate to clinical practice. Face-to–face attendance for lectures was not mandatory and the sessions were recorded in real-time for students to listen to outside of class. A summary of the key points and concepts was provided at the end of each session for students who did not listen to the eLecture pre-class;

3. Quizzes: quiz questions were presented at the start of each session. Students answered these individually to test their level of knowledge gained from the eLectures;

4. Peer discussion: Students formed discussion groups in pairs or small groups of 3-4 and compared their answers to the quiz with those of their peers;

5. Teacher discussion: quiz answers were discussed with the lecturer to identify and correct misunderstandings and coach students into presenting their responses with greater accuracy. This process allowed the lecturer to review the students’ achievements with the independent learning component of the course and gauge their understanding of the concepts;

6. Case studies: analysis of a case study to illustrate how drug science can be applied to safe medication administration with patients in clinical practice.

For the purpose of analysing the survey data, the ‘lecture’ is referred to as a ‘workshop’ because it was the experience of the lecturer that the classes felt less like a traditional lecture and more interactive. The workshop was dedicated to interactive dialogue, synthesis of theoretical concepts and application of drug science to the practice context.

EVALUATION METHODS

Procedures and participants

The study was undertaken at a Southern Queensland university. Purposive sampling was used and participants were recruited from an undergraduate nursing cohort enrolled in a
second year pharmacology course in 2013 (n=187) and in 2014 (n=220). A research participant information sheet was provided in the announcements section of the online course materials, which generated an email to all students enrolled in the course. Ethical approval for the survey was obtained from the university ethics committee and the strategic information and analysis unit.

Evaluation measures

A descriptive research method was used that involved an internet-based self-completion questionnaire (Schofield and Knauss, 2010). All students enrolled in the course for 2013-2014 were invited to complete a questionnaire online using a survey-hosting website known as surveymonkey and were provided with the web-link for access via email (SurveyMonkey, Inc 2013). Data were collected using a 10-item questionnaire. In 2013, the questionnaire was administered post-flipping only; in 2014, the questionnaire was administered both pre- and post-flipping. In 2014, the post-flipping questionnaire was reviewed prior to its use by a panel of four academics experienced in using the flipped classroom approach in nursing, public health or engineering courses. They confirmed that, after minor modifications, the questions were relevant to the study, easily understood and logically ordered (Schofield and Knauss 2010). In the pre-flipping questionnaire 2014, four open-ended questions were used to elicit responses about students’ expectations of the course with regard to what knowledge could help to prepare them for the workplace and, what they perceived the teaching team could do to satisfy their learning needs. In the post-flipping questionnaire 2013-2014, a mix of both closed and open-ended questions were use (common in this approach) and included standardised response options, so that data could be easily compared across individuals and groups, as well as free text boxes where students could submit further qualitative comments (De Vaus, 2007). Each question had two parts: part one included three to eight verbal response categories and asked students to answer what they
thought was the most appropriate. Part two was an open-ended question requesting that students elaborate on their responses to part one. The six components of this flipped classroom design were evaluated using 10 questions (Table 1).

**Table 1**

<table>
<thead>
<tr>
<th>Component</th>
<th>Question(s)</th>
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<tr>
<td>eLectures</td>
<td>Questions 1, 2, 3 and 5</td>
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<tr>
<td>Lecture format</td>
<td>Question 4</td>
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<td>Quizzes</td>
<td>Question 5</td>
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<tr>
<td>Peer discussion</td>
<td>Question 5</td>
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<tr>
<td>Teacher discussion</td>
<td>Question 6, 7 and 10</td>
</tr>
<tr>
<td>Case studies</td>
<td>Question 5</td>
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Questions 1 - 2 elicited responses about accessibility and frequency of viewing eLectures. Questions 3 sought students’ views as to how the eLectures could be improved. Question 4 sought data about class attendance. Question 5 explored whether the face-to-face activities improved understanding of eLecture content. Question 6-7 attempted to determine if the knowledge gained through eLectures helped students to feel comfortable contributing their views in class. Question 8 sought students’ views on how the classes could be improved. Question 9 was aimed at obtaining students’ beliefs about whether the flipped classroom helped them to engage with colleagues and content compared to their experiences of traditionally taught classes. Question 10 was aimed at discovering if students’ thought the flipped classroom method enhanced rapport with the lecturer. Question 5 is provided as an example of a verbal rating question (Table 2).

**Table 2**
Question 5. “When you listened to the eLectures before the workshop, did this knowledge help you to feel comfortable contributing your views during the group activities?

I never listened to the eLectures before the workshops
No, I did not feel I learned enough from the eLectures to share my views in the workshops
After the eLectures, I asked questions of my group but did not share ideas
After the eLectures, I asked questions of my group and shared my ideas
Yes, I had information to share due to what I had learned from the eLectures
I had information to share due to my own prior experiences

FINDINGS

Sample description

In total, fifty-one second-year undergraduate nursing students completed the questionnaire across two cohorts, representing 13% of the population enrolled in the pharmacology course 2013-2014. It is important to note that all students enrolled in the course were regarded as study participants but the completion of the survey was voluntary. The response rate was low (13%) even though the study was explained to students via online announcements and in workshops. The number of responses is comparable to some anonymous online feedback on courses collected at the end of each semester. On the one hand, this finding is concerning as it shows that sometimes the majority of students opt out of surveys even though they have the potential to improve the standard of their education. However, the response rate may also reflect that the flexible delivery permitted students to choose what aspects of the course activities they participated in. In addition, the response rate may be due time constraints as students are often are in paid employment concurrent with
their university studies (Salamonson and Andrew 2006; Rochford et al., 2009). Demographic data was not collected from the participants.

**Flipped classroom intervention evaluation**

Whilst the sample size was small, multiple verbatim quotations from students across two separate cohorts in 2013 and 2014 respectively, illustrate common themes within the data, and are representative of the multiple perspectives revealed by the participants of their experiences of a flipped classroom intervention (Liamputtong, 2013). Three of these themes reoccur across the data sets and show that students in different cohorts had some common experiences of the six components used consistently in this flipped classroom approach.

The data revealed that eLecture recordings were accessible and viewed by the majority of the respondents prior to the face-to-face class. The highest percentage recorded was for respondents who did not have any problems viewing the lectures representing 88% in 2013 (n=23), but this was lower at 64% in 2014 (n=16). The highest percentage recorded was for respondents who viewed every eLecture (35% in 2013; n=9) or viewed eLectures at least three-quarters of the time (32% in 2014; n=8).

Three predominant themes emerged from the pre-flipping data 2014 when students were questioned about their expectations of the course, of their own contribution to learning, and the teaching team.

**Competence, focus, and creating partnerships**

Students expected the course to be challenging due to the volume of content and the technical language. Students’ self-expectations were that they would focus, study hard, and listen to whatever was offered in order to achieve good grades. Nursing students were thinking ahead to the workplace and knew that they would need knowledge and
understanding of drug actions, confidence and competence in drug administration and know what resources/partnerships to draw on to maintain safe practice. Students felt that the teaching team could satisfy their learning objectives by being knowledgeable, competent to teach, accessible, focused – staying on track and prioritising information - and creating learning partnerships to guide them through their workload.

Three themes emerged from the post-flipping data 2013-2014 concerned with what students believed to be the beneficial aspects of a flipped classroom approach in the pharmacology course. These were *increased understanding*, *pause and replay*, and *wider and deeper thinking*.

**Increased understanding**

Increased understanding was perceived by nursing students to be a positive outcome of a flipped classroom approach that combined an eLecture prior to class with a face-to-face component in the workshop. Students stated that being introduced to scientific concepts prior to the workshop made the pharmacology content easier to comprehend and more interesting. Furthermore, the knowledge gained through the eLecture meant that students knew what to expect at the workshop and could prepare questions:

> It [the eLecture] gave you an understanding prior to the workshop that made it easier to comprehend what was being taught and have any questions ready on things you didn’t quite get that you could ask and have it expanded on in the workshop (2013)

> I found the eLecture is very direct and it helps me to understand better to listen to it before class (2014)

**Wider and deeper thinking**
Wider and deeper thinking was experienced by students through the linkage of the concepts within the course to their clinical application. Students recorded that they had developed deeper critical thinking skills and an appreciation of the wider issue relating to medication practice:

I think the workshop activities allowed me to extend my knowledge of the lecture material and apply these concepts to practical situations, and to develop critical thinking (2013)

I liked the fact it was engaging but also it was scenarios, which I think are so important in learning because every nursing case we get is like a scenario...it is so important to not just learn material but to apply it. Listening to the eLecture and being equipped with knowledge before the lecture allows you to think a little more in depth. It is not about memorising but about having the courage to put what you have learnt in context (2013)

**Pause and replay**

Pause and replay was reported by students to be a beneficial feature of the eLecture format because it allowed them to study independently, in their own time, listen to the information repeatedly and make notes or look up information for clarification. Several students felt that repetition benefitted their learning. In addition, students commented positively on how the eLectures were short and concise, explaining that content learning was more manageable in small chunks:

I liked the fact we could go back to eLectures, revise, pause, stop, rewind.

Great for a cognitive learning disability (2013)

Repetition definitely benefitted my learning (2014)
In addition to the variety of benefits of a flipped classroom identified by most of the participants, two explanations emerged as to why the flipped classroom provided little or no benefit to others. These reasons were conflicting commitments where family, work and other studies were competing for time and, preference for conventional instructional learning.

Whilst the majority (94%) of the students surveyed engaged with the eLectures, some were unable to attend face-to-face workshops due to family and work commitments, illness, bad weather or study load related to this and other courses. For example, one respondent indicated that he/she would have willingly attended if childcare was available. In 2013, 46% of respondents attended all twelve workshops compared to 32% in 2014. However, in 2014, 52% of the respondents attended more than three-quarters (over eight) but not all workshops compared to 27% in 2013.

**Conflicting commitments**

Conflicting commitments were reported by students to hinder their engagement with the flipped classroom and so this component of study was not a priority. In order to benefit fully from the flipped classroom approach in the pharmacology course, students were required to listen to the eLecture pre-class and then attend the face-to-face workshop. However, one outcome of having the core material online meant that students with conflicting commitments opted for home study because all the required reading, reference and revision materials were available online. The following quote is indicative of this choice:

I think I would have preferred to be able to attend in person as I know I would have benefitted from the added student-student contact, but the convenience of watching them online won me over in the end (2013).
This finding suggests that the added benefits of blending eLectures with face-to-face teaching needs to be fully explained to students. If students view the two components as separate and one as an alternative to the other, then it negates the value of flipping the classroom.

The next quote reinforces why some students choose to replace the linked workshops with digitally recorded lectures. It also highlights that tension exists between students who prepare for classes and those who do not:

Basically I was drowning and couldn’t keep up with a full-time workload and placement and working nightshifts so I had to triage my time and drug therapy lost out mainly because I could do most of the work at home. I found the workshops, with my limited availability were not time-effective and I had no desire to spoon feed the students that did not contribute (2014).

 Preference for instructional learning

Preference for instructional learning emerged as a choice for some students. The reaction of students, after they had experienced the flipped classroom format, was that they preferred a traditional teaching and learning approach. This preference included teachers delivering content and less active input from students. Comments indicative of this preference included:

I did not like the autonomy of working in the workshop. Information content was not really taught, which is what is needed in a hard class about drug therapy (2013).

I prefer topic experts leading discussions. Too many students bring nothing to the table (2014).

More traditional teaching please. Attempting to prompt an answer from those with none or little understanding doesn’t instill learning (2014).
DISCUSSION

This study set out to elicit students’ perspectives of the flipped classroom and determine if this approach could increase the understanding undergraduate nursing students have of drug science and its application to clinical practice. Potential limitations of the study were the low number of respondents overall and that the students that completed the questionnaire may have been those already most engaged by science-based subjects or motivated to influence change in the nursing programme. Thus, participant bias is possible and is considered when interpreting the findings. Nonetheless, the data from two different cohorts in 2013-2014 and the collation of the results revealed some recurrent themes and identified aspects of the flipped approach that were beneficial to some nursing students but not to others. These finding are consistent with other qualitative course evaluation data that reveal students may have an improvement in grade but still feel negative about the introduction of a flipped model of learning (Gilboy et al., 2015).

One key element for effective flipping is ensuring that teachers explain the potential benefits of the flipped classroom (O’Flaherty and Phillips, 2015). Flipping involves linking eLectures with face-to-face workshops and if students choose one component as an alternative to the other, then the approach loses its value. In this view, choosing to learn from the eLecture alone renders the workshop unnecessary. The flipped design may be a contributing factor to the variability in preparedness. According to O’Flaherty and Phillips (2015), pre-class activities that are not interactive, fail to provide formative feedback and do not coherently link to face-to-face activities impact negatively on student engagement.

Further findings revealed that students had a range of beliefs and prior experiences with regard to the impact of the flipped classroom (FC). By far the most positive outcome was
that students stated that the FC approach increased their understanding of pharmacology concepts and their application to clinical practice (29%) and promoted deeper and wider thinking (14%). This is an important finding as it reflects the potential to equip students for 21st Century health care environments (O’Flaherty and Phillips, 2015). According to Ryan and Tilbury (2013) when flexible learning is viewed through a pedagogic lens, it is not just about how learning is delivered but it can become a human attribute for both learners and teachers. Thus, flexible pedagogies can enhance learners’ capabilities to think, work and act in response to complexity, ambiguity and change beyond the classroom (Ryan and Tilbury, 2013).

Further, respondents felt that frequent access to the eLectures benefitted their learning (11%). Although this represents a low number of respondents, the finding is consistent with the report of Bloomfield and Jones (2013). They found that repetitious viewing of video clips of clinical skills enhanced learning of graduate entry first-year pre-registration students because it provided them an opportunity to revise the content. It has previously been identified that one of the main advantages of an eLearning format is that students can repeatedly interact with a concept until it is mastered (Cooke et al., 2012; Travale, 2008; Khan, 2011). Findings from this study show that a FC was reported by some students to benefit their understanding of drug science and its clinical application and promoted deeper thinking.

This study showed that family, work or health commitments were key reasons why students either did not access digitally recorded lectures (14%) or did not attend face-to-face workshops (16%). The nursing student population is a blend of different age groups, work and educational backgrounds, and ethnicity. With this diversity come many different personal and professional commitments and perceptions. Flexible learning is seen to be one way of meeting these needs by providing students with access to resources whenever and wherever they want.
According to Salyers (2007) providing flexible access to materials online and blending this with face-to-face learning in a flipped classroom approach has added benefits of reducing isolation and disengagement that some nursing students have experienced with e-learning alone due to the highly self-directed nature. However, the issue of non-attendance to university classes due to conflicting commitments is exacerbated by the availability of e-learning when it is perceived as a substitute for traditional teaching methods (Johnston et al., 2013). The authors reported time constraints and study load as contributing factors to students’ non-attendance. Nursing students undertaking their first anatomy and physiology course chose to access recorded lectures and although they did not consider them to be an effective replacement for live lectures, they still decided to miss class (Johnston et al., 2013). Obviously, the flipped classroom is of limited benefit to students who do not attend the follow up workshops and, for some, the availability of online materials will result in fewer interactions with peers and lecturers, more isolation and even reduced performance (Campbell et al., 2008). The last point is borne out by Johnston et al. (2013) who compared final scores of students in one course across two campuses. Students at one campus had access to digitally recorded lectures and those at the other campus did not. They found that whilst access to digital lectures at one campus allowed students flexible engagement with learning materials for time-poor students, overall academic performance was lower (P < 0.001). This finding raises the question of whether students, even as adult learners, have the necessary skills to make judgements about what combinations of teaching and learning options best support their academic learning.

Another somewhat surprising finding in our study was that students voiced preferences for traditional approaches to study that are instructional (13%). One explanation for this is provided by Jokinen and Mikkonen (2013) who reported that teachers working
within blended learning environments witnessed how puzzling students found the new pedagogical approaches, resulting in a reluctance to use new learning methods. O’ Flaherty and Phillips (2015) suggest that students and educators are often more comfortable with teacher-centred methods of instruction with students in a passive role. Further, some teachers felt that only more committed undergraduate and postgraduate students would be willing to embrace VLEs that support the exchange of ideas, sharing information and resource exploration or collaborative knowledge creation involving group work and peer feedback (Lameras et al., 2013). This finding indicates that it is essential to explain the potential advantages of any new approach especially if students perceive that such changes may negatively affect their performance or restrict their careers.

CONCLUSION

This study contributes to the debate concerning suitable methods to teach applied science in nursing. It does this by providing insights into the different learning needs and preferences of nursing students in a contemporary flipped classroom. It is evident that this approach has significant potential to equip students for 21st century health care environments by focusing on flexibility, knowledge application and critical thinking but it also highlights the challenges that educators face in effectively translating this pedagogy into practice. Further evaluations of flipped classroom approaches would be useful to determine the key components that facilitate high level thinking and engagement before, during and beyond the classroom.
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