

**Title page**

Investigation of blended learning video resources to teach health students clinical skills: an integrative review.

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**ABSTRACT**

**Objectives:** The aim of this review is to inform future educational strategies by synthesising research related to blended learning resources using simulation videos to teach clinical skills for health students.

**Design:** An integrative review methodology was used to allow for the combination of diverse research methods to better understand the research topic. This review was guided by the framework described by Whittemore and Knafl (2005),

**Data sources:** Systematic search of the following databases was conducted in consultation with a librarian using the following databases: SCOPUS, MEDLINE, COCHRANE, PsycINFO databases.

**Key words and MeSH terms:** clinical skills, nursing, health, student, blended learning, video, simulation and teaching.

**Review methods:** Data extracted from the studies included author, year, aims, design, sample, skill taught, outcome measures and findings. After screening the articles, extracting project data and completing summary tables, critical appraisal of the projects was completed using the Mixed Methods Appraisal Tool (MMAT).

**Results:** Ten articles met all the inclusion criteria and were included in this review. The MMAT scores varied from 50% to 100%. Thematic analysis was undertaken and we identified the following three themes: *linking theory to practice*, *autonomy of learning* and *challenges of developing a blended learning model*. Blended learning allowed for different student learning styles, repeated viewing, and enabled links between theory and practice. The video presentation needed to be realistic and culturally appropriate and this required both time and resources to create.

**Conclusions:** A blended learning model, which incorporates video-assisted online resources, may be a useful tool to teach clinical skills to students of health including nursing. Blended learning not only increases students' knowledge and skills, but is often preferred by students due to its flexibility.

**Keywords**

Blended learning

Video assisted online teaching

Health students

Nursing students

Clinical and communication skills

## BACKGROUND

The development of clinical skills across the health profession is a crucial component required for safe practice. The primary aim of clinical education is to facilitate health students' acquisition of both skill proficiency and professional socialization (Levett-Jones & Lathlean, 2009). Clinical skills need to be developed to a level of competence for safe patient care to fulfil the registration requirements for health practitioners (Australian Health Practitioner Regulation Agency 2017; Coyne & Needham, 2012). Specially, high level interpersonal and communication skills are crucial to nursing practice, and are of paramount importance within nursing programs for optimum person-centred patient care (Australian Commission on Safety and Quality in Health Care, 2012; Yeonja, Eunju, & Eunjung, 2015).

A range of patient situations and clinical simulation scenarios offer opportunities for health students to improve their clinical and communication skills under supervision (Abelsson, Rystedt, Suserud, & Lindwall, 2015). In the university environment, health students' clinical skill acquisition can be enhanced by simulation including videos that depict real-world clinical situations (Yeonja, et al., 2015). Simulation is the presentation of a realistic situation to simulate real life conditions without risk to the student or patient (Abelsson, Rystedt, Suserud, & Lindwall, 2016). Simulation also provides opportunities for developing critical thinking and understanding culture in a safe learning environment (Johnston, Weeks, Shuker, Coyne, Niall, Mitchell et al., 2017; MacLean, Kelly, Geddes, & Della, 2017). Importantly, in order to ensure that health students link the relevance of theory to their future practice it is imperative that teaching methods provide supportive instruction for the development of clinical skills (Coyne, Needham, & Rands, 2012). It is argued that traditional classroom based teaching methods fail to transfer crucial problem-solving techniques (Forbes, Oprescu, Downer, Phillips, McTier, Lord et al., 2016). In contrast, videos and simulation that include problem-solving skills prepare health students for the complexities associated with their future

professional role including provision of culturally appropriate care (Coyne & Needham, 2012; Johnsen, Fossum, Vivekananda-Schmidt, Fruhling, & Slettebø, 2016; Johnston, et al., 2017). Simulation is useful in providing students with patient scenarios without risk to patients (Berragan, 2014; Bland & Tobbell, 2016; Schiavenato, 2009). The content of videos allows for the demonstrations of clinical situations that undergraduate students are yet to experience; such as mental health nursing (Rigby, Wilson, Baker, Walton, Price, Dunne et al., 2012), basic life support (Park, Woo, & Yoo, 2016), midwifery assessment (Sidebotham, Jomeen, & Gamble, 2014) thus providing them with a contextualized opportunity for learning.

The acquisition of clinical proficiency is a gradual process, and technology can assist in its development (Cardoso, Moreli, Braga, Vasques, Santos, & Carvalho, 2012). Universities are responding to students' needs and are offering more flexible delivery and learning options to study online, off-campus and at a more convenient time for the individual (Sidebotham, et al., 2014). Many students appreciate being able to study independently and at their location of choice (Smyth, Houghton, Cooney, & Casey, 2012). This flexibility enables students to learn across various media platforms, where diverse electronic learning methods and communication approaches are possible (Glogowska, Young, Lockyer, & Moule, 2011).

However, one size does not fit all and students have differing preferred learning styles (Farley, Jain, & Thomson, 2011). One way to support individual student needs is to offer a pedagogical combination of both online and face-to-face education through the use of a 'blended learning' approach. Blended learning refers to an educational approach that combines traditional classroom face-to face methods with online materials and activities (Garrison & Kanuka, 2004; Park, et al., 2016). Blended learning provides opportunities for synchronous and the asynchronous delivery of information to personalize student learning (Kaur, 2013). Specifically, in this review of literature the use videos for the purpose of skill development within a health context were reviewed.

Although blended learning is considered crucial for today's health students' education (Walker, Dwyer, Moxham, Broadbent, & Sander, 2013), there are only a small number of studies which include the use of videos as a blended learning strategy to support clinical skills development. Therefore, the aim of this integrative review was to contribute to the knowledge on blended learning, in particular looking at video assisted learning materials in relation to health students' learning and clinical skills. For the purpose of this review the term 'student' refers to any health student, primarily undergraduate nursing students but also includes midwifery, medicine and postgraduate registered nurses. Specifically, this integrative review aimed to answer the research question "Does blended learning resources using video simulation enable interactive teaching of clinical skills for health students?" This synthesis of the literature will inform future use of blended learning as an educational strategy for teaching clinical skills.

## METHODOLOGY

An integrative review methodology permitted the inclusion of all research designs, including experimental and non-experimental studies, and ensured a comprehensive examination of the research topic (Whittemore & Knafl, 2005). The authors evaluated the retrieved articles using the five stages of an integrative review as outlined by Whittemore and Knafl (2005): *problem identification, literature search, data evaluation, data analysis and presentation of findings*.

### *Study selection criteria*

Searches were conducted by two authors (MP, EC) across SCOPUS, MEDLINE, COCHRANE and PsycINFO databases using the key words and MeSH terms: 'clinical assessment' OR 'nursing' OR 'nurse' OR 'nursing skill' OR 'nursing student' OR 'health' AND 'blended learning' OR 'video' OR 'simulation' OR 'interactive' OR 'teaching' OR 'video assessment' in August 2016. Searches were limited to peer reviewed journals, English language and published from 2006 to 2016. The key words

were developed in consultation with a health librarian to ensure relevant manuscripts were included and identified the need to look more broadly across the health disciplines rather than only including nursing.

As stated previously, the definition for blended learning combined both face-to-face learning with online learning using video-assisted teaching methods (Garrison & Kanuka, 2004). Articles were included if they measured the effects of blended learning with the specific element of video-assisted teaching technique as a component of the study. The total database search revealed 874 records and a further 25 articles were identified through grey literature. Duplicate publications were removed leaving 562 articles. In the database search phase, title and abstract were reviewed for relevance by team members (EC, HR, VC, VF, and MP) resulting in a further 525 articles being excluded. In the next stage full articles were retrieved and screened for relevance, a total of 37 full text articles were reviewed and those excluded did not include both blended learning and video resources, or did not include the target population. Ten studies met all inclusion criteria for review (see Figure 1).

(INSERT FIGURE 1)

**Fig. 1** Database search process

#### *Methods for data extraction*

Data extraction was undertaken and included the following; *author, year, aims, design, sample including discipline, skill taught, outcome measures and findings*. The review process was designed and adapted with reference to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Liberati, Altman, Tetzlaff, Mulrow, Gøtzsche, Ioannidis et al., 2009). The data were compiled into an excel spreadsheet to allow data comparison and synthesis.



### *Quality assessment*

Quality assessment was undertaken using the Mixed Methods Appraisal Tool (MMAT) – Version 2011, a critical appraisal tool that was chosen due to the heterogeneity of included studies (Pluye, Robert, Cargo, Bartlett, O’Cathain, Griffiths et al., 2011). The benefit of this appraisal tool is that it can be used to assess all research designs, through the use of a quality scoring system of zero, 25%, 50%, 75% or 100%, with a higher score indicating higher quality (Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009; Pluye & Hong, 2014). Previous researchers support the content validity, reliability and efficiency of the MMAT tool (Pace, Pluye, Bartlett, Macaulay, Salsberg, Jagosh et al., 2012). Three researchers [EC, MP, and VF] independently scored articles, and scores were compared to identify differences, which were resolved through discussion. All ten articles were included irrespective of their MMAT scores, as the researchers considered that the use of MMAT allowed for a description of the quality of the studies from which the evidence was gathered, further contributing to a comprehensive integrative review.

### *Data analysis*

The compilation of tables and comparative data analysis is suggested by Whittemore and Knafl (2005) as being supportive of a robust integrative review. Qualitative thematic analysis was conducted as a means to develop emergent themes from recurring categories and patterns from the included articles. Studies were read and analyzed independently by the authors, who separately identified the surfacing themes based on linkages of concepts; these were later compared to create predominant themes (Pluye & Hong, 2014).

## **RESULTS**

Ten studies met all the inclusion criteria and were included in the integrative review. Articles were published between 2008 and 2016; with eight published since 2012 (see Table 1). The studies were conducted within a variety of countries including the United Kingdom, India, Ireland, Germany, China, Korea, Australia and the USA. Participant sample sizes from the selected articles ranged from  $n=14$  to  $n=322$ . The research methodology used in the included studies varied, although mixed methods predominated with four studies, followed by three quasi-experimental, one randomized control study, one qualitative and one quantitative descriptive design. The most common outcome measures identified were knowledge and satisfaction, and performance of the clinical skill. Student self-assessment and grades were the most common form of evaluation method used to measure the outcomes.

MMAT scores varied from 50% to 100% with five studies assessed at 100% (Holland, Smith, McCrossan, Adamson, Watt, & Penny, 2013; Ilott, Bennett, Gerrish, Pownall, Jones, & Garth, 2014; Kelly, Lyng, McGrath, & Cannon, 2009; Rigby, et al., 2012; Terry, Moloney, Bowtell, & Terry, 2016); two at 75% (Agrawal, Kumar, Balasubramaniam, Bhargava, Sinha, Bakshi et al., 2016; Lehmann, Thiessen, Frick, Bosse, Nikendei, Hoffmann et al., 2015), one at 60% (Sowan & Idhail, 2014) and two at 50% quality rating (Park, et al., 2016; Wang, Liang, Blazeck, & Greene, 2015).

Results from the reviewed studies indicated that blended learning using videos increased student knowledge and competence relevant to the clinical skill being taught. Clinical skills represented in the simulation videos included basic life support (Lehmann, et al., 2015; Park, et al., 2016), medication administration (Holland, et al., 2013; Sowan & Idhail, 2014; Terry, et al., 2016), midwifery skills related to management of labor and care of the newborn (Agrawal, et al., 2016), respiratory assessment (Kelly, et al., 2009), dysphagia training (Ilott, et al., 2014), SBAR communication (Wang, et al., 2015) and mental health nursing (Rigby, et al., 2012). The blended learning videos also enable a

flexible and autonomous learning environment for students which increased student satisfaction and engagement with teaching. See Table 1 column skill focus for full summary.

**Table 1.** Summary of included articles

(INSERT TABLE 1)

#### Themes

The study outcomes were synthesized and three themes emerged, all of which were derived from concepts (Table 2). The themes were: *linking theory to practice*, *autonomy of learning* and *challenges of developing a blended learning model*.

*Linking theory to practice*: This theme was derived from six studies (Agrawal, et al., 2016; Holland, et al., 2013; Ilott, et al., 2014; Park, et al., 2016; Terry, et al., 2016; Wang, et al., 2015), and related to how the use of simulation videos in these studies provided opportunities for students to visualize the activity and engage in the theory or information supporting the skill. Videos allowed opportunities for repeated viewing, particularly when this related to a particular skill such as paediatric basic life support for medical students (Park, et al., 2016), which encouraged flexible and autonomous learning. The presentation of information in a blended learning format also allowed health students to engage at their own pace and level of comprehension (Park, et al., 2016; Terry, et al., 2016; Wang, et al., 2015), as well as providing a platform for discussion and extended learning with peers and tutors (Ilott, et al., 2014). In particular, Holland and colleagues (2013) evaluated the development of nursing students skills related to administration of medications, and noted that a best practice exemplar presented as an online video not only improved students assessment results but the students indicated that they understood the expectation of the task '*the video was useful to see what would happen*'.

#### *Autonomy of learning*

This theme evolved from five studies, (Ilott, et al., 2014; Kelly, et al., 2009; Rigby, et al., 2012; Sowan & Idhail, 2014; Terry, et al., 2016) and incorporated the concept that students have different learning needs and that a blended learning approach can support students with their different styles of learning. The videos provided opportunities for repeated viewing by nursing students and registered nurses with the opportunity for discussion and practice with peers within a face-to-face blended learning format (Ilott, et al., 2014; Kelly, et al., 2009; Rigby, et al., 2012). The videos ensured that consistent material was presented to all students yet enabled flexibility of teaching across different teaching spaces such as tutorials or lectures. For example, Terry et al, (2016, p. 5) noted that *‘participants [nursing students] in the online group, as distance students, habitually relied on online educational resources [IV administration] and hence may have developed their own learning strategies that compensated for limited face-to-face learning opportunities’*.

#### Challenges of developing a blended learning model

This theme was also uncovered from five of the studies (Kelly, et al., 2009; Park, et al., 2016; Rigby, et al., 2012; Terry, et al., 2016; Wang, et al., 2015), and highlighted the practical challenges such as video length, authenticity and information to support the video to enhance a cohesive learning resource. Care was required to ensure the developed material met the students’ learning needs and was both realistic and culturally appropriate to the student cohort. One group of authors emphasized the role of cultural sensitivity when communicating with other health professionals, stating that: *‘Cultural difference can certainly pose challenges to implementing pedagogical practices from one cultural context to another, and several recent studies have examined the specific case of the seeming incongruity of Western pedagogy and Chinese nursing education’* (Wang, et al., 2015, p. 4). The development of quality blended learning material was identified by the researchers (Park, et al., 2016; Rigby, et al., 2012) as time consuming and expensive in their initial development; however, researchers stressed that once developed, positive student outcomes were evident (Agrawal, et al., 2016; Park, et al., 2016; Terry, et al., 2016; Wang, et al., 2015). The challenge exists in ensuring that blended learning resources and supporting simulation videos use authentic representations, as

discussed by Terry and colleagues, (2016, p. 4) where nursing students learning to administer intravenous fluids commented that it was '*just like the real thing*,' '*virtually identical to the pump*.'

**Table 2.** Themes from literature synthesis

(INSERT TABLE 2)

## Discussion

The aim of this integrative review was to contribute to the knowledge on blended learning, specifically looking at simulation video assisted learning materials in relation to student learning and clinical skills. There exists a range of research on blended learning as an educational strategy, as well as the use of video-assisted teaching; however, limited research combines and examines these two elements. Methodological limitations were identified from MMAT scores and included selection bias, use of non-validated tools and lack of a comparison group.

Studies originated from a wide range of countries, indicating global interest in blended learning. Synthesis of the ten studies revealed three underlying themes: *linking theory to practice*, *autonomy of learning and challenges of developing a blended learning model*. Blended learning using simulation video was found to increase student knowledge and skill, as well as enhance the flexibility and autonomy associated with the learning of clinical skills (Ilott, et al., 2014; Kelly, et al., 2009; Lehmann, et al., 2015; Wang, et al., 2015). The review identified that student satisfaction and knowledge were measured by student grades and self-assessment (Agrawal, et al., 2016; Holland, et al., 2013; Ilott, et al., 2014; Lehmann, et al., 2015; Park, et al., 2016; Sowan & Idhail, 2014).

In comparison to didactic teaching, blended learning improved knowledge transfer and student satisfaction across a range of studies (Park, et al., 2016; Terry, et al., 2016; Wang, et al., 2015). Wang et al., (2016) acknowledge that the Chinese curriculum remains largely didactic and provides very limited exposure for development of communication skills between health professionals. However, students in their study expressed increased confidence in using SBAR to relay information to physicians after completing a workshop where they viewed, discussed and debriefed about the technique. The increase in student satisfaction and knowledge retention related to the fact that blended learning incorporated real-world scenarios providing a context for the theoretical underpinning together with an opportunity for experiential situational learning (Clark, Stanforth, & Humphries, 2009; Pugsley & Clayton, 2003). Clinical resources and opportunities for practice are often limited within a university setting and virtual education in combination with face to face lectures and teaching methods have been shown to yield better outcomes within a fiscally responsible environment (Agrawal, et al., 2016; Holland, et al., 2013; Ilott, et al., 2014).

Blended learning fosters independent student learning, which in turn is thought to encourage the development of lifelong learning, an important element for future nurses (Rigby, et al., 2012; Sowan & Idhail, 2014; Terry, et al., 2016). Furthermore, blended learning was found to be preferred by students due to its easy access, flexible viewing times and the opportunity for repeated practice that this model facilitates (Ilott, et al., 2014; Kelly, et al., 2009; Terry, et al., 2016). This is supported by research that claims that blended learning encourages an active approach to education, by creating a dynamic environment, which increases student engagement and enjoyment (Karoglu, Kiraz, & Özden, 2014). An active learning approach is ultimately recommended because it encourages deeper learning and urges students to take ownership of their education (Baeten, Kyndt, Struyven, & Dochy, 2010). An important aspect of creating blended resources is to understand the difference between blended and face to face learning and meet the principles for good practice for each mode of delivery rather than place face to face teaching information in an online environment (Brown, 2016). It is therefore

crucial that researchers examine whether online teaching methods can equally promote student engagement in contrast to other forms of teaching (Petty & Farinde, 2013).

Various studies highlighted the challenges of developing a blended learning model (Brown, 2016). The challenges included the extensive time it takes to create the educational model, the cost of the required resources, difficulties in online resource accessibility, cultural differences, and the importance of realistic representation within a virtual setting (Kelly, et al., 2009; Park, et al., 2016; Rigby, et al., 2012; Sowan & Idhail, 2014). Importantly, student access to high-speed internet connections is essential to ensure good access and ability to effectively use resources (Kaur, 2013). Furthermore, instructors must have the technical skills, adequate resources, understanding of simulation principles, appropriate budget and personal dedication to maintain the interactive nature of the material (Kaur, 2013; Massey, Byrne, Higgins, Weeks, Shuker, Coyne et al., 2017). Participating in blended learning can require a significant time commitment, both for instructors and consumers, and individuals may feel uncomfortable navigating the online resource (Lotrecchiano, McDonald, Lyons, Long, & Zajicek-Farber, 2013).

The evaluation process of blended learning poses additional challenges. Student self-assessment was the main form of evaluation used for most of the examined studies, which has its limitations as it is ultimately subject to bias (Lehmann, et al., 2015). It is difficult to engage students in an activity that is not assessed; therefore, student evaluations frequently have poor response rates thus reducing the accuracy and generalizability of results (Macaulay, 2013; Massey, et al., 2017). This integrative review identified differences concerning participant recruitment with participation appearing to be mandatory in some studies where it comprised part of student assessment (Agrawal, et al., 2016; Holland, et al., 2013). This could be viewed in two ways: a comprehensive evaluation by all students or concern that students may not have felt able to honestly respond to the evaluation as their responses were not anonymous.

This review is subject to various limitations. Firstly, the specificity of the research question resulted in a small number of included studies; the stringent inclusion criteria may have excluded studies of broader relevance to the research question. Secondly, the authors were unable to access studies written in languages other than English; this may have introduced selection bias. Finally, the chosen quality MMAT tool is limited to reporting methodological quality (Pluye, et al., 2011).

## Conclusion

There is evidence to suggest that a blended learning model, which incorporates video-assisted online resources, can be useful for the acquisition of clinical skills by health students. Blended learning not only increases students' knowledge and skills, but is often preferred by students due to its flexibility. The progressive use of technology in education suggests that blended learning will become a popular teaching method; however, quality evaluation is required to assess educational pedagogy, student engagement and educational efficacy. To ensure the quality of the blended learning video resource the length of time for the video should be short, authentic situations used and supporting information provided to enable students to understand the context and engage with video resource. Further research is needed on the most effective ways of incorporating video-assisted learning materials into a blended learning model and how to complete an unbiased evaluation of the resource.



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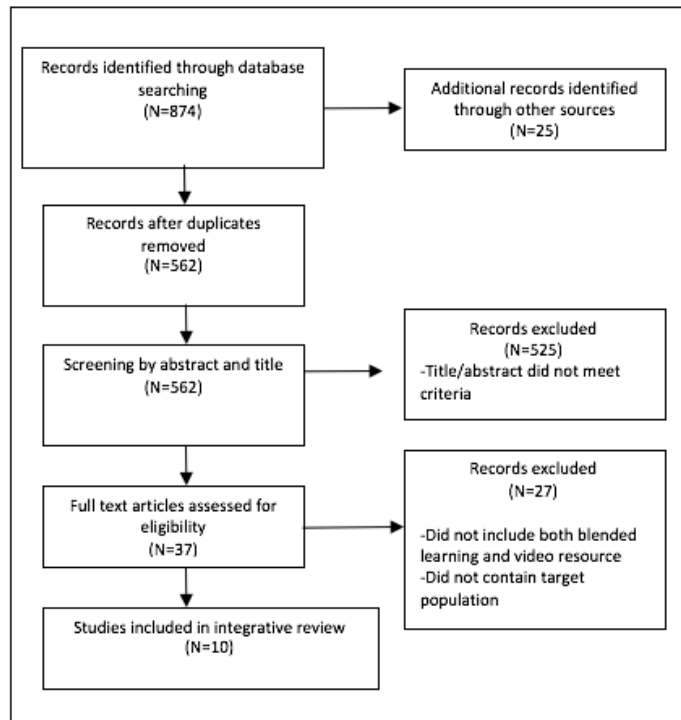
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## Integrative Review Tables

**Fig. 1** PRISMA database search process

**Table 1.** Summary of included articles

Author, year, country	Study aims	Design	Sample	Skill focus	Outcome measures	Findings	MMAT scores
Agrawal et al., (2016)  India	Evaluate the effectiveness of virtual classroom training in improving midwifery skills within a general nursing midwifery program	Quantitative-descriptive design	N=83 undergraduate nursing/midwifery students	Midwifery skills 2 <sup>nd</sup> and 3 <sup>rd</sup> stage labor, newborn care, newborn resus	Performance OSCE pre/post intervention	Skill and knowledge can be enhanced by virtual training and classroom teaching. Mean student OSCE score increased significantly (p<.001)	<b>75%</b>  Measurements inappropriate (unclear origin/validity of instruments)
Holland et al., (2013)  United Kingdom	Evaluate use of online exemplar as adjunct to clinical skills teaching for nursing students	Mixed method  Intervention / control groups	N=322 undergraduate nursing students	Oral medication administration	Performance OSCE  Student satisfaction survey  Focus groups	Online video significantly increased course pass rates (p<0.021) and student satisfaction of course (p<0.05)	<b>100%</b>
Ilott et al., (2014)  United Kingdom	Evaluate the learning effect and resource cost of workplace-based blended e-learning for stroke rehab nurses	Mixed method	N=22 registered nurses in clinical setting	Dysphagia training for example; modifying fluids, assisting with feeding and swallowing	Survey and focus group attitude, knowledge and practice	Learning effect was evident; dysphagia knowledge and attitudes achieved significance at p<0.05 level.	<b>100%</b>
Kelly et al., (2009)  Ireland	Evaluate the effectiveness of online videos for student outcomes and to explore student attitudes towards method	Quasi-experimental design	N=14 undergraduate nursing students	Respiratory skills including incentive spirometry and pulse oximetry	Survey knowledge  Performance OSCE	Positive student response to flexible learning and self-management.  Performance unchanged	<b>100%</b>
Lehmann et al., (2015)	Investigate impact of a blended learning approach (using virtual patients) on	RCT	N=57 undergraduate medical students	Paediatric Basic Life Support	Survey clinical decision-making skills, procedural knowledge	Procedural knowledge significantly improved for intervention group	<b>75%</b>  Groups not comparable; differences not

Germany	knowledge, performance and self-assessment				Performance OSCE	(p<.001). Virtual patient training combined with hands on improves performance	taken into account
Park et al., (2016)  Korea	Identify educational effects of blended e-learning on self-efficacy, problem solving and psychomotor skills for nursing skills	Quasi-experimental design	N=79 undergraduate nursing students	Basic cardiac pulmonary resuscitation and defibrillation	Survey self-efficacy, problem solving Performance OSCE	Blended learning education improved problem-solving and self-efficacy for nursing practice. Some improvement of performance  Strong correlation self-efficacy and performance (p=.019)	<b>50%</b>  Groups not comparable, incomplete outcome data + response rate
Rigby et al., (2012)  United Kingdom	Describe the process of a blended learning model to assist the use of information technology and maintenance of clinical skills	Qualitative	N=24 undergraduate nursing students	Mental health nursing including therapeutic communication	Focus group relevance to practice, facilitation of independent learning and clinical issues.	Blending face-to-face with e-learning is the most effective and acceptable delivery to meet students learning styles.	<b>100%</b>
Sowan et al., (2014)  USA	Study the design and students' response to interactive web-based course using video to teach nursing skills	Mixed method	N=102 undergraduate nursing students	Medication administration including nasal, oral, ophthalmic, intraocular, intravenous, subcutaneous, intradermal, intramuscular medications	Survey satisfaction  Focus groups self-efficacy	Multimedia in an interactive online course is valuable. Course yields satisfaction, self-efficacy and achievement p<0.01).	<b>60%</b>  Integration limitations of quantitative/ qualitative data
Terry et al., (2016)  Australia	Implement the online IVPE and evaluate student learning outcomes and perceptions of use	Mixed method quasi experimental	N=179 undergraduate nursing students	Intravenous pump emulator administration	Performance OSCE  Survey experience  Open ended questions	No sig. differences in performance. Blending face-to-face and online was most effective and positive student comments (p=NS)	<b>100%</b>
Wang et al., (2015)	Evaluate outcomes and attitudes of a workshop teaching Chinese nursing students to use the SBAR	Quasi-experimental design	N=18 postgraduate nursing students	Situation-background-assessment-recommendation [SBAR] communications	Survey knowledge self-perceived ability	Workshop participation significantly improved students' knowledge of and attitudes towards	<b>50%</b>  Selection bias present, incomparable groups

China	communication tool					SBAR	
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MMAT – Mixed method appraisal tool

RCT – Randomized control study

IVPE - Intravenous pump emulator

OSCE – Objective structured clinical examination

SBAR - Situation-background-assessment-recommendation

NS – not significant



**Table 2.** Themes from literature synthesis

Themes	Content	Empirical sources
Linking theory to practice	Videos allowed for opportunities for repeated practice	Terry et al., (2016), Park et al., (2016), Holland et al., (2013)
	Combining blended learning with face to face teaching provided best outcomes, including improved skills and knowledge	Terry et al., (2016), Wang et al., (2015), Park et al., (2016), Agrawal (2015), Holland et al., (2013)
	Blended learning provided opportunities for peer/tutor support	Illot et al., (2013) Holland et al., (2013)
Autonomy of learning	Learning style preferences opportunities for repeated viewing	Kelly et al., (2009), Illiot et al., (2013), Rigby et al., (2012)
	Independence of blended learning	Sowan et al., (2016), Rigby et al., (2012), Terry et al., (2016)
	Accessibility/flexibility of teaching materials	Terry et al., (2016), Sowan et al., (2016), Holland et al., (2013).
Challenges of developing a blended learning model	Blended learning must be realistic	Terry et al., (2016)
	Time, cost, resources needed to create a blended learning program	Park et al., (2016), Rigby et al., (2012),
	Cultural differences in education/inconsistencies in teaching	Wang et al., (2015), Kelly et al., (2009),

#### Highlights

- Blended learning using videos increases both knowledge and skills of nursing students
- Blended learning caters to different student learning styles
- Time and resources are required to ensure a realistic video representation

## Accepted Manuscript

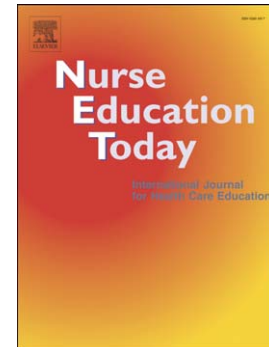
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