

## A Systematic Review of the Use of Smart Phones with WhatsApp Messaging and Practice Recommendations Within Curriculum Learning Activities in Undergraduate Nursing Programmes

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### Abstract

#### Background

WhatsApp Messenger is a popular and free messaging service providing instantaneous distribution and sharing of written, audio and video materials within a predefined group independent of location. This paper reviews the benefits and limitation of using these facilities of WhatsApp within undergraduate nursing education.

#### Method

The Google Scholar, Pubmed and CORE databases were searched for applications of WhatsApp Messenger in undergraduate nursing programmes. Search results were distilled down into ten articles using the PRISMA methodology.

## Results

Three important benefits of WhatsApp and one limitation were identified. Student nurses appreciated how WhatsApp facilitated the instantaneous distribution and sharing of written, audio and video learning materials within a private learning group. They thought that WhatsApp benefitted the social integration of their learning community and helped to reduce feelings of social alienation and professional isolation felt by some student nurses when on nursing placements. They also thought that WhatsApp helped to address various issues of professionalism and professional development. The availability of free access to a network capable of maintaining continuous connectivity was regarded as the primary limitation in the use of WhatsApp as an m-learning platform.

## Conclusion

Nursing students were positively inclined to the use of WhatsApp as an m-learning tool, particularly within the contexts of nursing placements and maintaining professional identity. However, WhatsApp has been largely used in an ad-hoc way taking minimal recognisance of educational theory. In overview, the current literature recommends studying the capabilities of WhatsApp as an m-learning tool over a wider range of educational perspectives across the nursing curriculum and in clinical practice, and testing the quality and retention of the knowledge taught using WhatsApp. We make two further recommendations. First, WhatsApp's use should be considered within the recognised guidelines for good educational practice. Second, because m-technology is a dynamic field with rapidly changing capabilities, users should be proactive in exploiting the full potential of the technology.

## Introduction

The use of 'smart phones' and their extended communication capabilities are widely used in everyday life for many purposes including searching for data, maintaining contact and circulating information. Although voice and text conversations remains their primary use, enhanced smart phone devices offer a wider range of connectivity possibilities [1,2] with a range of available functions and capabilities that depend on the features and applications (or "apps") ranging from web browsers and email clients to applications designed for specialist use, e.g. controlling a domestic security system from any location.

The emergence of the term "m-learning" (mobile learning) gives an indication of the popularity of mobile phone devices in learning, as an addition to the existing e-learning (electronic learning) which refers to learning facilitated through some form of electronic technology [3]. Indeed recent evidence suggests that social media activities are marginally diminishing with greater use of messaging applications and the creation of private messaging groups such as can be achieved using WhatsApp [4] (see appendix), particularly in the workplace and educational environments [2,5].

A growing number of educational institutions and health providers are exploring how best to take advantage of the developing social/messaging technologies [6]. Examples are the use of WhatsApp for the teaching of

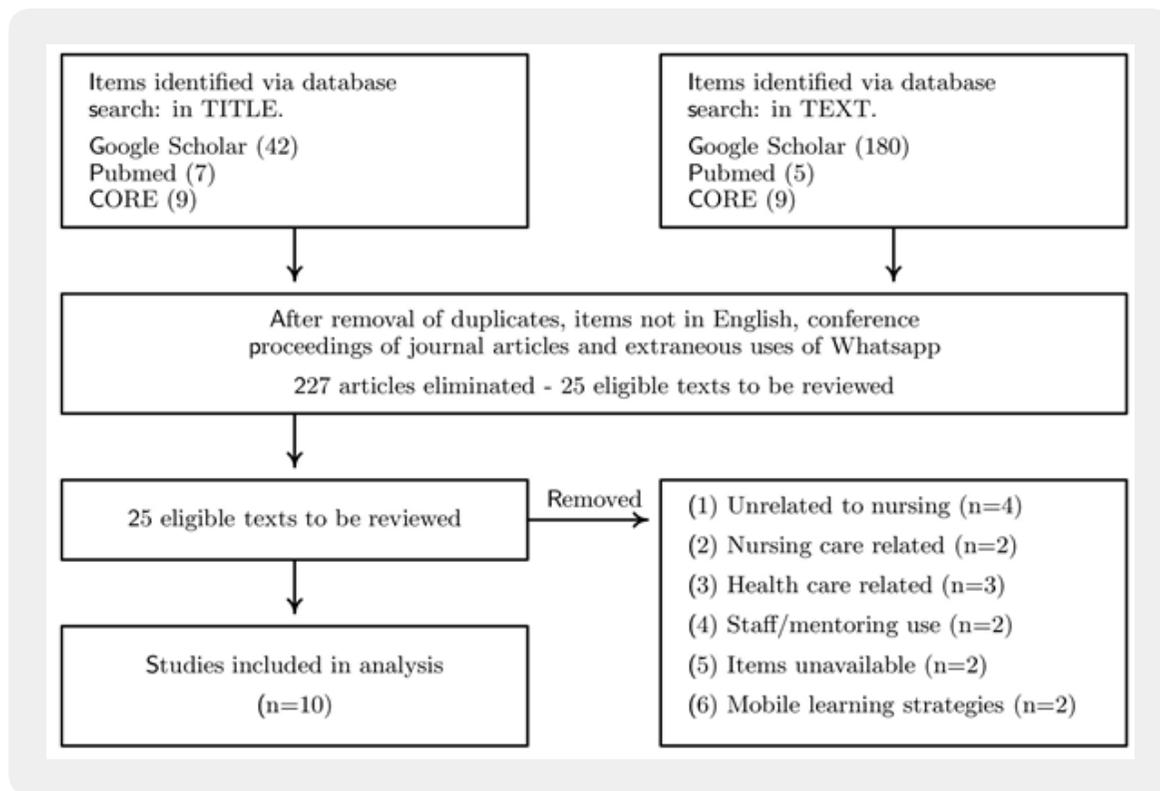
an undergraduate Physiology course [7], the use of mobile phones and social media to facilitate education and support for rural-based midwives in South Africa [8], the use of WhatsApp as a tool to supplement medical education for medical students on clinical attachment [9] and NHS England's decision to relax its position on the use of WhatsApp by clinical staff provided patient information is not discussed [10].

However, the scientific literature on the use, acceptability and impact of specific messaging applications is still developing [11]. Because these technologies evolve over relatively short time scales, agility in taking account of what has been reported in the literature and what is available is important in order to keep abreast of rapid practice changes and be aware of how to take best advantage of developing resources. This article provides a systematic review of published literature between 1<sup>st</sup> January 2015 and 31<sup>st</sup> March 2019 on the use of WhatsApp Messenger [4] in undergraduate nursing education and provides specific guidance for the use of the WhatsApp platform within small group-work learning.

## Methods

A systematic review of the literature on the use of m-learning using WhatsApp messenger in nursing education was undertaken. The review was conducted following the principles and recommendations outlined in 'The Preferred Reporting Items for Systematic Reviews and Meta-Analyses' protocol (PRISMA) [12]. Searches of the electronic databases Google Scholar, CORE [13] (The World's Largest collection of open access research papers) and PubMed between 1<sup>st</sup> January 2015 and 31<sup>st</sup> March 2019 were conducted on the options "in title" and "in text" using the criterion "Nursing" AND "WhatsApp" AND "smart-phone" OR "mobile" NOT "Facebook" NOT "Instagram" NOT "Twitter" NOT "Linkedin" NOT "Medical".

Fifty eight and one hundred and ninety four articles were identified from the "in title" and "in text" searches respectively. Duplicated articles, article not written in English, articles not pertaining directly to education and conference reports of already included journal articles were eliminated leaving a total of twenty five articles for individual inspection. Various criteria (see Figure 1) eliminated a further fifteen articles leaving ten articles between the dates of 1<sup>st</sup> January 2015 and 31<sup>st</sup> March 2019 for detailed discussion.



**Figure 1:** Schematic of the PRISMA [12] approach used to sift the Google Scholar, PubMed and CORE electronic databases from 1<sup>st</sup> January 2015 to 31<sup>st</sup> March 2019 for articles pertaining to the application of m-learning in nurse education using the WhatsApp instant messaging service.

## Findings and Conclusions

The key components of the individual articles identified from the scientific literature by the systematic review are summarised and presented in Table 1. The majority (6 out of 10 articles) of the literature identified using the search criteria listed in Figure 1 were exploratory or descriptive in nature with only four investigations using an experimental process (design with potential to identify statistically significant differences in variables measured [14-17]).

**Table 1**

Article & Year	Study design	Objectives	Participants	Context	Duration	Outcomes	Conclusions	Recommendation
Lee et al. [14] - 2016	RCT design. Analysis used descriptive statistics, $\chi^2$ test, Pearson's correlation.	Effectiveness of mobile based video learning in nursing skill education.	71 nursing students:- control group 35 and intervention group 36.	Laboratory learning.	One week	Intervention group performed significantly better in task, had better learning motivation and expressed higher levels of satisfaction with learning process.	Intervention group showed significantly higher learning motivation, class satisfaction and better/more confident practical skills.	Further research needed on effectiveness of learning using mobile-based video clips in wider areas of the curriculum and clinical practice.
Wahila et al. [15] - 2018	RCT design. Intervention group (N=38) used WhatsApp. Control group (N=38) used email.	Investigate use of WhatsApp to support learning of nursing students.	76 nursing students on clinical placements.	Nursing placement. WhatsApp group formed a virtual classroom community.	Seven weeks	Knowledge enhancement and sharing best practice were significant in WhatsApp group. Other factors such as knowledge application and social capital not significantly different between groups.	WhatsApp engaged nursing students in their learning. Not shown to be significantly better than email learning. WhatsApp preferred over email although social learning role not confirmed.	Extend nursing topics to be taught using WhatsApp. Suggest testing knowledge retention and assessments of material taught using WhatsApp.
Pimmer et al. [16] - 2018	Questionnaire. Responses used a 5-point Likert scale. Responses assessed using descriptive statistics.	Examine use of WhatsApp during nursing placements and correlations with socio-professional indicators.	196 nursing students comprised of 25 male and 171 female participants.	WhatsApp usage reported during placement learning and also for social purposes.	WhatsApp usage measured over periods of one week.	Nursing students used WhatsApp often during placement and even more so for general social use. WhatsApp generated good identity development, placement satisfaction and helped to reduce feelings of professional isolation. Ease of use, attitude, and usefulness all scored well but usefulness to enhance interaction with other students and nurses scored most highly.	WhatsApp relevant to interpersonal learning in clinical settings. Tool for enhancing communication rated most highly by nurses. Instantaneous connectivity of WhatsApp's good for clinical learning environment which otherwise students often associate with isolation and limited on-the-spot support.	No specific recommendation.
Buabeng-Andoh [17] - 2018	Questionnaire (26 questions) Descriptive statistics, correlation and multiple regression	Investigated influence of age and gender on effort involved, attitude towards and efficacy of m-learning in nurse education.	Undergrad. nursing students (N=586)	Classroom learning	Not known	Gender differences found with regard to perceived usefulness. Age differences found with regard to perceived ease of use (preferred by younger ages).	Smart-phones mainly used for homework. However, students showed positive attitude towards m-learning.	Objective measures needed to link students' real use of mobile technology with m-learning.
Li et al. [18] - 2017	Two focus groups plus individual interview. Thematic analysis of views and suggestions of nursing students and educators in using m-learning	Evaluation of implementation of m-learning in an undergrad. nursing course. Emphasis on device usability, interaction learning and social technology.	20 student participants	Classroom learning	Not known	Three overarching themes were identified, namely <u>Device usability</u> :- Portability, information available, psychological comfort, satisfaction. <u>Interaction learning</u> :- Student to student and student to educator <u>Social technology</u> :- System connectivity	Concerns including physical limitations of device and network issues. Enhanced interactions between students and with educator. Enhanced portability and accessibility to learning information. Amount and reliability of online unfiltered learning material limits effectiveness of m-learning.	Further work needed to address variability in m-learning as it pertains to different user groups and subject areas
O'Conner & Andrews [19] - 2018	Self-reported questionnaire (25 questions). Thematic analysis of open question responses	To investigate student views on (a) how mobile apps could support learning (b) how best to take advantage of mobile apps in practice.	200 nursing students across all years of a four year Bachelor of Nursing programme.	Support of nurse learning in clinical practice	Not known	Students reported better access to educational materials, improved knowledge base, increased confidence and less anxiety.	Effective as an educational knowledge resource. Improved student confidence and reduced anxiety.	Faculty should investigate use of m-learning to improve learning outcomes, identify how best to configure apps to meet student needs. Need to improve integration of hardware and educational software to support clinical training.

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Willemse et al. [20] - 2019	Students submitted electronic reflections. Thematic analysis.	Explore experiences of undergrad. nursing students participating in a m-learning enactment using WhatsApp to enhance learning experiences.	101 nursing students enrolled in a primary care and clinical skills module.	Reflection upon their experience of using WhatsApp in an authentic m-learning enactment.	Three cycles each of duration two weeks.	Seven themes identified. Mobile device afforded a 'learning platform'; 'enhanced engagement; 'learning within a group easier'; 'time flexibility to complete tasks. Poor network performance degraded communications. Using mobile devices perceived as unprofessional.	Mobile enactment with undergraduate nurses showed that WhatsApp made for easier information sharing, enhanced peer support, group cohesion and promoted learning.	Access to free around the clock Wi-Fi is essential for students working off-campus. Backup resources should be available to nursing students whenever possible to compensate for any poor network performance.
Willemse [21] - 2015	Participants accounts of experiences using WhatsApp. Thematic analysis of email responses.	Review of the experiences of undergraduate nurses on the improvement in primary health care education resulting from using WhatsApp.	21 undergrad. nursing students participated in WhatsApp discussion group.	WhatsApp discussion group to enhance integration of theory and clinical practice of health assessment competency in a primary care health module.	Unknown	Themes identified were 'positive experience', 'usefulness of for integrating theory and clinical practice', 'availability of resources for preparing tests', 'a mechanism for clarification', 'offered anonymity in discussion groups'. Important negatives were that students without a suitable device are excluded and that applications rapidly drain battery of device.	Positive student opinion views of WhatsApp to improve theory and clinical practice integration in health assessment competency in a primary health care module. Teaching and learning processes were enhanced through the facilitation of collaborative practice and sharing of course information.	Use findings to design an intervention study to test impact of m-learning in health care education delivery and outcomes.
Ajuwon et al. [22] - 2018	Thematic analysis. Two focus groups and a workshop.	Feasibility of using WhatsApp to support and supervise student nurse tutors on placements.	19 student nurse tutors divided into focus groups of sizes 9 and 10 students.	Placement learning.	Six weeks	Four themes identified namely:- Sharing/discussing "tricks of the trade", provided direction and initiated reflective practice, professional discussion and development opportunities. Ability to maintain a continuous teaching presence a problem.	Study identified indicators of good supervision practice despite network accessibility. Study concluded WhatsApp is a feasible and valuable tool for improving supervision in teaching practice placements.	Design improvements to WhatsApp platform to help ensure all students are engaged as contributors to group discussions.
Willemse & Bozalek [23] - 2015	Data collected in focus group discussions and individual interview. Thematic analysis.	Explore and describe the knowledge and view point of educators and students on the introduction of m-learning into a nursing programme.	Four focus groups of six individual interview:- 8 with students & 3 with educators.	Promote the efficacy of nurse education given the growing need for nursing professionals.	Unknown	Peer m-learning used email WhatsApp and Facebook as communication tools. Mobile devices viewed positively for m-learning and practical guidance. Ethical issues raised about using the internet and mobile devices in clinical settings.	Most useful m-learning tools for integrating theory and clinical practice into a nursing programme were email then WhatsApp and last Facebook.	Nursing students need training in how to use m-learning tools to best advantage. Need to reflect on use of m-technology in presence of growing budgetary constraints in clinical facilities.

The findings from these studies are further discussed in groupings according to their study design.

## Randomised Control Trials

The effectiveness of WhatsApp as an m-learning tool for delivering traditional laboratory/classroom teaching material within a virtual laboratory/classroom was investigated using randomised control trials. One trial divided 71 nursing students at random into a control group of 35 and an intervention group of 36 participants [14]. The control group was taught a practical nursing task within a laboratory setting, whereas the video of the practical nursing task being taught to the control group in the laboratory was distributed to the intervention group (who had not attended the laboratory demonstration). Over the following week the

intervention group used WhatsApp's video capability to teach themselves the same task. On completion of the trial it was concluded that the intervention group performed significantly better than the control group in terms of higher learning motivation and class satisfaction in learning and performing the practical nursing task.

In another trial 76 nursing students on clinical placements of seven weeks duration were divided randomly into control and intervention groups of 38 students [15]. The control group was taught by email while the intervention group received the same instruction, but communicated using WhatsApp. Although students preferred to use WhatsApp over email as the teaching medium, on completion of the study no conclusive evidence was found to support the view that WhatsApp was a more effective teaching tool.

### **Descriptive Quantitative**

The effectiveness of WhatsApp as an m-learning tool for facilitating interactions between students, their educators and their peers was investigated as a supportive mechanism for combating the drop-out resulting from unsatisfactory clinical placements in nursing education programmes [16]. Students' perceptions of WhatsApp were measured on a 5-point Likert scale and collected on a weekly cycle from questionnaires issued to 196 (F=171, M=25) nursing students during their nursing placements. Responses were elicited across twelve domains including 'usefulness for placement work', 'general use', 'social capital', 'professional isolation and identity', 'placement satisfaction and ease-of-use' among others topics. Responses were analysed using descriptive statistics. The study concluded that WhatsApp generated good placement satisfaction with strong development of identity and reduced levels of professional isolation. Ease of use and attitude scored well with WhatsApp's perceived usefulness to enhance communication with other students and educators scoring most highly.

Another descriptive study investigated how age and gender influenced students' perception of WhatsApp when used for m-learning across various classroom tasks [17]. A 26 item questionnaire was issued to a gender balanced group of 600 undergraduate nursing students, approximately 50% of whom were aged 21-24 years with approximately 25% aged 17-20 years and 25% aged 25 years and above. The study concluded that younger students found the WhatsApp platform easier to use and that men thought m-learning to be significantly more useful than women, although no gender difference was observed between the sexes in respect of improved performances using m-learning and its ease-of-use.

### **Descriptive Qualitative**

The remaining six studies were qualitative and used thematic analysis to investigate various aspects of m-learning within nursing education. Data for analysis were most frequently collected via focus group discussion usually involving a cohort of approximately 20 participants followed by individual in-depth interviews, or in the case of larger investigations, by a thematic analysis of respondent's emails. The themes identified could be largely classified as issues of technology, issues of the perceived effectiveness of m-learning as a teaching tool and issues of professionalism.

One study evaluated the implementation of m-learning in an undergraduate nursing course with regard to device usability and strengthened student-educator and student-student interactions [18]. The study found that m-learning enhanced these interactions, but students raised concerns about the physical limitations of the devices and networks and the reliability of unfiltered learning materials freely available over the internet. Another study sought student views about how mobile apps could support learning, and how best to use these apps in practice [19]. Questionnaires were distributed to 200 (M=16,F=184) nursing students across all four years of an undergraduate nursing programme. Responses were analysed under the themes ‘mobile device and app use’, ‘mobile apps for learning’ and ‘implementation of mobile apps’. Students thought that mobile apps allowed better access to educational materials, improved their knowledge base and increased their self confidence. However, the study concluded that configuring apps to meet student needs will require better integration of hardware and educational software in support of clinical training.

Two studies investigated the role of WhatsApp for m-learning within the context of primary care. One study undertook a three-phase m-learning enactment related to the outcomes of a primary care and a clinical skills module [20] whereas the other study elicited responses from undergraduate nursing students about their experiences of using WhatsApp within the context of primary health care education [21]. Table 2 lists the themes identified in these studies.

**Table 2:** Themes generated from feedback of the experience during enactment of primary care and clinical skills training modules [20] and primary healthcare education studies [21].

m-learning enactment of a primary care and clinical skills module [20]	Experiences of WhatsApp in primary healthcare education [21]
<b>Themes in use of WhatsApp</b>	
‘mobile devices afforded a learning platform’	‘positive experiences using WhatsApp group’
‘m-learning enactment enhanced engagement’	‘usefulness of WhatsApp for integrating theory and clinical practice’
‘learning within a group made learning easier’	‘availability of resources for test preparation’
‘flexibility in time allocated to complete tasks’	‘opportunity for clarification’
‘challenges experienced with data/airtime/Wi-Fi’	‘anonymity’
‘impaired communication due to poor network access’	‘exclusion of students as a result of lack of an appropriate device’
‘use of mobile devices in practice perceived as unprofessional’	‘application caused battery of device to discharge quickly’

Participants in the enactment study were fourth year nursing undergraduate students (n=101) each of whom submitted their views electronically for thematic analysis at the end of each of three two-week phases. Participants in the primary health care education study were undergraduate nursing students (n=21) who submitted email responses for thematic analysis.

Each study identified seven themes, but no theme was unambiguously common to both studies. However some themes were loosely connected, for example, ‘m-learning enactment enhanced engagement’ and ‘learning within a group made learning easier’ was loosely aligned with ‘positive experiences using WhatsApp group’ and ‘the usefulness of WhatsApp for integrating theory and clinical practice’. The themes ‘challenges experienced with data/airtime/Wi-Fi’ and ‘impaired communication due to poor network access’ in one thematic study had no direct equivalent with the themes ‘exclusion of students as a result of lack of an appropriate device’ and ‘the application caused the battery of the device to discharge quickly’ identified in the other study although both fall within the scope of technological considerations.

In overview, students found that the mobile enactment using WhatsApp made for easier information sharing, but with the caveat that access to free high quality Wi-Fi is essential. They also thought that WhatsApp enhanced peer support, group cohesion and promoted learning within an enjoyable environment. The primary healthcare education study concluded that the virtual environment provided by WhatsApp facilitated the sharing of course materials and supported/enhanced the teaching and learning process leading to better integration of theory and clinical practice in a primary healthcare module.

Of the remaining two studies, one explored the ability of WhatsApp to provide support on teaching practice placements within an informal learning environment [22] and the other elicited students’ and educators’ viewpoints on the introduction of m-learning into an undergraduate nursing programme [23]. The themes identified in these studies are listed in Table 3.

**Table 3:** Themes investigated in the studies of WhatsApp’s ability to provide support during teaching practice placements [22] and the study eliciting student/educators’ viewpoints on m-learning in an undergraduate nursing programme [23].

WhatsApp’s ability to provide support on teaching practice placements [22]	Student/educators’ viewpoints on introduction of m-learning in undergraduate nursing programme [23]
<b>Themes in use of WhatsApp</b>	
‘sharing and discussing tricks-of-the-trade’	‘mobile devices as a communication tool’
‘continuous teaching and social presence’	‘WhatsApp as a method of communication’
‘providing direction and initiating reflective practice’	‘Email, WhatsApp and Facebook as methods of communication’
‘stimulating professional discussion and professional developing opportunities’	‘Nurses as role models in the clinical setting’
	‘mobile device impact on professionalism in clinical practice’

Four themes were identified in the investigation of WhatsApp’s ability to provide support on teaching practice placements, whereas five themes were identified in the investigation of student/educators’ viewpoints in relation to the introduction of an m-learning nursing programme. No direct commonality exists between the themes raised in each study although loose alignments are again present, for example, ‘stimulating

professional discussion and professional developing opportunities' can be loosely aligned with 'mobile device impact on professionalism in clinical practice' and 'providing direction and initiating reflective practice' can be loosely aligned with 'Nurses as role models in the clinical setting'.

With regard to WhatsApp's ability to provide support on teaching practice placements, the study concluded that despite technical challenges, WhatsApp was a feasible and useful platform for enhancing supervision during teaching practice placements or in situations where face-to-face interactions are difficult or impossible. In respect of student/educators' viewpoints on the introduction of m-learning into an undergraduate nursing programme, the study concluded that email was the most useful learning tool for integrating theory with clinical practice followed by WhatsApp and lastly Facebook, although there was evidence that the WhatsApp and Facebook platforms were not being used to best advantage. Students also raised ethical issues concerning the use of the internet and mobile devices in clinical settings.

## **Discussion of Findings**

This systematic review was undertaken to investigate the evidence-base and experiences of the use of WhatsApp m-learning in undergraduate nurse education. As noted following the search process, the studies identified were mostly of a descriptive or qualitative nature (see section 3). This highlights that in this rapidly developing technology that new developments are not founded on a highly investigated evidence-base for use in practice and may be led more by market forces and less by scientific consumer feedback. To move from an ad hoc to a sound scientific basis requires the evidence base to move from a descriptive context to a sounder scientific basis.

All studies reported that undergraduate nursing students found WhatsApp Messenger easy to use. One study [17] across a wider spectrum of ages within a gender balanced population suggested that younger individuals, independent of gender, found WhatsApp marginally easier to use than older students. Interestingly this study reported that men found m-learning to be more useful than women although this difference was not manifest in different enhancements in performance between the sexes. Setting aside the issue of ease-of-use, the overlapping findings of the ten studies considered in this survey may be succinctly summarised under several general headings.

### **Sharing of Learning and Operational Information**

All studies reported that nursing students thought WhatsApp to be an effective tool for instantaneously sharing learning and operational information such as written and video materials particularly if the latter is task oriented [14]. WhatsApp was thought to help to strengthen interactions between students and their peers and educators and made group working easier and more enjoyable [18]. However, no convincing evidence was found that WhatsApp was more effective than email for communicating learning materials [15], and indeed some evidence suggested the contrary, namely that email was a more effective tool for integrating nursing theory and practice than either WhatsApp or Facebook [23] despite nursing students preference for the WhatsApp platform.

## **Undergraduate Placements**

Unsatisfactory nursing placements were thought to be an important driver of drop-out from nursing education programmes [16]. Nursing students thought that WhatsApp was particularly suited to the nursing placement work that forms an integral part of all undergraduate programmes of nursing education. Nursing students valued the instantaneous connectivity WhatsApp made possible with their educators and with their peers, and thought that this instantaneous connectivity enhanced the teaching and learning process [21]. Essentially, WhatsApp integrated their placement within a virtual classroom teaching environment thereby introducing a sense of belongingness, reducing feelings of isolation and reinforcing professional identity as well as providing a mechanism for obtaining on-the-spot professional guidance [16].

## **Improved Interaction Between Student and Educator/Peers**

Nursing students thought that the use of WhatsApp helped to strengthen interactions with their educators and with their peers [18], improved their self-confidence [19] and enhanced group cohesion within an enjoyable learning environment [20]. In the context of nursing placements, where face-to-face interactions are impossible, students thought that these issues might be problematic in the absence of WhatsApp [22].

## **Issues of Concern**

Issues of concern raised by nursing students could be classified as either technological or ethical. Central to the effective functioning of WhatsApp as an m-learning platform is the availability of a suitable mobile device for each participant of a learning group in combination with free access to a network capable of maintaining continuous connectivity [18-20,22]. Undergraduate nurses also questioned whether or not the use of WhatsApp in a clinical environment breached ethical standards [23]. This question has surface elsewhere in clinical care and been addressed. For example, NHS England [10] decided to lift their embargo on the use of mobile messaging services such as WhatsApp in the clinical environment provided users do not discuss patient information.

## **Gaps in the Literature**

Two issues relevant to nurse education are not reported in the literature. First, no guidance is reported for the 'formal processes' for the use of WhatsApp within the nurse education curriculum, which means that the application is used on an 'ad hoc' basis. Second, the wider capabilities of WhatsApp remain unreported. For example, in learning which involves group collaboration focussed on a topic area, the content of the interactions could be analysed utilised and used as the basis for report generation. The system has the ability to store the complete history of group interactions, to track group discussions and allow these to be summarised as a narrative for future inspection and appraisal. Skills and knowledge deficits could be identified and used to inform and support learning. With the correct permissions in place, this recall feature of WhatsApp allows the group to gain greater understanding of the learning process by comparison with lost discussions, summary notes or audio transcriptions that are onerous to analyse.

## General Recommendations from the Individual Study Authors in the Systematic Review

In overview there are several important recommendations from the authors of the literature within the systematic review (Table 1). It is recommended that the capabilities of WhatsApp as an m-learning tool should be investigated through further research over a wider range of educational perspectives across the nursing curriculum and in clinical practice. Furthermore, it is recommended that research should also focus on testing the quality and retention of knowledge taught using WhatsApp. This would help to improve understanding of its efficacy, strengths and limitations as an m-learning tool across various user groups. The main concerns in using WhatsApp as an m-learning platform were related to hardware capability and the reliability of network performance. These led to the recommendation that to be fully effective, m-learning tools required 24 hour WiFi coverage with additional backup through access to relevant alternative resources.

## Recommendations Arising from the Analysis of the Systematic Review

The recommendations in Section 4.1 arising from individual studies from the literature are supported by the investigations undertaken. In terms of generating further understanding from the systematic review of selected research studies and current educational practice in undergraduate nursing, we propose two further recommendations.

### Recommendation 1

Consider using WhatsApp within recognised guidelines for educational practice. For illustration, in successful educational team work within small group learning communities there are a number of factors that have been widely identified as being key ingredients for productive working [24,25]. The use of WhatsApp as a platform for conducting small group learning communities with reference to the role components for facilitator and participants is summarised in Table 4.

**Table 4:** *The learning group should be appropriately constituted with facilitators/educators and nursing students, it should have a finite lifetime determined by the goals/objectives, but beyond which the group is dissolved. Information available to facilitator and participants and shared by the group is confidential to the group and must meet shared codes of ethical professional practice within a clinical environment.*

	Small group learning objectives	WhatsApp Facilitation
Facilitator	Provide educational direction. Manage delivery of course materials, exercises etc. so that the objectives of the group can be achieved within the allocated time scale. Advise on progression of learning.	Circulate course materials Set work schedule with diary prompts. Agree time and format for group output. Correlate learning objectives with group discussion.
	Monitor group progress and individual engagement. Ensure approximately equal participation from group members so that each feels their contribution matches that of others.	Track discussion content and contributors to discussion. Insert timely feedback on submitted work.

	Progress discussion of the group in a purposeful direction and in an orderly and timely manner.	Agree and circulate to the group criteria for formative and summative assessment.
<b>Partici- pants</b>	Group and individual roles.	Group identity, contact information and record of task distribution are private to group.
	Agree criteria against which the output of the group can be measured.	Adhere to pre-agreed time lines for group activities with self-directed alerts/prompts/feedback
	Commit to the goals/objectives of the group Guidelines for what is expected from participants in terms of shared commitment and ethical perspectives of sharing performance.	Devolve agreed tasks to group participants who then circulate their findings to the group. Virtual meetings schedule for discussion with discussion topic.
	Adhere to 'ground rules' for social, online and intellectual behaviour	Maintain transparency of all on-line content.
	Establish a decision-making model	Clarity on progression of contributions towards agreed outcome.
	Effective group process; commitment to open communication, mutual accountability and appropriate self-evaluation.	Content and nature of communication captured

## Recommendation 2

M-learning has emerged over a relatively short time frame. It is likely future developments will be as rapid. Institutions and individuals would benefit from a heightened awareness of these trends and emergent capabilities that are already becoming evident in related areas of digital advancement and machine learning [26]. As digital capabilities become even 'smarter', systems could be envisaged that possess the capability for analysing content and providing direction within m-communications, that react to provide prompts and links to other relevant resources and functions as interconnectivity of devices advances. Educators should be aware of how this growing capacity will allow mobile devices to be used in a more powerful manner within education.

## Conclusions

M-learning in nursing is a relatively new field of study. Student perceptions of WhatsApp as an m-learning platform are positive. Student nurses agreed that WhatsApp was a useful tool for integrating theory and clinical practice, making learning easier through its support for learning within a group and was generally rated highly satisfactory. Students thought that the instantaneous connectivity provided by the WhatsApp platform was particularly important for students during nursing placements, a necessary component of undergraduate nursing education, but one that is thought to be an important contributor to student drop-out when placements are unsatisfactory. As well as providing a mechanism for seeking on-the-spot professional guidance, its virtual classroom environment helped reduce feelings of social and professional isolation and helped to reinforce professional identity.

The IT industry is largely driven by technological developments and feedback from its customer base, but not from scientific literature. Arguably this occurs because the time needed to develop scientific investigations is significantly longer than some industry timescales. Therefore in order to apply findings from 'fast-feedback' type research into wider practice applications, users need to draw on professional judgement in the absence of sound science. To do so would enhance the theoretical basis of using WhatsApp as a teaching tool. To ensure the integration of technology does not lose the theoretical basis for learning, reference should be made to educational learning approaches to manage learning in WhatsApp-facilitated group work, and to augment traditional classroom group-learning approaches.

## Limitations

We note that the reviewed literature on the use of WhatsApp in nursing education is limited in scope, with a predominance of research which is descriptive and exploratory. Recommendations within the individual studies and from the systematic review support the need for further research. It could be argued that the review is already weak, because of the limited research that has been undertaken. However, this review provides a detailed systematic account of the research findings that exist and goes further to suggest ways of enhancing the use of WhatsApp with reference to the theories allied to the context of its use; in this case small group work learning in nursing education.

The quality of the individual papers used in this systematic review relies on the PRISMA [12] process of literature searching. Further databases could have been explored although the major literature databases were included and considered to contain the majority of any works published in the time frame indicated as could alternative messaging systems. However it was considered that WhatsApp's has a unique set of attributes and user functions that to understand its impact it was important to examine its use in isolation.

## Appendix

### WhatsApp messenger

Briefly, WhatsApp [4] is owned by Facebook and can be downloaded free of charge to a compatible mobile phone or tablet without the need for registration. The initial use of WhatsApp requires the phone/tablet to have an installed sim card allowing WhatsApp to become associated with that phone number via a verification process. The phone number becomes the 'username' and the account is locked to that phone although contacts can be transferred to a new device. Once installed and verified, the sim card is no longer used by WhatsApp. Sim cards can be changed on that device without affecting the operation of WhatsApp.

Although WhatsApp shares some functionality with social networking applications, including limited social interaction in individual and group use, sharing of video materials and real-time location, it is a private messaging application [27] and therefore requires communicating participants to have WhatsApp installed on their Smart Phones and to know each other by some route before a WhatsApp connection can be established. Because WhatsApp uses 'data' to send messages its operating costs are often significantly less than texting although this may vary if using the 'roaming' facility. The roaming facility, however, may be useful for transmitting information from any location, for example, to meet friends in a crowded area.

WhatsApp can also be linked to a desktop computer or laptop allowing files (e.g. teaching materials) to be instantly and seamlessly transferring from educator to a group by the mechanism of drag and drop. This contrasts with the more unwieldy operation of distributing material by email. WhatsApp also stores a complete history of group interactions thereby allowing the group to track discussions, allowing these to be summarised as a narrative for future inspection and appraisal.

### Features

- Stores contacts as individuals and named groups.
- Communicates quickly with individuals and group members.
- Replaces emails with instant messaging.
- Text exchange of words, narrative or phrases between two or more individuals or groups.
- Select a message in a chat and reply directly to it.
- Delete messages that you may have sent in error.
- ‘Reply Privately’ while in group chat allow one-to-one messaging only.
- Share current live location using GPS over messages in real time.
- Connect with individuals world-wide without incurring international charges.
- Voice messages; Private online video calling (not universally available)

### Privacy and Security Facilities

- ‘Everyone (Public) to My Contacts or Nobody (Private).
- Users should be at least 16 years of age
- Location sharing: allows your movements to be tracked by another person in contact with. You have the option of 15 Minutes, 1 Hour or 8 Hours to decide how long you would like to share your real-time location. This feature should only be used with individuals you know and trust.

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