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Review

Nurses' perspectives, attitudes and experiences related to e-learning: A systematic review☆

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ABSTRACT

Objective: To summarize the current evidence on registered nurses (RNs) perspectives, attitudes and experiences related to e-learning.
Design: A systematic review of the literature.
Data sources: The CINAHL, PubMed, Embase, the Cochrane Library, Scopus and Web of Science databases were searched for studies published in English from 2000 to 2021.
Review methods: The study followed the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Inclusion criteria comprised studies with cross-sectional, quasi-experimental, qualitative, and randomised control designs on the attitudes toward, perspectives and experiences of registered nursing about e-learning. Quality appraisal for each study, based on their designs, was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist. Data were synthesized using a narrative approach.
Results: In the 15 included studies, 4 were high quality while 11 were moderate quality. Four themes were revealed in this review including e-learning approaches, facilitators of e-learning and barriers to e-learning barriers to e-learning among RNs and learning in practice barriers.
Conclusions: The systematic review uncovered that E-learning is an effective method for integrating knowledge with practice and promoting professional development among RNs in healthcare settings. However, RNs may lack motivation to engage with E-learning and face challenges associated with user-friendly platforms.

1. Introduction

Nurses are expected to be lifelong learners (Xing et al., 2020), and engaged in ongoing professional development (Gaur et al., 2020) through continuing education (Mlambo et al., 2021). As a requirement for annual registration and licensure, nurses continue to engage in continuous professional education, acquire new competencies, enhance their skills and keep their practices at par with the international best practices (Canadian Nurses Association, 2015). Face-to-face education can be difficult due to heavy workloads, limited time, geographical location, costs and insufficient learning opportunities in the region and lack of supervisory support. However, electronic learning (e-learning) addresses some of these barriers when face-to-face instruction is impossible (Bishop et al., 2019). E-learning includes all forms of teaching and learning that occur through information and computer technologies (Singh et al., 2021). Learners can use digital equipment, such as laptops or computers along with self-directed and self-regulated learning (Clark and Mayer, 2016). Therefore, e-learning is an adaptable, accessible, and convenient platform for continuing education (El-Sabagh, 2021) among nurses.

There are two major e-learning approaches namely self-directed and interactive e-learning. Self-directed e-learning tools refer to computer or online learning programs that include informational resources on a course topic and assessment mechanisms for self-evaluation (Sun et al., 2022). Learners can study at their own pace and in such locations as their homes, workplaces or while in transit. Interactive e-learning tools,

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in addition to face-to-face learning, facilitate the distribution and exchange of information between instructors and the learner (Mohammed et al., 2017). The two approaches possess distinct merits and challenges; however, evidence suggests that the two approaches do not exceed each other in terms of their effects on specified clinical/learning outcomes (Lahti et al., 2014; McDonald et al., 2018).

Many factors influence the effectiveness of e-learning outcomes (Xing et al., 2020). Lack of information computer technology (ICT) skills, technical difficulties with online resources, software capacity and need for training and practical assistance have been identified in studies as e-learning issues (Guven Ozdemir and Sonmez, 2021; Xing et al., 2020). Limited access to computers in clinical settings may result in the restriction, unreliability, and ineffectiveness of online learning resources (Kynge, 2020). Thus, it is critical to provide adequate ICT equipment, technical support, and training to enable the participation of nurses in e-learning and improve the learning process. Increased self-efficacy in computing and ease of use have a beneficial effect on the online learning process (Benwell et al., 2016). Nurses are often reported to have a favourable attitude toward e-learning, and this was associated with a significant improvement in outcomes including improvement in healthcare delivery, acquisition of relevant knowledge and development of requisite skill sets (Rouleau et al., 2019). Unlike developed countries, which have made significant strides in e-learning for registered nurses (RNs) (Al-Azawei et al., 2016), developing countries have experienced delays in implementation. Specifically, there is paucity of literature regarding the implementation of e-learning for nurses in the Middle East Region (MER).

To fill this gap in the literature, this study initially aimed to conduct a systematic review of relevant research in the 17 countries of the MER. However, the existing studies from the MER were insufficient because they focused on nursing students rather than RNs. Accordingly, the researchers attempted to expand the scope of the search to include all developing countries, including Saudi Arabia, however, the initial search did not yield results. Subsequently, a systematic search of the global literature was undertaken. The objectives of this review were to investigate: (a) nurses' attitudes, perspectives and experiences related to e-learning as a way of improving how they deliver care; (b) the effect of e-learning on nurses' knowledge and skills; and (c) the enabling or constraining factors identified by nurses in e-learning courses that enhance or prevent the acquisition of nursing knowledge and skills.

2. Methods

This systematic review was conducted following the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (See Supplementary material 1), and the Joanna Briggs Institute (JBI) critical appraisal checklist for the different types of studies reviewed (Liberati et al., 2009).

2.1. Eligibility criteria

This systematic review was conducted following the protocol described in the Joanna Briggs Institute's (JBI) Methodology for systematic reviews. The PICo framework, which addresses the population, phenomena of interest and context of a study, was the foundation for the systematic selection of qualitative and quantitative studies and the determination of the inclusion and exclusion criteria (Stern et al., 2020). Studies that met the following criteria were included in the review: focused on the RN who worked in hospitals (population with no age limit); and used e-learning (digital, electronic, computer) as an intervention to investigate nurses' perspectives, attitudes and/or experiences related to e-learning (phenomena of interest), additionally meeting the inclusion and exclusion criteria as specified in Table 1.

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Conducted among RNs worldwide (context)	Guidelines, protocols, opinion papers, conference abstracts and review articles were excluded from this systematic review
Articles in English-language	Any article written in a language other than English
Peer-reviewed articles	Not peer-reviewed

2.2. Study selection

Two reviewers (RA and SYW) independently screened titles and abstracts of identified studies extracted in Microsoft Excel formats, and then later screened the full texts of eligible studies. In cases of conflicts, both reviewers discussed and reached a consensus.

2.3. Search strategy

A search of the Cochrane Library and the JBI Library of Systematic Reviews did not yield any systematic reviews on this topic. Thus, a systematic search was conducted across CINAHL, PubMed, Embase, the Cochrane Library, Scopus, and the Web of Science databases. The reference lists of all articles were searched for additional studies. Studies published in English from 2000 (the year the internet was first used for e-learning) (Connolly and Stansfield, 2007) to 5 September 2021 were searched to identify relevant articles on e-learning among RNs and were considered for inclusion. This research time spanned the Covid-19 era when e-learning became a significant factor in international teaching and learning contexts. The initial keywords used in the review were 'registered nurse' OR 'nurses' (population); 'distance learn*' OR 'distance education' OR 'distance studies' OR 'distance study*' OR 'online learn*' OR 'online course*' OR 'online education' OR 'online studies; OR 'online study' OR 'e-learning' OR 'e-Learning' (intervention); 'worldwide' (setting); and 'experience*' OR 'perception*' OR 'response' OR 'choice' OR 'option' OR 'thoughts' OR 'demand' OR 'need' OR 'feelings' OR 'behaviour' OR 'belief' OR 'view' OR 'opinion' OR 'attitude' (outcomes). The complete strategy implemented is presented in Table 2.

2.4. Assessment of methodological quality and risk of bias

The four JBI critical appraisal tools (Stern et al., 2020) were used to assess the methodological quality and risk of bias of the included articles: The Critical Appraisal Checklist for Randomised Controlled Trials; the Critical Appraisal Checklist for Quasi-experimental Studies; the Critical Appraisal Checklist for Analytical Cross-sectional Studies and the Critical Appraisal Checklist for Qualitative Research. Items of each tool used were scored independently by two reviewers, RA and SYW available to resolve conflicts when one arose. The responses on each appraisal tool comprised 'Yes', 'No', 'Unclear' or 'Not applicable. Each positive appraisal ('Yes') was assigned one point; the other responses were not scored. Methodological quality was determined by the proportion of the criteria on the checklist that were met (Mbuzi et al., 2018). The risk of bias was estimated using the 'high', 'moderate', and 'low' grades described by Andrade (2019). The total responses yielded an aggregate score of 13 for studies with RCT, 9 for quasi-experimental, 8 for cross-sectional and 10 for qualitative designs. The overall score for each included article was converted to a percentage with <49 %, 50–80 % and >80 % indicating indicated high, moderate, and low risk of bias, respectively (Andrade, 2019).

2.5. Data extraction

The quantitative and qualitative data from the included studies were individually extracted by RA and SYW using the standardised JBI data extraction method (Stern et al., 2020) in Microsoft word format. The

Table 2
Search strategies for electronic databases.

Database	Search Terms
PubMed $n = 2002$	1. registered nurse OR registered general nurse 2. distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning 3. experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude 4. ((registered nurse OR registered general nurse) AND (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning)) AND (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) 5. ((registered nurse OR registered general nurse) AND (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning Ore Learning)) AND (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) Filters: Full text 6. ((registered nurse OR registered general nurse) AND (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning)) AND (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) Filters: Full text, Journal Article 7. ((registered nurse OR registered general nurse) AND (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning Ore Learning)) AND (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) Filters: Full text, Journal Article, Humans 8. ((registered nurse OR registered general nurse) AND (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning)) AND (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) Filters: Full text, Journal Article, Humans, Adult: 19+ years
Scopus $n = 3$	1. TITLE-ABS-KEY (registered AND nurse OR registered AND general AND nurse) 2. TITLE-ABS-KEY (distance AND learn* OR distance AND education OR distance AND studies OR distance AND study* OR online AND learn* OR online AND course* OR online AND education OR online AND studies OR online AND study OR e-learning OR elearning) 3. TITLE-ABS-KEY (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) 4. (TITLE-ABS-KEY (registered AND nurse OR registered AND general AND nurse)) AND (TITLE-ABS-KEY (distance AND learn* OR distance AND education OR distance AND studies OR distance AND study* OR online AND learn* OR online AND course* OR online AND education OR online AND studies OR online AND study OR e-learning OR elearning)) AND (TITLE-ABS-KEY (experience)
Cochrane library $n = 1752$	1. (registered nurse OR registered general nurse):ti,ab,kw 2. (distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e- learning) 3. (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude):ti,ab,kw 4. #1 and 2 and #3
CINAHL (via EBSCOhost); $n = 117$	1. registered nurse OR registered general nurse 2. distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning 3. experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude 4. (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) AND (S1 AND S2 AND S3) 5. (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude) AND (S1 AND S2 AND S3) 6. (experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief Orvie OR opinion OR attitude) AND (S1 AND S2 AND S3)
Embase (via OVID) ($n = 184$)	1. registered nurse'/exp. OR 'registered nurse' OR (registered AND ('nurse'/exp. OR nurse)) OR 'registered general nurse' OR (registered AND general AND ('nurse'/exp. OR nurse)) 2. (((((((((distance AND learn*OR distance) AND education OR distance) AND studies OR distance) AND study* OR online) AND learn*OR online) AND course*OR online) AND education OR online) AND studies OR online) AND study OR 'elearning' OR elearning 3. experience* OR perception*OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude 4. #1 AND #2 AND #3 5. #4 AND 'article/it AND [adult]/lim
Web of Science ($n = 507$)	1. registered nurse OR registered general nurse 2. distance learn* OR distance education OR distance studies OR distance study* OR online learn* OR online course* OR online education OR online studies OR online study OR e-learning OR eLearning 3. experience* OR perception* OR response OR choice OR option OR thoughts OR demand OR need OR feelings OR behaviour OR belief OR view OR opinion OR attitude 4. ((#1) AND #2) AND #3 5. ((#1) AND #2) AND #3 and Articles (Document Types) 6. ((#1) AND #2) AND #3 and Articles (Document Types) and English (Languages)

data items include general characteristics of the study (author(s), publication year, setting, study aim, type of research design), demographics data (gender, age, years' experience), data-collection techniques (tools used, relevant components and data-analyses techniques) and the main findings. All differences between the reviewers were addressed by discussion.

2.6. Data synthesis

We employed thematic narrative synthesis to summarize the effects of e-learning on clinical/learning outcomes of RNs using the Guidance on the Conduct of Narrative Synthesis in Systematic Reviews (Popay et al., 2006). The steps taking for the thematic analysis as described by Braun and Clarke (2006) including familiarizing oneself with the data, generating initial codes, searching for themes, reviewing the themes, defining and naming the themes was followed. The narrative synthesis was conducted in line with the study's research questions.

3. Results

3.1. Review profile

A total of 4565 articles were identified through the database and manual searches. After the removal of 2760 duplications, the titles, and abstracts of 1805 articles were screened, and 981 were excluded from the analyses. A total of 824 were full-text screened, resulting in 45. 45 full-text articles were assessed using the inclusion criteria. Following this process, 15 articles: 3 RCTs (Bishop et al., 2019; das Graças Silva Matsubara and De Domenico, 2016; Liu et al., 2014), 3 quasi-experimental (Bahrambeygi et al., 2018; Van De Steeg et al., 2015; Sheen et al., 2008), 6 cross-sectional (Xing et al., 2020; Warzyniec et al., 2019; Xing et al., 2018; Karaman, 2011; Liang et al., 2011; Yu et al., 2007) and 2 qualitative studies (Riley and Schmidt, 2016; Cottrell and Donaldson, 2013) were included for the final analysis. The results of the search are presented using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram (Fig. 1). Further, the characteristics of the studies included for final analysis are presented in Table 3.

3.2. Quality of the included studies

Scores on the JBI critical appraisal checklists represent various sources of bias that may alter the study's results. Among the included studies four studies had a low risk of bias (cross-sectional: Chong et al., 2016; Liang et al., 2011; quasi-experimental: Warzyniec et al., 2019; RCT: Bishop et al., 2019) while 11 studies had a moderate risk of bias (qualitative studies: Riley and Schmidt, 2016; Cottrell and Donaldson, 2013; cross-sectional: Xing et al., 2020; Bahrambeygi et al., 2018; Xing et al., 2018; Karaman, 2011; Yu et al., 2007; quasi-experimental: Van De Steeg et al., 2015; Sheen et al., 2008; RCTs: das Graças Silva Matsubara and De Domenico, 2016; Liu et al., 2014) (Tables 4-7). The overall weakness of the included studies was the lack of randomised control trials; only three RCTs (Bishop et al., 2019; das Graças Silva Matsubara and De Domenico, 2016; Liu et al., 2014). The other twelve were of various designs. All of the studies had adequate sample sizes for their designs.

3.3. Synthesis of outcomes

From the analysis four themes were revealed including e-learning approaches, facilitators of e-learning and barriers to e-learning barriers to e-learning among RNs and learning in practice. In addition, sub-themes were identified for facilitators of e-learning (access to knowledge, flexible nature of e-learning, and other facilitators) and barriers to e-learning (lack of information-technology capabilities or user-friendly information-technology, lack of motivation, and lack of time).

3.3.1. E-learning approaches

Of the studies that employed e-learning educational methods for continuing education among RNs, self-directed learning is commonplace (50 %) compared to interactive (25 %) and hybrid learning (12.5 %). Regardless of the approach, e-learning improved learning outcomes namely knowledge, behaviour, and case management. Clinical/learning activities include palliative care management activities namely pain assessment and management, symptom management, communication, ethics, and care at the final hours (Bishop et al., 2019), shared decision-making in cancer management (Warzyniec et al., 2019), psychiatric case management (Liu et al., 2014), learning behaviour (Bahrambeygi et al., 2018), and theoretical lessons on venous thromboembolism (VTE) risk assessment, preventive methods, guidelines for VTE prophylactic, diagnosis, and pharmacological and non-pharmacological therapy (Bahrambeygi et al., 2018) and delirium (Van De Steeg et al., 2015).

3.3.2. Facilitators of e-learning

3.3.2.1. Access to knowledge. Regardless of prior experience with e-learning, the main motivator for e-learning engagement was access to knowledge and technical skills among RNs (Xing et al., 2020; Chong et al., 2016; Cottrell and Donaldson, 2013; Riley and Schmidt, 2016; Liu et al., 2014; Karaman, 2011; Sheen et al., 2008; Yu et al., 2007). Three studies out of the 8 studies that reported access to knowledge as a motivation for e-learning found that e-learning provides nurses with a personalized learning environment (Xing et al., 2020; Liu et al., 2014; Karaman, 2011; Sheen et al., 2008; Yu et al., 2007) where they can

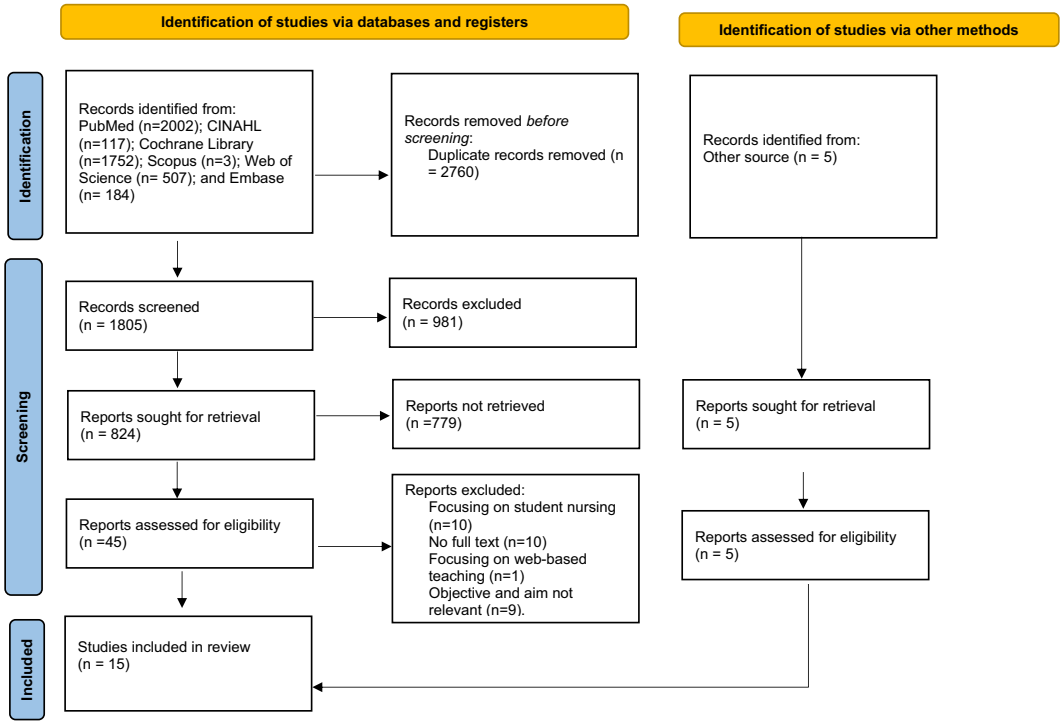

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA).

Table 3
Characteristics of included studies.

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
1. (Xing et al., 2020)	China	Cross-sectional study	To study nurses' preferences and attitudes about e-learning to ascertain the factors that persuaded or discouraged their participation in e-learning and to establish the relationship between the nurses' perspectives and their characteristics.	RNs (n = 534) Female: 529 (99.1 %) Mean age: 36 yrs. Years' experience: 4–8 yrs	A self-report questionnaire	e-learning experiences, barriers, motivating factors, learning preferences, and attitudes toward e-learning	SPSS version 22. Univariate, bivariate, and multivariate statistics analysis techniques	Approximately 50 % of nurses have utilised e-learning to supplement their continuing education. About 85.6 % of nurses preferred using their mobile phones for e-learning while 50.6 % had positive attitudes toward e-learning. Additionally, independent of previous e-learning experience, the most important motivators for e-learning participation were time and location flexibility. The main barriers to nurses participating in e-learning, according to the present research, were a lack of time, a lack of interest in the courses, and a lack of computer proficiency. This significant research established that this vital information may be delivered online at a mutually convenient time for staff nurses.
2. (Bishop et al., 2019)	USA	Randomised controlled trial	To explore nurses' perceptions before and after completing the online The End-of-Life Nursing Education Consortium (ELNEC) core palliative care education.	RNs (n = 106) Female: 100 (94.7 %) Age range: 25–44 yrs. Years' experience: 4–yrs	The online survey tool titled, the Palliative Care Practices of Registered Nurses	One group received the online ELNEC project education only, whereas the other group completed the online ELNEC education and attended a 3-h face-to-face. Participants were given 8 weeks to complete the online ELNEC modules.	REDCap12 electronic data capture tools. Content analysis and descriptive statistics were used to analyse survey data.	Following the educational intervention, registered nurses perceived an increase in incompetence. The nurses' view that this education altered their clinical practice shows the critical nature of delivering this education in order to enhance the quality of patient care for individuals suffering from severe illness and their families.

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
3. (Warzyniec et al., 2019)	USA	Cross sectional research design	To investigate the effect of a one-hour web-based SDM education programme on cancer nurses' self-reported shared decision-making knowledge, attitudes, flexibility, and communication skills.	RNs ($n = 61$) Female: 55 (90.2 %) Age range: 20–60 yrs. Years' experience range: 4–9 yrs	A one-time post-test online survey	The one-hour web-based SDM education session. The SDM nurses, the acceptability questionnaire, and a six-item sociodemographic questionnaire.	IBM SPSS version 25.0. Univariate, multivariate statistics analysis techniques	The results suggest that web-based education may help oncology nurses enhance their SDM competence. Evaluations of this one-hour web-based SDM education session indicate that this educational effort increased participants' self-reported SDM competence, with a total score higher than 80 % on the SDM.
4. (Bahrambeygi et al., 2018)	Iran	Quasi-experimental study	To investigate the efficacy of an e-learning programme designed to improve nurses' knowledge and behaviour related to the care of patients with VTE.	RNs ($n = 100$) Female:95 (95 %) Age range: 30–40 yrs. Years' experience: 3–5 yrs	Questionnaires (pretest/post-test) and checklists were used to evaluate the impact of the intervention.	Knowledge of VTE risk assessment, preventive methods, guidelines for VTE prophylactic, diagnosis, and pharmacological and non-pharmacological therapy	IBM SPSS version 19.0. Univariate, bivariate, and multivariate statistics analysis techniques	The research discovered that although both groups showed an improvement in their level of knowledge between the pre- and post-tests, there was no significant connection between the kind of instructional techniques used and changes in knowledge level. The research discovered that e-learning is more successful than conventional approaches in improving learners' behaviour. Participants also had limited ability to use the Internet and the facility had infrastructural problems regarding ICT.
5. (Xing et al., 2018)	China	Cross-sectional study	To investigate Chinese nurses' attitudes and needs regarding online learning, as well as to discover variations in attitudes and requirements between nurses working in rural and urban hospitals.	RNs (n = 534). Female:529 (99.1 %) Mean age: 37 yrs. Years' experience: 5–7 yrs.	A self-reported, online questionnaire survey	A 28-item scale was used to assess nurses' attitudes about online learning. A multiple-choice question with nine choices was used to assess nurses' requirements for online learning.	SPSS for Windows version 24.0. Univariate, bivariate, and multivariate statistics analysis techniques	Rural nurses had more favourable attitudes about, and a greater need for, online learning than urban nurses. Nurses who have access to a computer and the internet at work are more optimistic than those who do not. Communication skills and patient education were the most popular

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
								areas of interest for nurses, regardless of where they worked.
6. (Chong et al., 2016)	Malaysia	Cross-sectional study	To investigate nurses' access to computer and internet facilities, their motivation in and inclinations for e-learning, and their attitude about e-learning.	RNs (n = 300) Female: 285 (95 %) Mean age: 43 yrs. Years' experience: 4–12 yrs.	Self-reported questionnaires	Background items, questions on access to computer and internet facilities, interest and preferences in e-learning, and attitudes toward e-learning. Were assessed using a 28-item scale,	SPSS version 21. Univariate, bivariate, and multivariate statistics analysis techniques	In general, this research found that Malaysian nurses believed that e-learning was critical for improving their knowledge and technical abilities, as well as their attitudes about nursing care, competence, and clinical performance. The results of this research indicate that the majority of Malaysian nurses (58 %) viewed e-learning positively. The research demonstrates that nurses' views about e-learning were unrelated to their job experience, credentials, or previous e-learning experience.
7. (das Graças Silva Matsubara and De Domenico, 2016)	Brazil	Randomised controlled study	To evaluate the learning results of professionals who participate in classroom learning vs remote learning to describe the participants' sociodemographic characteristics and digital fluency, to compare learning outcomes to independent factors, and to evaluate the appropriateness of educational methods in the Moodle Virtual Environment Survey on learning in a constructivist online learning environment.	RNs (n = 97) Female: 83 (85.5 %) Mean age: 30 yrs. Years' experience: 4–12 yrs	Constructivist On-Line Learning Environment Survey	Experience contained questions on relevance, critical reflection, interactivity, support from tutors, colleague support and understanding.	SPSS version 21. Univariate, bivariate, and multivariate statistics analysis techniques	The evaluation instrument scores for both groups, utilised in pre- and post-intervention phases, showed a significant difference for higher scores in the experimental group in the pre-phase The control group, on the other hand, demonstrated a higher percentage average of use in pre-and post-educational interventions (p 0.005), demonstrating that classroom teaching can provide additional benefits when learners have less knowledge, particularly when distance learning tutor functions do not meet student educational needs, as reported in the

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
								qualitative phase of the research.
8. (Riley and Schmidt, 2016)	Australia	Qualitative study	To explore the variables that affect rural nurses' engagement with online learning in a rural health area in the Australian state of New South Wales (NSW).	RNs ($n = 14$) Female: 12 (86 %) Age range: 20–69 yrs. Years' experience: 5–7 yrs	A semi-structured interview	What they felt worked well with online learning and then were asked to imagine an online world where anything was possible and describe what that might look like	Thematic analysis technique	Rural nurses stated that the primary motivation for accessing online learning was to fulfil required continuing professional development obligations, with very little participation beyond this need. The provision of CPD online raises issues about knowledge transferability for these remote nurses. Numerous nurses in this research reported experiencing annoyance, which reduced their confidence in using computers and accessing online learning, thus diminishing their enjoyment and participation with online learning.
9. (Van De Steeg et al., 2015)	Nether-lands	Quasi-experimental research designs	To evaluate the effectiveness of an e-learning course on nurses' delirium knowledge, characterise nursing staff baseline delirium knowledge, and identify demographic factors associated with baseline delirium knowledge and the success of the e-learning course.	RNs ($n =$ 978) Female: 911 (93.2 %) Mean age: 36 yrs. Years' experience: 3–9 yrs	Nursing staff's baseline knowledge test Nursing staff's final knowledge test	Baseline knowledge exam comprised a random selection of 24 questions – multiple-choice, true/false, and matching – from a database including 82 distinct questions regarding delirium and delirium treatment. Online courses on delirium knowledge. Following completion of the e-learning course, participants were invited to complete a final knowledge exam, the delirium, consisting of 24 randomly chosen questions.	STATA 12.1 and MLwiN 2.25. Univariate, bivariate, and multivariate statistics analysis techniques	Baseline knowledge exam comprised a random selection of 24 questions - multiple-choice, true/false, and matching - from a database including 82 distinct questions regarding delirium and delirium treatment. Online courses on delirium knowledge. Following completion of the e-learning course, participants were invited to complete a final knowledge exam, the delirium, consisting of 24 randomly chosen questions.
10. (Liu et al., 2014)	Taiwan	Randomised controlled trial	To discuss the creation and efficacy of an evidence-based e-learning programme for	RNs (n = 534) Female: 529 (99.1 %) Mean age:	A hard copy or online questionnaire distributed via Google	Case management knowledge and satisfaction were employed as factors to assess learning	IBM SPSS, version 19.0 Univariate, bivariate, and multivariate	Roughly 90 % of the experimental group believed the programme was flexible.

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			continuing education in case management for Taiwanese psychiatric nurses.	36 yrs. Years' experience: 4–8 yrs. 95 (95) 100 35 4–8	Documents (presently Google Drive)	results. The scale used to assess knowledge about case management (20 multiple-choice items)	statistics analysis techniques	The significant increase in knowledge scores seen in the post-test and follow-up tests indicates that the training was effective in improving nurses' case management knowledge. The programme increased participants' enjoyment of learning, and they valued the opportunity to choose their learning subject and time (range 3.95–4.14).
11. (Cottrell and Donaldson, 2013)	United Kingdom	Qualitative study	To explore registered nurses' perceptions of the Learn blood transfusion Module 1: Safe Transfusion Practice e-learning course in terms of its ability to accommodate individual learning styles and requirements.	RNs ($n = 7$) Female: 5 (71.4 %) Mean age: 45 yrs. Years' experience: 7- 15 yrs	A semi-structured interview	Learning preferences Course design and interactive learning Activist/ kinaesthetic learner Future learning needs	Thematic analysis technique	Five themes emerged: educational preferences, interactive learning, course design, patient safety, and future educational needs. The findings demonstrate that the e-learning software captures the participants' learning styles and needs successfully. All sorts of learners, including reflectors, theorists, and activists, as well as visual learners, can participate actively in the online learning experience. Additional perspectives on the course design and the transfer of information to practise upon completion of the course are given in an attempt to bridge the knowledge practice divide.
12. (Karaman, 2011)	Turkey	Cross-sectional study	To investigate nurses' perceptions of online continuing education and to determine the viewpoints of various groups, such as geographic groups, working companies, computer usage frequency, and age.	RNs ($n =$ 1041) Female: 989 (95 %) Age range: 25–54 yrs. Years' experience: 3–8 yrs	A self-reported, online questionnaire survey	Four variables were assessed: the perceived fit between circumstances and online learning services, perceived utility, considered ease of learning, and student characteristics.	SPSS version 18. Univariate, bivariate, and multivariate statistics analysis techniques	In general, nurses have found online education to be an effective educational option. Nurses see online learning options as being appropriate for their work environment and

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
								requirements. This has to do with the adaptability and convenience of online education. In terms of learning habits and traits, nurses are prepared for online learning. The findings of this research suggest that nurses who use computers more often have a more favourable attitude toward online education.
13. (Liang et al., 2011)	Taiwan	Cross-sectional study	To identify nurses' attitudes toward web-based continuing learning.	RNs (n = 267) Female: 147 (55.1 %) Age range: 20–60 yrs. Years' experience: 3–5 yrs	A self-reported, online questionnaire survey	Internet Self-efficacy Survey (ISS) which includes two scales (the basic and advanced self-efficacy scales). The AWCL	SPSS version 25. Univariate, bivariate, and multivariate statistics analysis techniques	Nurses' basic and advanced Internet self-efficacy was found to be significant predictors of perceived usefulness and ease of use of web-based continuing education, implying that both basic and advanced Internet self-efficacy are critical in motivating nurses to participate in web-based continuing education.
14. (Sheen et al., 2008)	Taiwan	Quasi-experimental research designs	To identify the experiences of registered nurses with an e-learning education programme.	RNs (n = 52) Female: 52 (100 %) Age range: 26–47 yrs. Years' experience: 7–8 yrs	Procedures used to complete the e-learning education program Three stages (planning, implementation and evaluation)	Because only five courses were required for N2 clinical nurses to advance to the N3 level at the study hospital, the webpage content was designed to include case study (1.5 h), career development (1 h), teaching and learning (1 h), nursing and law (1 h), and communication (1 h).	SPSS for Windows 13.0. Univariate, bivariate, and multivariate statistics analysis techniques	Nurses in both programs felt satisfied with the course contents and instructors. Only substantial disparities in teaching and learning, as well as communication, were discovered between programmes. Time and energy are required for learning, particularly while commuting to and from class locations and preparing course assignments.
15. (Yu et al., 2007)	Taiwan	Cross-sectional study	To investigate the feasibility of creating e-learning and the reasons for either embracing or rejecting e-learning as a means of delivering CE for PHNs.	RNs (n = 233) Female: 195 (83.7 %) Mean age: 48 yrs. Years' experience: 5–9 yrs	A self-administered questionnaire	The reasons for adopting e-learning. The reasons for rejecting e-learning.	SPSS version 10. Univariate, bivariate, and multivariate Statistics analysis techniques	The present research discovered that personal variables have a significant influence on determining whether individuals

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Table 3 (*continued*)

Authors, year	Setting	Study Design	Aim of study	No. of participants (gender, age, years' experience	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
								embrace or reject e-learning. For some nurses, the lack of a personal computer and internet connection is an acknowledged obstacle to e-learning adoption.

CE, continuing education; PHE, public health nurse; RN, registered nurse; N, nurse; SPSS, Statistical Package for the Social Sciences; IBM, International Business Machines; VTE, venous thromboembolism; RedCap 12, Research Electronic Data Capture; AWCL, Attitudes Toward Web-based Continuing Learning survey; STATA, Statistical Software for Data Science; MLwiN, software for Multi-level Modelling; ELENEC, End-of-Life Nursing Education Consortium; SDM, shared decision making.

review and repeat lessons on medical subjects at a time convenient for them and at their own pace. Additionally, several studies reported that the desire to be a lifelong learner (Xing et al., 2020; Chong et al., 2016; Sheen et al., 2008; Yu et al., 2007) is an enabler of e-learning among RNs.

3.3.2.2. Flexible nature of e-learning. Time and geographical flexibility (Xing et al., 2020; Bahrambeygi et al., 2018; Riley and Schmidt, 2016; Liu et al., 2014; Karaman, 2011; Sheen et al., 2008) was also found to a major enabler of e-learning uptake among RNs. Studies have shown that e-learning has less impact on family life (Xing et al., 2020; Sheen et al., 2008), and can help to fulfil job-related needs (Xing et al., 2020; Sheen et al., 2008). Additionally, Sheen et al. (2008) reported that the time -saving nature of e-learning can motivate RNs to use e-learning.

3.3.2.3. Other facilitators. Other enabling factors of e-learning among RNs include cost-effectiveness (Xing et al., 2020; Riley and Schmidt, 2016; Sheen et al., 2008), the availability of internet facilities (Xing et al., 2018) and high levels of internet self-efficacy (Xing et al., 2018; Karaman, 2011; Liang et al., 2011).

3.3.3. Barriers to e-learning

3.3.3.1. Lack of information-technology capabilities or user-friendly information-technology. The main barrier to RNs' participation in e-learning was a lack of information-technology capabilities or user-friendly information technology (Xing et al., 2020; Bishop et al., 2019; Xing et al., 2018; das Graças Silva Matsubara and De Domenico, 2016; Riley and Schmidt, 2016; Cottrell and Donaldson, 2013; Sheen et al., 2008; Yu et al., 2007). Lack of internet facilities and computers (Xing et al., 2020; Xing et al., 2018; Cottrell and Donaldson, 2013; Yu et al., 2007) and lack of computer proficiency (Xing et al., 2020; Bahrambeygi et al., 2018; das Graças Silva Matsubara and De Domenico, 2016; Yu et al., 2007) were identified by RNs as factors impeding the uptake of e-learning. Lack of support from supervisor and/or other colleagues (Xing et al., 2020; das Graças Silva Matsubara and De Domenico, 2016), poor internet self-efficacy (Xing et al., 2020; Bahrambeygi et al., 2018), dense content of modules (Bishop et al., 2019; das Graças Silva Matsubara and De Domenico, 2016), and lack of interest in course modules (Xing et al., 2020) were also documented as barriers in utilising e-learning.

3.3.3.2. Lack of motivation. Lack of motivation was identified in eight of the fifteen articles (Van De Steeg et al., 2015; Sheen et al., 2008; Xing et al., 2020; Bishop et al., 2019; Bahrambeygi et al., 2018; Xing et al., 2018; Chong et al., 2016; Karaman, 2011) addressing aspects of learners' motivation to achieve personal and professional objectives and goals. The analyses of the variables revealed that the RNs shared two separate experiences: internal and external challenges. Internal challenges included low engagement and motivation, disturbances in perception, limited adaptability, elevated levels of concern and stress, lack of self-discipline and self-efficacy and lack of a connection between the learner and facilitator. Of the external factors, lack of financial reimbursement hindered e-learning engagement (Bishop et al., 2019). Further, lack of motivation not only interfered with learning but also prevented RNs from fulfilling their healthcare needs and expectations (Liang et al., 2011; Yu et al., 2007; Riley and Schmidt, 2016).

3.3.3.3. Lack of time. Six studies (Bishop et al., 2019; das Graças Silva Matsubara and De Domenico, 2016; Cottrell and Donaldson, 2013; Sheen et al., 2008; Xing et al., 2020; Yu et al., 2007) examined the role of timing in e-learning among RNs and reported lack of time as a barrier. However, Xing et al. (2020), reported that RNs perceived the flexibility afforded through e-learning was an important facilitator. Notably, competing work and personal priorities were considered major barriers to the uptake of e-learning (Bishop et al., 2019; Yu et al., 2007).

3.3.4. Learning in practice

Learning in practice within the context of e-learning was identified in nine of the 15 studies as an effective method for integrating knowledge with practice through education and training (Bishop et al., 2019; das Graças Silva Matsubara and De Domenico, 2016; Liu et al., 2014; Warzyniec et al., 2019; Van De Steeg et al., 2015; Sheen et al., 2008; Xing et al., 2020; Bahrambeygi et al., 2018; Xing et al., 2018). Specifically, intervention studies reported that e-learning led to improvements in clinical knowledge (Warzyniec et al., 2019; Bahrambeygi et al., 2018; das Graças Silva Matsubara and De Domenico, 2016; Van De Steeg et al., 2015; Liu et al., 2014), and clinical practice (Bishop et al., 2019), promoted positive attitudes (Bahrambeygi et al., 2018) and promoted skill development (Warzyniec et al., 2019; das Graças Silva Matsubara and De Domenico, 2016). Basic and advanced internet self-efficacy was an important predictor of nurses' perceived usefulness and proficiency in the use of web-based continuing education (Liang et al., 2011). RNs viewed e-learning as vital for their professional development, including their attitudes toward nursing care, competence, and clinical performance (Karaman, 2011; Liang et al., 2011; Yu et al., 2007; Riley and Schmidt, 2016; Cottrell and Donaldson, 2013). Regarding preference, one study reported that RNs preferred using their mobile phones for e-learning (Xing et al., 2020) while another reported that RNs preferred to use computers for e-learning (Chong et al., 2016).

4. Discussion

The gaps in the initiation of e-learning for RNs (Al-Azawei et al., 2016) between developed and developing countries, the lack of comprehensive

Table 4
Critical Appraisal Checklist for Randomised Controlled Trials included in the study.

	Critical Appraisal Checklist for Randomised Controlled Trials[a]													Total Score	Overall appraisal
Article	1	2	3	4	5	6	7	8	9	10	11	12	13	13	
(Bishop et al., 2019)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	12	Included
(das Graças Silva Matsubara and De Domenico, 2016)	Y	U	Y	Y	Y	Y	Y	U	Y	N	Y	Y	Y	10	Included
(Liu et al., 2014)	Y	Y	U	Y	Y	Y	U	Y	N	Y	U	Y	Y	9	Included

Critical Appraisal Checklist for Randomised Controlled Trials description [Yes = Y, No = N, Unclear = U].
1, Was true randomisation used for the assignment of participants to treatment groups; 2, Was allocation to treatment groups concealed; Were treatment groups similar at the baseline; 4, Were participants blind to treatment assignment; 5, Were those delivering treatment blind to treatment assignment; 6, Were outcomes assessors blind to treatment assignment; 7, Were treatment groups treated identically other than the intervention of interest; 8, Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed; 9, Were participants analysed in the groups to which they were randomised; 10, Were outcomes measured in the same way for treatment groups; 11, Were outcomes measured in a reliable way; 12, Was appropriate statistical analysis used; 13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?
[a] Joanna Briggs Institute Critical Appraisal Checklists.

Table 5
Critical Appraisal Checklist for Quasi-experimental Studies included in the study.

	Critical Appraisal Checklist for Quasi-experimental Studies[a]									Total Score	Overall appraisal
Article	1	2	3	4	5	6	7	8	9	9	
(Warzyniec et al., 2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9	Included
(Van De Steeg et al., 2015)	Y	Y	U	Y	U	Y	N	Y	Y	6	Included
(Sheen et al., 2008)	Y	Y	Y	Y	N	Y	Y	N	Y	7	Included

Critical Appraisal Checklist for Quasi-experimental Studies description: [Yes = Y, No = N, Unclear = U].
1, Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first); 2, Were the participants included in any comparisons similar; 3, Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest; 4, Was there a control group; 5, Were there multiple measurements of the outcome both pre and post the intervention/exposure; 6, Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed; 7, Were the outcomes of participants included in any comparisons measured in the same way; 8, Were outcomes measured in a reliable way; 9, Was appropriate statistical analysis used?
[a] Joanna Briggs Institute Critical Appraisal Checklists.

Table 6
Critical Appraisal Checklist for Cross-sectional Studies included in the study.

	Critical Appraisal Checklist for Cross-sectional Studies [a]								Total Score	Overall appraisal
Article	1	2	3	4	5	6	7	8	8	
(Xing et al., 2020)	Y	Y	Y	Y	N	U	Y	Y	6	Included
(Bahrambeygi et al., 2018)	Y	Y	Y	Y	U	U	Y	Y	6	Included
(Xing et al., 2018)	Y	Y	U	Y	Y	Y	U	Y	6	Included
(Chong et al., 2016)	Y	Y	Y	Y	Y	U	Y	Y	7	Included
(Karaman, 2011)	Y	Y	Y	Y	U	N	Y	Y	6	Included
(Liang et al., 2011)	Y	Y	Y	Y	Y	U	Y	Y	7	Included
(Yu et al., 2007)	Y	Y	Y	Y	U	N	Y	Y	6	Included

Critical Appraisal Checklist for Analytical Cross-sectional Studies description: [Yes = Y, No = N, Unclear = U].
1, Where are the criteria for inclusion in the sample clearly defined; 2, Were the study subjects and the setting described in detail; 3, Was the exposure measured in a valid and reliable way; 4, Were objective, standard criteria used for measurement of the condition; 5, Were confounding factors identified; 6, Were strategies to deal with confounding factors stated; 7, Were the outcomes measured in a valid and reliable way; 8, Was appropriate statistical analysis used?
[a] Joanna Briggs Institute Critical Appraisal Checklists.

Table 7
Critical Appraisal Checklist for Qualitative studies included in the study.

	Critical Appraisal Checklist for Qualitative Studies [a]										Total Score	Overall appraisal
Article	1	10	3	4	5	6	7	8	9	10	10	
(Riley and Schmidt, 2016)	Y	8	Y	Y	Y	Y	N	N	Y	Y	8	Included
(Cottrell and Donaldson, 2013)	Y	8	Y	Y	Y	Y	N	N	Y	Y	8	Included

Critical Appraisal Checklist for Analytical Cross-sectional Studies description: [Yes = Y, No = N, Unclear = U].
1, Is there congruity between the stated philosophical perspective and the research methodology; 2, Is there congruity between the research methodology and the research question or objectives; 3, Is there congruity between the research methodology and the methods used to collect data; 4, Is there congruity between the research methodology and the representation and analysis of data; 5, Is there congruity between the research methodology and the interpretation of results; 6, Is there a statement locating the researcher culturally or theoretically; 7, Is the influence of the researcher on the research, and vice-versa, addressed; 8, Are participants and their voices adequately represented; 9, Is the research ethical according to current criteria or, for recent studies, is there evidence of ethical approval by an appropriate body; 10, Do the conclusions drawn in the research report flow from the analysis or interpretation of the data?
[a] Joanna Briggs Institute Critical Appraisal Checklists.

findings on the topic of numerous studies (Xing et al., 2018) and the paucity of studies on RNs versus nursing students (in the MER search), drove this integrative review. To the best of our knowledge, this review is one of the first that has explored the e-learning experiences, attitudes, and perspectives of RNs. The present study, summarizing 15 studies, found e-learning capable of enhancing learning due to its flexible nature and ability to provide a gamut of clinical knowledge. To better situate the discussion of the facilitator and barriers to e-learning, we first present a narrative synthesis of the comparative effectiveness of e-learning versus traditional as this will provide relevant stakeholders with the necessary impetus to implement the review recommendations targeted at the utilization of e-learning for RNs continuing education.

4.1. E-learning versus the traditional method of continuing education among RNs

In this study, regardless of the e-learning approach (self-directed vs. interactive) and activities (clinical skills versus theoretical learning) and level of development (developed versus developing countries) e-learning improved learning outcomes and indicates that online-based learning in practice is an effective method for integrating knowledge with practice among RNs compared to the traditional approach. Specifically, the benefits of the traditional learning method among RNs include a positive learning attitude, retention, professional competence, and skills. The finding is further collaborated by the findings of positive perception and attitude, with most RNs in the included studies viewing e-learning as vital to their clinical practice and professional development. A recently conducted integrated review found that e-learning offers benefits such as knowledge retention, improved attitude, and observable positive changes in practice (Stevens et al., 2021). *E*-learning creates a conducive environment for interaction between learners and facilitators, making the process stimulating and entirely exciting (Regmi and Jones, 2020). Furthermore, e-learning makes the learning process more intriguing by the fact that the facilitators, or generally, the teachers can utilize both pedagogical and technological tools that are readily available (Regmi and Jones, 2020). Nonetheless, the review outcome is limited by the relatively small number of the included studies. The major strength of the study is its integrative approach and quality appraisal revealed moderate to excellent study quality.

4.2. Facilitators of e-learning continuing education among RNs

4.2.1. Access to clinical knowledge per preference

Access to on-going clinical knowledge at a time convenient was the main facilitator of e-learning uptake in this systematic review. To achieve best practices among health care professionals including nurses, medical education must be appealing and innovative, with a paradigm shift from entrenched curriculum and educational methods. This is achievable with e-learning as the field continues to evolve (Gómez Rivas et al., 2021). The ability of e-learning programmes to match the needs of the nurses and offer relevant learning opportunities as reported in the included study (Xing et al., 2020), might also account for their popularity and increased use in many countries. E-learning is vastly becoming an important force in driving health education globally and its use has received wide attention, especially in the area of continuous professional development (Nicoll et al., 2018; Barteit et al., 2020). E-learning provides the opportunity for learners to revisit and review already concluded teachings for better understanding and assimilation (Mathivanan et al., 2021).

4.2.2. Time and geographical flexibility

Time and geographical flexibility were a major facilitator to the uptake of e-learning in this review. In a qualitative study based in a faculty from a medical sciences university in Iran that used webinars, participants identified learning opportunities ('up-to-date scientific interaction') and freedom from time, space, and attendance requirements as benefits of e-learning (Jafarzadeh-Kenarsari et al., 2019). E-learning eliminates geographical limitations as it requires only three items namely the internet, a computer, and a programme (Jafarzadeh-Kenarsari et al., 2019). Engaging in e-learning eliminates the time and location restrictions imposed by traditional classroom/on-site approach and affords individuals to pace their learning according to needs while also networking with colleagues and facilitators (Xing et al., 2020; Bahrambeygi et al., 2018; Riley and Schmidt, 2016; Liu et al., 2014; Karaman, 2011; Sheen et al., 2008).

Although RNs perceived time flexibility as a notable strength of e-learning, lack of time and competing for work demands are impediments to participation in e-learning for continuing education purposes. This finding is similar to evidence from an earlier integrative review (Schweitzer and Krassa (2010) which identified nurses' inability to take time off from work to attend continuing education programmes as a significant barrier to participation in continuing education, although the previous study was limited to traditional (non-e-learning) continuing education method. According to Schweitzer and Krassa (2010), the cost of attendance and childcare and home responsibilities were significant barriers to participation in continuing education. However, given the time flexibility of e-learning methods, we expect the problem of the cost of attendance and childcare and home responsibilities to be significantly reduced, especially when e-learning is embedded into work schedules. Hence, to facilitate the uptake of e-learning among RNs, it may be important to integrate online courses as part of the work schedules for nurses. For instance, online seminars and workshops could be organized in the workplace, provided that the necessary e-learning facilities have been put in place. Further, employers may also seek seed grants which may help improve the infrastructures needed for effective e-learning. In situations where employers have found e-learning for continuing education among RNs a cost-effective adventure, incentives (such as reimbursement for continuing education time since e-learning affords employers extra saving on logistics) may be offered to nurses who opt to participate in courses remotely, as non-remuneration for the time engaged in e-learning is a barrier to the uptake of e-learning (Bishop et al., 2019).

4.3. Barriers to e-learning for continuing education among RNs

4.3.1. Lack of e-learning equipment

Regarding the use of e-learning technology or platforms, not having the necessary skills, resources or support needed to master its use was a barrier among nurses. To broaden the scope of literature in which to discuss our findings, we examined several studies on e-learning in populations of future nurses in Egypt, Iran, Pakistan, South Africa South Korea, and Turkey (Abdelaziz et al., 2011; Akimanimpaye and Fakude, 2015; McVeigh, 2009; Seada and Mostafa, 2017). These studies reported that lack of computer skills and lack of familiarity with and/or discomfort using information technology, such as the internet (Abdelaziz et al., 2011; Jamil et al., 2016; Guven Ozdemir and Sonmez, 2021) impeded the students' acceptance of e-learning. A qualitative study reported that, despite efforts to promote ICT adoption and demonstrating the benefits for health care, some nurses have never fully embraced the technology (Farokhzadian et al., 2020). Lack of internet facilities, computers (Xing et al., 2020; Xing et al., 2018; Cottrell and Donaldson, 2013; Yu et al., 2007) and computer proficiency (Xing et al., 2020; Bahrambeygi et al., 2018; das Graças Silva Matsubara and De Domenico, 2016; Yu et al., 2007) were hinderances for RNs uptake of e-learning. These problems can be mitigated by providing adequate support for nurses engaging with e-learning. Previous studies have reiterated the importance of technical and administrative support before and while undertaking e-learning-based programmes (Zaman et al., 2021; Xing et al., 2020; das Graças Silva Matsubara and De Domenico, 2016) with such support being provided via face-to-face, online, via telephone, and via social media messaging (Regmi and Jones, 2020).

4.3.2. Lack of motivation

Lack of motivation, was associated with the internal challenges

nurses faced to using e-learning, and could be perceived as opposition, and disinterest, In a mixed-methods study of e-learning with a total of 108 professors and undergraduate students in Iran, the respondents identified several possible causes of internal challenges: increased preparation time for e-learning content, the reduced role of the lecturer and changes in the learners' performance, participation, and satisfaction (Al-Azawei et al., 2016). According to Alami et al. (2020), unintended consequences of information technology include the deterioration of working conditions, reduced contact and communication time with patients, technology's misalignment with the clinical context, and causing anxiety, stress, and cognitive overload (Alami et al., 2020). Therefore, if e-learning is properly embedded with clinical environments, some of these unintended consequences of technology may be reduced to its barest minimum.

E-learning is a cost-effective and convenient learning approach which possesses numerous merits over traditional contact learning including a significant reduction in transportation, accommodation, and possibly course materials costs (Gooshi et al., 2014). Interestingly, e-learning does not seem to overcome the factor of lack of reimbursement for continuing education time which is a notable anti-motivational element for continuing education among RNs in the era predating increased e-learning utilization. One would expect that employers should leverage the cost-effective merit of e-learning to improve its uptake by providing RNs with reimbursement for online continuing education. Despite, the paucity of evidence regarding how e-learning affects employers' decisions for reimbursement, this study revealed that lack of reimbursement remains a reason for lack of motivation among RNs to engage in e-learning.

4.4. Recommendations for future research

Future RCTs are required to examine the effectiveness of e-learning versus traditional methods as well as the comparative effectiveness of various e-learning approaches and platforms. Given the gamut of challenges facing e-learning, there is a need for the development of a robust model of e-learning approach for continuing education among RNs, to improve and optimise patient care. In addition, the barriers which include lack of information-technology skills, learning in practice and lack of motivation which is exacerbated by lack of reimbursement of continuing education time, underscore the need for robust mixed-method studies on the digital literacy of nursing and medical instructors as well as employers. Future effectiveness and implementation studies must be designed bearing in mind the interest of both RNs and employers.

4.5. Implications for practice

Considering the various findings related to facilitators, barriers and effectiveness of e-learning in this study, caution must be exercised in the application of the review recommendations. Online education facilitates the learning of theoretical knowledge and clinical skills necessary to support RNs in their day-to-day nursing practice. It offers some advantages over the traditional face-to-face learning method including time and location flexibility, access to clinical knowledge per preference and possible cost-effectiveness. Notwithstanding, the gamut of challenges facing e-learning among RNs possesses implications for practice. First, for optimum exploitation of the benefits of e-learning, digital literacy should be promoted and engrafted into hospitals and nursing programmes. Early exposure to ICT can foster positive attitudes and self-confidence in computer use among nurses. The findings of this review indicate that institutional support is critical for encouraging e-learning. *E*-learning continuing education should form part of work schedules or RNs should be reimbursed for continuing education time, regardless of RNs' preferred training location. Clinical and administrative scenarios should be well-tailored to the particularities of the nursing practice and services. Hospital administrators may solicit nurses from research institutions to share their positive experiences, suitable strategies, and policies for increased utilization of cost-effective e-learning platforms and approaches to access among RNs.

4.6. Strengths and limitations

The strength of this systematic review lies in the integrative approach including qualitative, quasi-experimental, cross-sectional, and quantitative studies. However, this review has limitations. Only articles published in English were included, and this restriction, along with the exclusion of all grey literature, may have resulted in the omission of relevant literature. Furthermore, the various designs have inherent limitations. Qualitative research is subjective, its methodological validity and reliability are not always clear and generalising the results to other populations are problematic. In quantitative studies, the research context is not considered, and a natural context is generally not used for investigations (Korstjens and Moser, 2017).

5. Conclusion

RNs possess a positive attitude and perception toward the utilization of e-learning for continuing education. E-learning is arguably an effective learning method for continuing education among RNs. The use of e-learning is facilitated by the time and geographical flexibility and access to knowledge at the convenience of the individual. Barriers to e-learning among RNs include lack of equipment, poor digital literacy, and lack of institutional support especially reimbursement for continuing education time. Robust e-learning for RNs' continuing education should be designed bearing in mind the known barriers.

CRediT authorship contribution statement

All the authors have contributed substantially (Study design: RA, SYW, LE&ZS; data collection: RA; data analysis: RA, SYW, LE&ZS; and manuscript preparation: RA, SYW, LE&ZS). All authors agree with the content of the manuscript.

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Ethical statements

There is no ethical approval requirement for this study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

Abdelaziz, M., Kamel, S.S., Karam, O., Abdelrahman, A., 2011. Evaluation of E-learning program versus traditional lecture instruction for undergraduate nursing students in a faculty of nursing. Teach. Learn. Nurs. 6 (2), 50–58.

Akimanimpaye, F., Fakude, L., 2015. Attitudes of undergraduate nursing students towards e-learning at the University of the Western Cape, South Africa: teaching and

learning in health care professions. Afr. J. Phys. Health Educ. Recreat. Dance 21 (sup-1), 418–433.
Alami, H., Lehoux, P., Gagnon, M.-P., Fortin, J.-P., Fleet, R., Ag Ahmed, M.A., 2020. Rethinking the electronic health record through the quadruple aim: time to align its value with the health system. BMC Med. Inform. Dec. Making 20 (1), 1–5.
Al-Azawei, A., Parslow, P., Lundqvist, K., 2016. Barriers and opportunities of e-learning implementation in Iraq: a case of public universities. In: The International Review of Research in Open and Distributed Learning, 17(5). https://doi.org/10.19173/irrodl.v17i5.2501.
Andrade, H.L., 2019. A critical review of research on student self-assessment. Front. Educ. 87. Frontiers.
Bahrambeygi, F., Shojaeizadeh, D., Sadeghi, R., Nasiri, S., Ghazanchaei, E., 2018. The effectiveness of an e-learning program on nurse's knowledge and behaviour for caring of patients with thromboembolism: a comparative study. J. Nurs. Healthc. Manag. 1, 105.
Barteit, S., Guzek, D., Jahn, A., Bärnighausen, T., Jorge, M.M., Neuhann, F., 2020. Evaluation of e-learning for medical education in low-and middle-income countries: a systematic review. Comput. Educ. 145, 103726.
Benwell, N., Hird, K., Thomas, N., Furness, E., Fear, M., Sweetman, G., 2016. Effectiveness and efficiency of training in digital healthcare packages: training doctors to use digital medical record keeping software. Aust. Health Rev. 41 (5), 479–484.
Bishop, C.T., Mazanec, P., Bullington, J., Craven, H., Dunkerley, M., Pritchett, J., Coyne, P.J., 2019. Online end-of-life nursing education consortium core curriculum for staff nurses: an education strategy to improve clinical practice. J. Hosp. Palliat. Nurs. 21 (6), 531–539.
Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101.
Canadian Nurses Association, 2015. Framework for the Practice of Registered Nurses in Canada. Canadian Nurses Association, Ottawa, ON [2019-06-06]. https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/Framework_for_the_Pracice_of_Registered_Nurses_in_Canada_1_.pdf.
Chong, M.C., Francis, K., Cooper, S., Abdullah, K.L., Hmwe, N.T.T., Sohod, S., 2016. Access to, interest in and attitude toward e-learning for continuous education among Malaysian nurses. Nurse Educ. Today 36, 370–374.
Clark, R.C., Mayer, R.E., 2016. E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning. john Wiley & sons.
Connolly, T., Stansfield, M., 2007. Developing constructivist learning environments to enhance elearning. In: Buzzetto-More, N. (Ed.), Principles of Effective Online Teaching, pp. 19–38.
Cottrell, S., Donaldson, J.H., 2013. Exploring the opinions of registered nurses working in a clinical transfusion environment on the contribution of e-learning to personal learning and clinical practice: results of a small scale educational research study. Nurse Educ. Pract. 13 (3), 221–227.
das Graças Silva Matsubara, M., De Domenico, E.B.L., 2016. Virtual learning environment in continuing education for nursing in oncology: an experimental study. J. Cancer Educ. 31 (4), 804–810. https://doi.org/10.1007/s13187-015-0889-x.
El-Sabagh, H.A., 2021. Adaptive e-learning environment based on learning styles and its impact on development students' engagement. Int. J. Educ. Technol. High Educ. 18, 53. https://doi.org/10.1186/s41239-021-00289-4.
Farokhzadian, J., Khajouei, R., Hasman, A., Ahmadian, L., 2020. Nurses' experiences and viewpoints about the benefits of adopting information technology in health care: a qualitative study in Iran. BMC Med. Inform. Decis. Making 20 (1), 1–12.
Gaur, R., Mudgal, S.K., Kaur, S., Sharma, R., 2020. Undergraduate nursing students' attitude towards online classes during lockdown period in India: imposed or interested. Intern. J. Commun. Med. Public Health 7 (9), 3371–3377.
Gómez Rivas, J., Teoh, J.Y.-C., Rodriguez Socarrás, M., 2021. Social media and E-learning. In: Urologic Surgery in the Digital Era. Springer, pp. 221–237.
Gooshi, M., Sirati, M., Khaghanizade, M., 2014. Utilization conditions of virtual education at continuing education for nurses: a review. International Journal of Medical Reviews 1 (3), 111–118.
Guven Ozdemir, N., Sonmez, M., 2021. The relationship between nursing students' technology addiction levels and attitudes toward e-learning during the COVID-19 pandemic: a cross-sectional study. Perspect. Psychiatr. Care 57 (3), 1442–1448.
Jafarzadeh-Kenarsari, F., Abouzari-Gazafroodi, K., Zaersabet, F., 2019. Exploration of the experiences and viewpoints of faculty members on continuing education webinars: a qualitative study. Qual. Rep. 24 (9), 2215–2232.
Jamil, B., Sethi, A., Ali, S., 2016. Attitude of nursing students towards e-learning. Adv. Health Prof. Educ 2, 24–29.
Karaman, S., 2011. Nurses' perceptions of online continuing education. BMC Medical Education 11 (1), 1–6.
Korstjens, I., Moser, A., 2017. Series: Practical guidance to qualitative research. Part 2: Context, research questions and designs. Eur. J. Gen. Pract. 23 (1), 274–279. https://doi.org/10.1080/13814788.2017.1375090.
Kynge, L., 2020. Finding the best way to deliver online educational content in low-resource settings: Qualitative survey study. JMIR Med. Educ. 6 (1), e16946.
Lahti, M., Hätönen, H., Välimäki, M., 2014. Impact of e-learning on nurses' and student nurses knowledge, skills, and satisfaction: a systematic review and meta-analysis. Int. J. Nurs. Stud. 51 (1), 136–149. https://doi.org/10.1016/j.ijnurstu.2012.12.017.
Liang, J.-C., Wu, S.-H., Tsai, C.-C., 2011. Nurses' internet self-efficacy and attitudes toward web-based continuing learning. Nurse Educ. Today 31 (8), 768–773.
Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P., Moher, D., 2009. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J. Clin. Epidemiol. 62 (10), e1–e34.
Liu, W.-I., Rong, J.-R., Liu, C.-Y., 2014. Using evidence-integrated e-learning to enhance case management continuing education for psychiatric nurses: a randomised controlled trial with follow-up. Nurse Educ. Today 34 (11), 1361–1367.
Mathivanan, S.K., Jayagopal, P., Ahmed, S., Manivannan, S., Kumar, P., Raja, K.T., Prasad, R.G., 2021. Adoption of e-learning during lockdown in India. Int. J. Syst. Assur. Eng. Manag. 1–10.
Mbuzi, V., Fulbrook, P., Jessup, M., 2018. Effectiveness of programs to promote cardiovascular health of Indigenous Australians: a systematic review. Intern. J. Equity Health 17 (1), 1–17.
McDonald, E.W., Boulton, J.L., Davis, J.L., 2018. E-learning and nursing assessment skills and knowledge - an integrative review. Nurse Educ. Today 66, 166–174. https://doi.org/10.1016/j.nedt.2018.03.011.
McVeigh, H., 2009. Factors influencing the utilisation of e-learning in post-registration nursing students. Nurse Educ. Today 29 (1), 91–99. https://doi.org/10.1016/j.nedt.2008.07.004.
Mlambo, M., Silén, C., McGrath, C., 2021. Lifelong learning and nurses' continuing professional development, a metasynthesis of the literature. BMC Nurs. 20 (1), 62. https://doi.org/10.1186/s12912-021-00579-2.
Mohammed, A., Kumar, S., Maina, B., Shuaibu, A., 2017. E-Learning: a tool for enhancing teaching and learning in educational institutes. Int. J. Comput. Sci. Inf. Technol. 8 (2), 217–221.
Nicoll, P., MacRury, S., van Woerden, H.C., Smyth, K., 2018. Evaluation of technology-enhanced learning programs for health care professionals: systematic review. J. Med. Internet Res. 20 (4), 9. https://doi.org/10.2196/jmir.9085.
Popay, J., Roberts, H., Sowden, A., et al., 2006. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A Product from the ESRC Methods Programme. https://www.researchgate.net/publication/233866356_Guidance_on_the_conduct_of_narrative_synthesis_in_systematic_reviews_A_product_from_the_ESRC_Methods_Programme.
Regmi, K., Jones, L., 2020. A systematic review of the factors–enablers and barriers–affecting e-learning in health sciences education. BMC Med. Educ. 20 (1), 1–18.
Riley, K., Schmidt, D., 2016. Does online learning click with rural nurses? A qualitative study. Aust. J. Rural Health 24 (4), 265–270.
Rouleau, G., Gagnon, M.P., Côté, J., Payne-Gagnon, J., Hudson, E., Dubois, C.A., Bouix-Picasso, J., 2019. Effects of E-learning in a continuing education context on nursing care: systematic review of systematic qualitative, quantitative, and mixed-studies reviews. J. Med. Internet Res. 21 (10), e15118 https://doi.org/10.2196/15118.
Schweitzer, D.J., Krassa, T.J., 2010. Deterrents to nurses' participation in continuing professional development: an integrative literature review. J. Contin. Educ. Nurs. 41 (10), 441–447.
Seada, A., Mostafa, M.F., 2017. Students' Satisfaction and Barriers of E–Learning Course among Nursing Students, Mansoura University, 3(3). IDOSI Publications, pp. 170–178.
Sheen, S.-T.H., Chang, W.-Y., Chen, H.-L., Chao, H.-L., Tseng, C.P., 2008. E-learning education program for registered nurses: the experience of a teaching medical center. J. Nurs. Res. 16 (3), 195–201.
Singh, H.K., Joshi, A., Malepati, R.N., Najeeb, S., Balakrishna, P., Pannerselvam, N.K., Singh, Y.K., Ganne, P., 2021. A survey of E-learning methods in nursing and medical education during COVID-19 pandemic in India. Nurse Educ. Today 99, 104796. https://doi.org/10.1016/j.nedt.2021.104796.
Stern, C., Lizarondo, L., Carrier, J., Godfrey, C., Rieger, K., Salmond, S., Apóstolo, J., Kirkpatrick, P., Loveday, H., 2020. Methodological guidance for the conduct of mixed methods systematic reviews. JBI Evid. Synth. 18 (10), 2108–2118. https://doi.org/10.11124/JBISRIR-D-19-00169.
Stevens, C., Horrigan, J., Koren, I., Heale, R., 2021. E-learning for nurses-an integrative review. Divers. Res. Health J. 4 (1), 49–64.
Sun, W., Hong, JC., Dong, Y., Huang, Y., Fu, Qian. (2022). Self-directed learning predicts online learning engagement in higher education mediated by perceived value of knowing learning goals. Asia-Pacific Education Research. doi:https://doi.org/10.1007/s40299-022-00653-6.
Van De Steeg, L., IJkema, R., Wagner, C., Langelaan, M., 2015. The effect of an e-learning course on nursing staff's knowledge of delirium: a before-and-after study. BMC Med. Educ. 15 (1), 1–8.
Warzyniec, A., Tariman, J.D., Simonovich, S.D., 2019. Shared decision making: effects of an online education session on knowledge, attitudes, adaptability, and communication skills among nurses. Clin. J. Oncol. Nurs. 23 (6), E93–E99.
Xing, W., Ao, L., Xiao, H., Cheng, L., Liang, Y., Wang, J., 2018. Nurses' attitudes toward, and needs for online learning: differences between rural and urban hospitals in Shanghai, East China. Int. J. Environ. Res. Public Health 15 (7), 1495.
Xing, W., Ao, L., Xiao, H., Liang, L., 2020. Chinese nurses' preferences for and attitudes about e-learning in continuing education: a correlational study. J. Contin. Educ. Nurs. 51 (2), 87–96.
Yu, S., Chen, I.-J., Yang, K.-F., Wang, T.-F., Yen, L.-L., 2007. A feasibility study on the adoption of e-learning for public health nurse continuing education in Taiwan. Nurse Educ. Today 27 (7), 755–761.
Zaman, N., Goldberg, D.M., Kelly, S., Russell, R.S., Drye, S.L., 2021. The relationship between nurses' training and perceptions of electronic documentation systems. Nurs. Rep. 11 (1), 12–27.