1. Introduction

Technological innovation has not only impacted social change in recent years but has been the prime driver of educational transformation (Garrison, 2011). The newest consumers of post-secondary education, the so-called 'digital natives', have come to expect education to be delivered in a way that offers increased usability and convenience (Palfrey & Gasser, 2013). Health care professionals (HCPs) in the clinical setting, particularly those in rural and remote communities, have similar expectations in regards to continuing professional development (Maloney et al., 2013; Sinclair & Levett-Jones, 2011; Wellard & Bethune, 2000). Today's health workforce has a professional responsibility to maintain competency in practice through achieving a minimum number of hours of continuing professional development each year (Sinclair, Bowen, & Donkin, 2013). Consequently, HCPs seeking educational opportunities are reliant on sourcing these independently according to individual learning needs (Mills, Field, & Cant, 2011). However, difficulties exist with some health professionals' access to ongoing professional development, particularly those with limited opportunities for face-to-face education (Bennett et al., 2014; Lenthall et al., 2011) due to geographical isolation or for those not enrolled in a formal program of study (Curran, Fleet, & Kirby, 2006; Doorenbos et al., 2011). These issues challenge traditional methods of teaching delivery; and electronic learning (e-learning) is at the nexus of overcoming these challenges.

The term e-learning originated in the mid-1990s as the internet began to gather momentum (Garrison, 2011). Electronic learning can be broadly defined as any type of educational media that is delivered in an electronic form.(Clark & Mayer, 2011) Terms such as computer-assisted learning, online learning, web-based learning and e-learning are often used synonymously but all reflect information delivery via an electronic device. This broad definition allows for a gamut of multimedia to be used for the purpose of constructing, delivering and assessing knowledge learned. Multimedia typically used in e-learning ranges from the now archaic Compact Disc Read-Only Memory (CD-ROMs), to the simple Microsoft PowerPoint, or the more advanced and complex virtual worlds such a second life.

Electronic learning can be delivered in asynchronous[1] or synchronous[2] formats, with the latter (for example interactive online lectures via platforms such as BlackboardCollaborate or WebEx) more commonly used in formal educational settings with set timetables of study (Garrison, 2011).

For the purpose of this review, e-learning is defined as any educational intervention that is mediated electronically via the internet asynchronously. The distinction between synchronous and asynchronous delivery is important within the context of this review. HCPs seeking specific knowledge are reliant on sourcing information independently via the internet, journals, textbooks or other colleagues. Alternatively, they can access asynchronous e-learning programs that are available through established learning networks or affiliated professional organisations in order to meet individual learning needs and objectives (Melhuish & Falloon, 2010; Sinclair, Carstairs, Shanahan, & Schoch, 2014; Sinclair & Levett-Jones, 2011). Asynchronous e-learning is a learner-centred approach that affords the opportunity to engage in learning at a time and location that is convenient and enables the learner to balance professional development with personal and work commitments (Sinclair et al., 2014). These learning opportunities are self-directed and do not require a human to facilitate learning, rather, technology officiates/facilitates the learning process and, in the asynchronous e-learning context, the learner negotiates meaning independently (Melhuish & Falloon, 2010).

The measurement of learning outcomes from health-related e-learning research has focused on several domains including self-efficacy (Blackman, Mannix, & Sinclair, 2014; Shen, Cho, Tsai, & Marra, 2013), user satisfaction (Liaw, 2008; Sun, Tsai, Finger, Chen, & Yeh, 2008), knowledge outcomes (Alemagno, Guten, Warthman, Young, & Mackay, 2010; Atack & Luke, 2008; Beeckman, Schoonhoven, Boucqué, Van Maele, & Defloor, 2008; Bennett et al., 2014; Brunero & Lamont, 2010; Estrella, Sisson, Roth, & Choi, 2012; Larsen & Zahner, 2011; Tait, Tait, Thornton, & Edwards, 2008), clinical skills development (Blackman et al., 2014; Bloomfield & Jones, 2013; Kelly, Lyng, McGrath, & Cannon, 2009), as well as instructional design (Cook et al., 2010) and facilitators/barriers to its use (Docherty & Sandhu, 2006). The

[1] A student centred e-learning experience that allows learning to occur at any time that is convenient to the learner and not governed by time, place, other learners or institutions

[2] An e-learning experience that allows simultaneous interaction between students and/or educators

benefits of e-learning are well reported in terms of increased accessibility to education, efficacy, cost effectiveness, learner flexibility and interactivity (Ehlers & Pawlowski, 2006). What is less clear is whether improved self-efficacy or knowledge gained through e-learning influences healthcare professional behaviour or skill development, whether these changes are sustained, and ultimately whether these changes have a positive impact on patient outcomes.

2. Aim

The aim of this systematic review is to identify, appraise and synthesise the best available evidence for the effectiveness of asynchronous e-learning programs on healthcare professional behaviour and patient outcomes.

3. Methods

This paper reports a systematic review and is structured in accord with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009)

3.1 Search strategy and selection criteria

The review protocol (Sinclair, Kable, & Levett-Jones, 2015) aimed to identify both published and unpublished studies using a variety of databases. A three-step search strategy was utilised. An initial limited search of MEDLINE and CINAHL was undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe identified articles. A second search, using all identified keywords and index terms was then undertaken across all included databases. Finally, the reference lists of all identified reports and articles were searched for additional studies. Studies in English published from 2004 to July, 2015 were considered for inclusion in the review. This time frame was selected on the basis that recent systematic reviews in the domain of e-learning (Du et al., 2013; Lahti, Hätönen, & Välimäki, 2014) only identified suitable papers from the year 2004 onwards. A search for unpublished studies using Google Scholar, Mednar and Proquest was undertaken to locate any relevant dissertations, theses or conference proceedings. Quantitative terms used for identifying randomized controlled trials were informed by the Cochrane Highly Sensitive Search Strategy for Medline (Higgins & Green, 2008) and adapted for each database searched to maximise identification of relevant studies.

The search was first conducted in July 2014 and again in July 2015. The search strategy was devised by the primary author in conjunction with the faculty librarian.

The databases of CINAHL, Cochrane – Other Reviews, Cochrane Trials, Cochrane Review, Embase, ERIC, JBI, Medline, Mosby's Index, and Scopus were searched using the following search terms: (Internet/computer/web based learning OR computer assisted learning OR online learning OR e-learning OR distance education OR internet OR educational technology OR information communication and technology) AND (clinical assessment OR patient behaviour) AND health professionals (various terms) AND quantitative terms (random*, RCTs OR before and after stud* OR intervention* OR experimental OR quantitative stud*). The database search results are available as additional online material.

3.2 Inclusion/exclusion criteria

All identified papers were assessed against the inclusion and exclusion criteria as outlined in Sinclair et al. (2015). This review considered studies that evaluated any asynchronous educational intervention that was mediated electronically via the internet. Participants were Health Care Professionals (HCPs), working in any health care context. A HCP was considered to be any individual who requires a degree qualification, or was working towards one, to practice in their respective field. The identification of Randomised Controlled Trials (RCTs) and quasi-RCTs was the primary focus. In the absence of RCTs and quasi-RCTs, other research designs such as non-randomized before and after studies and analytical and descriptive observational studies were considered.

This review only considered studies that evaluated the intervention's impact on clinician behaviour or patient outcomes using objectively administered evaluation criteria. For the purposes of this review, impact on clinician behaviour was defined as the degree to which the intervention influenced their ability to perform the skill for which the intervention was designed. The impact on patient outcomes was defined as the degree to which patients' health care outcomes were affected (either positively or negatively) as a result of the intervention.

Papers were excluded if the studies reported findings related to user experience or knowledge increase exclusively; experiences or attitudes of educators regarding e-learning; mobile learning interventions or the evaluation of blended learning interventions

exclusively or; interventions that utilised any form of learner-teacher or learner-learner interaction.

3.3 Appraisal of methodological quality

Papers selected for retrieval were appraised by two independent reviewers for methodological validity (eligibility) prior to inclusion in the review using the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument standardized critical appraisal instrument[3] (JBI-MAStARI, see Table 1). This process afforded increased methodological rigour, and evaluated potential bias and threats to validity (Joanna Briggs Institute, 2014). Both reviewers were trained in the use of the appraisal tools prior to this process. A minimum quality threshold criterion was established and agreed between the two reviewers prior to review, and higher weighting was placed on criteria six to ten. Any disagreements that arose between the reviewers were resolved through discussion. Criteria such as participant blinding and allocation concealment were considered less applicable due to the nature of the educational research being reviewed.

MAStARI critical appraisal tool question	**Potential bias**
1. Was the assignment to treatment group truly random?	Selection bias
2. Were participants blinded to treatment allocation?	Selection bias
3. Was allocation to treatment groups concealed from the allocator?	Selection bias
4. Were the outcomes of people who withdrew described and included in the analysis?	Attrition bias
5. Were those assessing outcomes blind to treatment allocation?	Ascertainment bias
6. Were the control and treatment groups comparable at entry?	Design bias
7. Were groups treated identically other than the named intervention	Systematic difference/ contamination bias
8. Were outcomes measured in the same way for all groups?	Psychometric veracity of instruments
9. Were outcomes measured in a reliable way?	Detection /instrument/ measurement bias
10. Was appropriate statistical analysis used?	Performance/ detection bias

Table 1. MAStARI critical appraisal tool for Randomized Control / Pseudo-randomized Trial

[3] JBI critical appraisal checklist for randomised control/pseudo-randomised trial & descriptive/case series

A cut-off score of six was agreed prior to appraisal, unless a paper met criteria 6-10 in full, otherwise scores below six resulted in the paper being excluded from the review on methodological grounds (See Table 2).

Authors / MAStARI question	Q1	Q2	Q3	Q4	Q5	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Score**
Bandla et al. (2012)	N	N	U	N	U	Y	Y	Y	Y	Y	5
C-Villanueva et al. (2012)	Y	Y	U	N	U	Y	N	Y	Y	Y	6
Durmaz et al. (2012)	Y	N	N	Y	U	Y	N	Y	Y	Y	6
Elgie et al. (2010)	N	N	N	Y	Y	N	Y	Y	Y	Y	6
Gordon et al. (2011)	Y	N	Y	U	Y	Y	Y	Y	Y	Y	8
Pape-Koehler et al. (2013)	N	Y	Y	U	Y	Y	Y	Y	Y	Y	8
Smeekens et al. (2011)	Y	U	U	N	Y	Y	Y	Y	Y	Y	7

Y=Yes, N=No, U=Unclear, NA= Not Applicable response for each question

Table 2: Results of methodological appraisal

3.4 Data extraction

Data were reviewed by two independent reviewers from included papers using the JBI-MAStARI data extraction instrument. The data included details about the interventions, populations, study methods and outcomes of significance to the review question and aim.

3.5 Data synthesis

Data synthesis was conducted by the primary author and discussed regularly with the research team. Due to substantial instructional design, clinical, population, comparator and methodological variation between the identified studies, statistical pooling was not possible and a meta-analysis could not be performed. Consequently, the findings of this systematic review are presented as a narrative review.

4. Results

4.1 Search results

A total of 943 papers were identified in the initial search (See Figure 1 – Systematic review flow diagram). Duplications were identified and deleted after exporting the results into the reference management database Endnote®. A preliminary review of the titles and abstracts resulted in the identification of 22 papers for review. An additional two potential papers were identified from a manual review of the remaining papers reference lists. No additional papers were identified in the search of the grey literature. The papers for these studies were retrieved, read and assessed using the inclusion and exclusion criteria leaving 12 papers, which were then assessed for quality using the JBI MAStARI appraisal tool. Five papers were excluded on methodological grounds (see Table 3) leaving a total of seven papers for the review. The key features of the studies included in this review are summarised in Table 4.

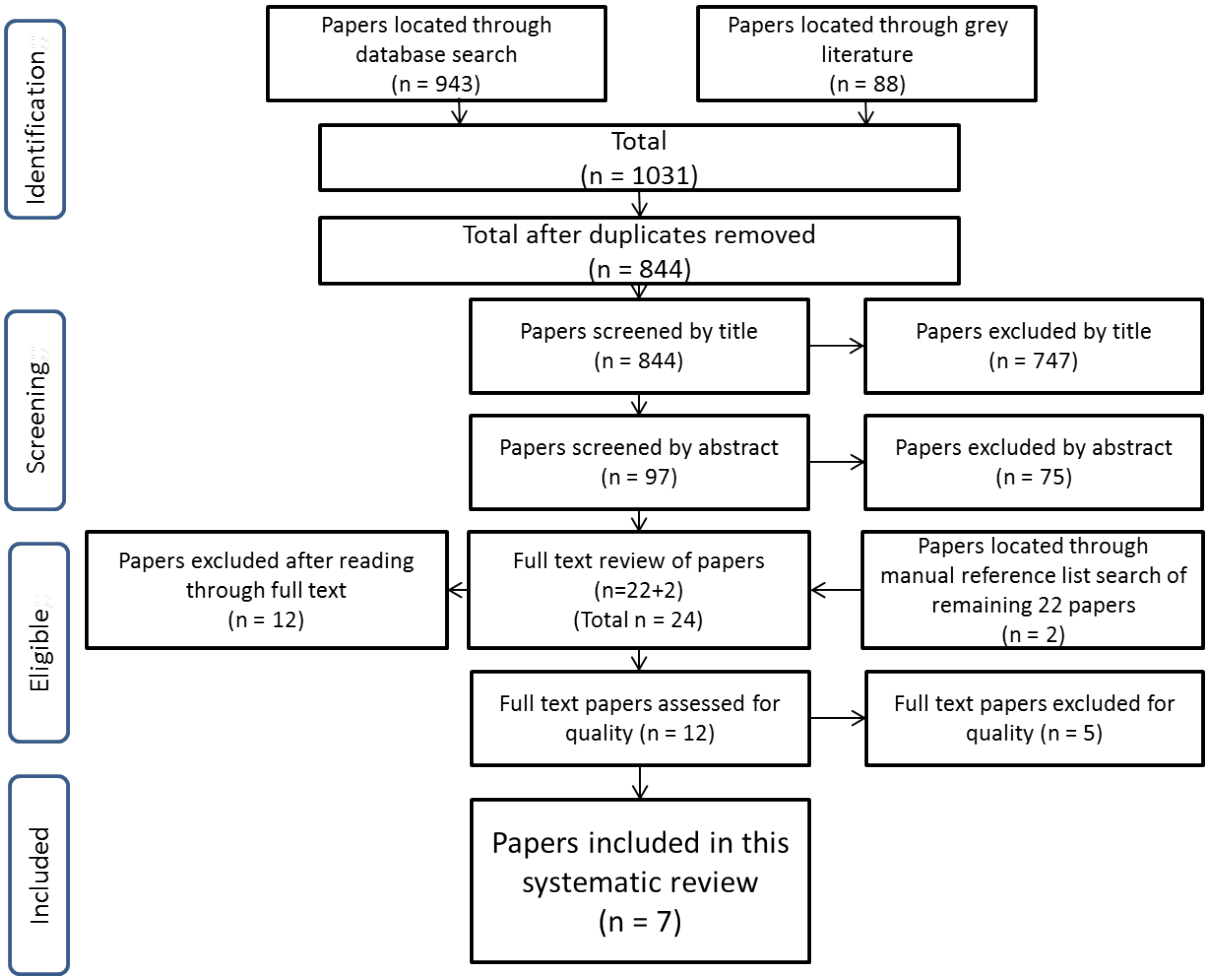

Figure 1: Systematic review flow diagram, adapted from Moher et al. (2009)

4.2 Characteristics of included studies

Papers included in the final review originated from six countries, Germany, United States of America (2), Spain, Turkey, Holland and the United Kingdom, and were published between 2010-2013. Five studies were randomised controlled trials utilising pre-post experimental designs (Cantarero-Villanueva et al., 2012; Durmaz, Dicle, Cakan, & Cakir, 2012; Gordon, Chandratilake, & Baker, 2011; Pape-Koehler et al., 2013; Smeekens et al., 2011), one was a randomised controlled trial utilising a post only experimental design (Elgie, Sapien, Fullerton, & Moore, 2010). The type of randomisation varied between all studies. Finally, Bandla et al. (2012) reported a quasi-experimental prospectively controlled study. All studies utilised parallel designs with the exception of one that employed a 2x2 factorial design (Pape-Koehler et al., 2013).

There was substantial variation in the methodological quality of the seven studies included in this review (see Table 2). No studies fulfilled all the criteria to be recognised as a high-quality study. The main threats to the internal validity of included studies were from selection and attrition bias. Selection bias was anticipated by the authors prior to the search due to the practical limitations associated with educational research. Attrition bias was evident in most studies and only two studies reported intention to treat analyses (Durmaz et al., 2012; Elgie et al., 2010).

4.3 Outcome measures

Although the papers included in this systematic review report multiple outcome measures including knowledge increase and satisfaction with e-learning, the focus of this systematic review is on healthcare professional behaviour change and patient outcomes, therefore only results in this area will be discussed.

All studies reported designs which utilised objectively administered evaluation criteria to measure a diverse range of clinical skills in sleep medicine, palpation and ultrasound, pre/post-operative care (patient admission and deep breathing and coughing exercises), emergency preparedness, child abuse screening, and laparoscopic cholecystectomy. All studies, with the exception of Gordon et al. (2011) who used an online prescribing assessment module, utilised simulation-type scenarios with objective evaluation criteria as a

basis to measure outcomes. Elgie et al. (2010) and Smeekens et al. (2011) used a simulated on-site emergency scenario and standardised patient simulation respectively plus evaluation criteria to measure outcomes in their studies. Three studies utilised Objective Structured Clinical Examination (OSCE) (Bandla et al., 2012; Cantarero-Villanueva et al., 2012; Durmaz et al., 2012); and one utilised an Objective Structured Assessment of Technical Skills (OSAT) (Pape-Koehler et al., 2013). Only two studies to reported assessment of inter-rater reliability (Elgie et al., 2010; Pape-Koehler et al., 2013). Smeekens et al. (2011) utilised a panel of subject matter experts but did not report any assessment of inter-rater reliability. No other studies reported evidence of the psychometric integrity of the tools used in measuring study outcomes. All seven studies reported healthcare professional behaviour change in terms of ability to perform a targeted clinical skill for which the intervention was designed. The search strategy did not identify any appropriate studies that met the inclusion criteria that reported patient outcomes.

4.4 Participant characteristics

Inclusion/exclusion criteria and sample and power calculations were only reported in three studies (Cantarero-Villanueva et al., 2012; Gordon et al., 2011; Pape-Koehler et al., 2013). The failure to report sample size or power calculations, may indicate that some studies were not sufficiently powered to detect intervention effects on the target outcomes, possibly increasing the risk of type II statistical error. Participant numbers ranged from 38 (Smeekens et al., 2011) to 190 (Bandla et al., 2012). One study used a combination of undergraduate medical students and early career doctors (Pape-Koehler et al., 2013). Studies by Bandla et al. (2012) and Gordon et al. (2011) included only undergraduate medical students and early career doctors respectively. Smeekens et al. (2011) and Elgie et al. (2010) participants consisted of registered nurses, however Elgie et al.'s (2010) sample population consisted of nurses with varied licensure with registered nurses comprising of 95% of the total population (n=39). Finally, Cantarero-Villanueva et al. (2012) and Durmaz et al. (2012) participants consisted of physical therapy undergraduate students and second year undergraduate nursing students respectively.

4.5 Excluded studies

Prior to studies being assessed by the JBI-MAStARI appraisal tool the main rationale for exclusion was either that studies use subjective assessment criteria to measure skill-based outcomes or that the intervention contained teacher-learner or learner-learner interaction throughout the intervention. A list of the studies excluded after methodological appraisal are included in table 3. Five papers were excluded due to poor reporting of methodological quality; these papers were generally characterised by reporting that did not follow the Consolidated Standards of Reporting Trials (CONSORT) statement for the reporting of randomised controlled trials, with the exception of studies that did not conduct RCT (Marshall et al., 2011; Postgate et al., 2009).

4.6 Effectiveness of e-learning on health care professional behaviour

All studies reported the outcomes of e-learning effectiveness on specific participant target skills. The findings suggested that e-learning was at least as equivalent to learning approaches or superior to no instruction at all. Durmaz et al. (2012) study reported that e-learning was more effective ($p = 0.04$) than skill laboratories alone for second year undergraduate nursing students in teaching preoperative patient admission skills. However, in the same cohort's post intervention deep breathing and coughing exercises, e-learning was not found to be more effective than clinical laboratory instruction ($p = .867$). Pape-Koehler et al. (2013) 2x2 factorial design reported that e-learning was more effective than no training or practical instruction alone ($p < 0.001$). The effectiveness of e-learning compared to no training at all was demonstrated in three studies (Elgie et al., 2010; Gordon et al., 2011; Smeekens et al., 2011). Gordon et al. (2011) was the only study to include a longitudinal element in its design and reported that e-learning was superior to no intervention at all ($p < 0.0001$) and that paediatric prescribing skills outcomes were maintained three months post intervention ($p < 0.0001$) . Bandla et al. (2012) reported that e-learning was as effective as classroom instruction, findings in contrast with Cantarero-Villanueva et al. (2012) who reported that e-learning was more effective than traditional learning in a blended learning context ($p < 0.001$). Results demonstrated some variation in HCP outcomes depending on the skill being taught, and the learning approach utilised.

4.7 Effectiveness of e-learning on patient outcomes

No papers were identified that met the reviews inclusion criteria that reported the effectiveness of an e-learning program on patient outcomes.

4.8 Intervention instructional design and quality

All interventions utilised asynchronous web based e-learning interventions. However there was substantial variation in instructional design elements, module size and numbers, and time taken to complete the intervention. Four studies (Cantarero-Villanueva et al., 2012; Elgie et al., 2010; Pape-Koehler et al., 2013; Smeekens et al., 2011) used externally developed web based interventions, two converted Microsoft PowerPoint presentations to an e-learning format using proprietary based software (Bandla et al., 2012; Gordon et al., 2011) and Durmaz et al. (2012) used an internally designed web based intervention. The time taken to complete the interventions varied from one to two hours (Gordon et al., 2011; Pape-Koehler et al., 2013; Smeekens et al., 2011) to 20hrs (Cantarero-Villanueva et al., 2012)), or was not reported (Bandla et al., 2012; Durmaz et al., 2012; Elgie et al., 2010). Learning stimuli varied across all interventions and consisted mainly of animation, video, static images, narration and text. Three studies discussed the theoretical constructs which guided intervention design. Durmaz et al. (2012) structured their intervention according to information processing theory. Elgie et al. (2010) and Gordon et al. (2011) utilised situation cognitive theory and cognitive load theory respectively. Gordon et al. (2011) was the only study which reported the instructional design framework (Gagne, Wager, Golas, Keller, & Russell, 2005) that guided their e-learning design. Due to the use of externally designed interventions in the majority of studies, it was not possible to assess whether content quality review was conducted.

Three studies compared e-learning to no instruction at all (Elgie et al., 2010; Gordon et al., 2011; Smeekens et al., 2011), Bandla et al. (2012); and Durmaz et al. (2012) used classroom instruction and a skills laboratory as comparators respectively. Cantarero-Villanueva et al. (2012) utilised a blended learning approach whereby all participants undertook a six hour face-to-face session comprised of two hours theory and four hours practical work. The intervention group then undertook an externally designed e-learning program while the control group had access to course related documents and books. Pape-Koehler et al.'s,

(2013) study consisted of four groups, group one had access to a two-hour e-learning program, group two underwent a two-hour practical workshop, group three underwent a blended learning program which consisted of one hour e-learning and one hour of practical workshop, and the control group received no instruction at all. The differences in these interventions demonstrate the variation in approaches used that limit the evaluation of effectiveness of e-learning on healthcare professional skill development and behaviours.

5. Discussion

This systematic review aimed to identify, appraise and synthesise the best available evidence regarding the effectiveness of e-learning programs on clinician behaviour and patient outcomes. No studies that met the inclusion criteria were identified that reported the effectiveness of e-learning on patient outcomes. This review differs from previously reported systematic reviews (George et al., 2014; Lahti et al., 2014; McCutcheon, Lohan, Traynor, & Martin, 2015) in that the inclusion criteria specified that outcome measures must be assessed using objectively administered evaluation criteria. It also included interventions that utilised asynchronous online e-learning programs and excluded those that utilised any instructor or learner interaction. This resulted in a smaller number of studies being identified for this review compared with previous systematic reviews in this subject area (Cook et al., 2008; George et al., 2014; Lahti et al., 2014; McCutcheon et al., 2015). Previous reviews reported multiple outcome measures, including knowledge improvement and learner satisfaction, however this review focused on aims relating to the effectiveness of e-learning on HCP behavioural change and patient outcomes.

The variation in intervention design and evaluation measures of included studies meant that we were unable to make generalisable inferences about the effectiveness of e-learning on HCP behaviour. However, it is clear that there is insufficient evidence to determine whether asynchronous e-learning programs mediated exclusively via the internet positively impact HCP behaviour or patient outcomes. All studies in this review reported different interventions including differences in: the size of e-learning programs, the number of modules undertaken, and the time taken to complete them. Three of the seven studies identified did not use any alternate delivery modes in the control group and two studies used a blended learning approach as part of the intervention. Many of the studies failed to

describe critical instructional design elements of the interventions development, making it difficult to assess their pedagogical veracity. Only three studies (Durmaz et al., 2012; Elgie et al., 2010; Gordon et al., 2011) described the theoretical basis or instructional design elements underpinning the design of the intervention, however no in-depth discussion was provided.

There has been a growth in recent years of externally provided asynchronous e-learning programs for the continuing professional development of HCP. Exemplars from Australia include the Australian Primary Health Care Nurses Association's online portal (https://apna.e3learning.com.au/), the Renal Society of Australasia online nephrology education portal (http://nen.moodle.com.au/login/index.php) and the Australian National Cancer Nursing Education Project (http://www.edcan.org/). Anecdotally, the only evaluation that occurs in these environments is at a user satisfaction and knowledge level. In disciplines beyond the health domain, including teaching (Bell & Federman, 2013; Kirkwood & Price, 2014) and engineering (Lero et al, 2012), e-learning research has predominantly focused on short term cognitive outcomes. As with health education, these disciplines have been unable to report whether improved knowledge, attitudes and self-efficacy translate into actual behaviour change (Bell & Federman, 2013). Studies that have explored the translation of learning into practice have relied on self-reported instruments of intention to apply behaviour (Kirkwood & Price, 2014) rather than measure actual behaviour.

With the rapid growth in online continuing professional development opportunities there is a need to understand the contextual elements of e-learning and their influence on behaviour change. E-learning is not an educational panacea and cannot be viewed as a one size fits all answer to all CPD learning needs. From a pedagogical and instructional design perspective, it is unlikely there will be consensus about the ideal duration, configuration or instructional design required for e-learning to achieve target learning outcomes. Learning is influenced by multiple factors and interventions will always require different modes of delivery and instructional design approaches suited to the topic area. The heterogeneity of the interventions identified in this review support this notion.

5.1 Strengths and limitations of this review

This review has several strengths and limitations. Firstly it was informed by a peer reviewed search protocol (Sinclair et al., 2015) and findings were reported using the guidelines

provided in the PRISMA statement. It was conducted with specific inclusion and exclusion criteria that were developed in response to the emergence of asynchronous e-learning programs to support HCP continuing professional development, outside formal programs of study. It excluded studies that used subjective self-reported measurement scales, instruments that are open to reporting and social desirability biases (Van de Mortel, 2008) and not necessarily grounded in sound theoretical frameworks. Despite the use of a peer reviewed protocol and a rigorously designed search strategy, the search outcomes and subsequent findings are still at risk of selection bias and we cannot exclude the possibility that relevant studies were not identified in the search strategy. The search strategy was restricted to studies published in English language and may not have identified suitable studies written in other languages. The overall methodological quality of evidence included in this systematic review was variable, consequently statistical pooling was not possible and a meta-analysis could not be performed.

5.2 Implications for educational practice and future research

The findings of this review can assist educators and researchers involved in the development of e-learning programs, particularly those for the use by HCP outside formal educational contexts. While e-learning affords the opportunity to disseminate knowledge, educators need to consider whether learning objectives are realistically suitable for the learning environment for which they are intended and consequently whether e-learning is the most appropriate instructional method for learning needs.

One of the enduring challenges for HCP e-learning behavioural research is demonstrating its effectiveness beyond measuring knowledge and satisfaction (Cook et al., 2008). This is particularly pertinent for asynchronous e-learning programs that are freely available to learners outside formal education contexts. Studies included in this systematic review measured HCP behaviour using face-to-face evaluative methods such as OSCE, processes that are impractical for evaluating e-learning delivered over a wide geographical area and have limited application outside formal programs of study. Consequently, a need exists to develop and validate alternate objective measures that are informed by sound theoretical constructs to evaluate e-learning behavioural outcomes. This requires researchers to move away from evaluating e-learning programs using self-reported instruments of behavioural

change that have no theoretical basis in their design. E-learning research needs to progress beyond the evaluation of knowledge and satisfaction, towards the utilisation of psychometrically tested instruments guided by proven theoretical models of behaviour change.

Studies that used subjectively based self-reported measures of intention to change behaviour were excluded from this review (Heitzler, 2011; Schroter et al., 2009; Stark, Graham-Kiefer, Devine, Dollahite, & Olson, 2011). Self-reported intention to change may not translate into actual behaviour change (Davis et al., 1999). Given that the immediate antecedent of behaviour is intention and that intention is influenced by variables including attitude, perceived social pressures and behavioural control (Ajzen, 2002), an individual may have the intention to carry out a behaviour, but not necessarily possess the volitional control to enact it (Chiou, 1999). Behaviour change is a complex and multifaceted phenomenon and consideration needs to be given to the wider complexities of the targeted behaviour change in question. In order to develop the empirical evidence base in e-learning for HCP, consideration of theoretical frameworks that reflect the contextual and personal variables that influence behavioural intention and consequently, behaviour change are required.

Participant characteristics of studies identified in this review, with the exception of Elgie et al. (2010) and Smeekens et al. (2011), were predominantly undergraduate HCP students. There is limited research in the context of post-graduate continuing professional development of HCP who are not enrolled in formal programs of study.

The methodological quality of studies included in this review was variable. Inadequate reporting of trials makes it difficult for clinicians and researchers to critically appraise their methods and results. Future RCTs need to follow the CONSORT guidelines (Moher et al., 2012) for reporting studies and ensure their designs include appropriate randomisation to minimise potential for selection bias, include sample size and power calculations to demonstrate trials are adequately powered to detect differences between the intervention and control groups, and to utilise control groups that are exposed to some alternate form of instruction in order to be able to demonstrate the reported changes can be attributed to the intervention.

6. Conclusion

E-learning research for healthcare professionals continuing professional development to date has predominantly focussed on participant satisfaction and knowledge acquisition (Bennett et al., 2014; Curran, Fleet, & Kirby, 2010; Durmaz et al., 2012; Eaton-Spiva & Day, 2011; Fleet, Fox, Kirby, Whitton, & McIvor, 2011). However, the conceptual and practical challenges for research that correspond with higher levels of educational evaluation such as behaviour change and the application of learning to clinical practice has meant that limited research has been conducted in this area, particularly in the post-graduate context. In the future, studies that measure clinical behaviour change and patient outcomes should be a priority for future e-learning research. In order to develop the empirical evidence base in e-learning, future research needs to incorporate more robust designs and interventions that are guided by sound instructional design principles and theoretical frameworks. Focus needs to be directed towards the development of reliable and validated instruments to objectively evaluate behavioural outcomes for interventions that are delivered in locations that make it impractical to conduct face-to-face evaluation. In doing so, e-learning research will move from assessing knowledge generation and participant experiences towards cultivating an understanding of the extent to which e-learning can influence HCP behavior and consequently improve, patient outcomes.

Table 4: Summary of included papers in systematic review papers (n=7)

	Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
1.	**Bandla et al (2012)** **U.S.A** **2C**	**Group 1**: 4 module PPT based e-learning converted with Microsoft Producer (n=97) **Group** 2: 2.5hrs classroom instruction (n=93) **Content area**: Sleep medicine	**Design**: Pre-post intervention. Alternate group allocation **Participants**: (n=190) medical students	Post only OSCE[4] to measure sleep history assessment skills	OSCE (max score: 35 mean/SD) **Group 1**: 23.9/3.1 **Group 2**: 23.3/3.3 *p* value: Not reported	- same ppt was used as primary instruction for both groups - no guiding instructional design framework - no subject matter expert review of content quality - no discussion re: OSCE inter-rater reliability - inclusion/exclusion criteria not reported - no sample size or power calculation reported - potential confounding of results due to student exposure to content during clinical placement
2.	**Cantarero-Villanueva et al (2012)** **Spain** **1C**	**Group 1**: 6hrs f2f (2hrs theory + 4hrs practical) + 20hrs of e-learning (n=23) **Group 2**: 6hrs f2f (2hrs theory + 4hrs practical) + documents/ books (n=21) **Content area**: Physical Therapy	**Design**: Single blinded pre-post intervention RCT **Participants**: Undergraduate (UG) Physical therapy students (n=44)	Post OSCE to measure palpation and ultrasound of lumbo-pelvic region	Global OSCE (max score: 9 - mean/SD) **Group 1**: 8.40/1.29 $p < 0.001$ **Group 2**: 6.66/2.24	- blended learning intervention - external website, no discussion regarding guiding instructional design framework -variation in time intervention accessed (61.6% used for 1hr/day for duration of intervention - reported sample size and power calculation - exclusion criteria reported (previous training) (two experienced staff - no discussion re: inter-rater reliability)

[4] Objective Structured Clinical Examination

Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
3. Durmaz et al (2012) Turkey 1C	**Group 1**: e-learning (n=41) **Group 2**: Skill laboratories (n=41) **Content area**: Pre/post op management	**Design**: Pre-post intervention RCT via random numbers table **Participants**: Second-year UG nursing students (n=82)	Post OSCE to measure pre-operative patient admission (skill 1) and post-operative deep breathing and coughing exercise skills (skill 2)	Based on ITT analysis Skill score (max score: 100 mean/SD) **Group 1**: Skill 1: 72.4/12 (p = 0.04) Skill 2: 67.5/13 **Group 2**: Skill 1: 66.6/13.3 Skill 2: 66.9/16 (p = 0.867)	- Time to complete e-learning intervention not reported - high attrition (Skill 1 n=33 v 21 (control); Skill 2 n=36 v 26 (control)) - no sample size or power calculation reported - inclusion/exclusion not reported - Intervention structured according to information process theory (content evaluated) - no discussion re: OSCE inter-rater reliability
4. Elgie et al (2010) U.S.A 1C	**Group 1**: 15 e-learning modules (n=16) **Group 2**: no intervention (n=26) **Content area**: Emergency preparedness	**Design**: Post-only intervention RCT using standard randomization table **Participants**: School nurses (n=52) (RN=95.2%)	Post On-site Mock Emergency Scenario (OMES) to measure emergency preparedness skills performance	Reported as mean %/95% CI **Group 1**: 65.5%/60.2-70.8 **Group 2**: 28.3%/22.3- 34.3; ($p < 0.0001$)	- no discussion on methods but ceased analysis once 'significance' had been achieved - inter-rater reliability tested for OMES scores - Intervention design – situated -cognitive learning theory - externally developed modules - videotaped OMES assessed by two Paediatric Emergency Medicine physicians blinded to assessors - convenience sample - potential selection bias - no sample size or power calculation reported - no inclusion or exclusion criteria reported

	Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
5.	**Gordon et al (2011)** **U.K** **1C**	**Group 1**: Three module (1-2hrs) e-learning (PPT & Wondershare: self-contained flash program) (n=76) **Group 2**: no intervention (n=86) **Content area**: Paediatric prescribing skills	**Design**: pre-post intervention RCT **Participants**: 'Junior' doctors (n=162)	Prescribing assessment to measure prescribing skills at 1 month and 3 months using set marking criteria post intervention	Total score % **Group 1**: *Pre-test:* 67% *Post-test:* 79% *Post-test(3/12):* 79% **Group 2**: *Pre-test:* 67% ($p = 0.56$) *Post-test:* 63% ($p < 0.0001$) *Post-test(3/12):* 69% ($p < 0.0001$)	- sample size and power calculation reported - reported exclusion criteria - Gagne's nine events of instruction/cognitive load theory (aim to prevent overload of working memory)/quality review of content - Assessment of skill but not translated into practice
6.	**Pape-Koehler et al. (2013)** **Germany** **1C**	**Group 1**: e-learning (2hr) (n=18) **Group 2**: practical (2hr) (n=17) **Group 3**: blended (1+1hr) (n=18) **Group 4**: No training (control) (n=17) **Content area**: Surgical performance - laproscopic cholecystectomy	**Design**: 2x2 factorial pre-post intervention RCT randomised by lot (draw) **Participants**: Doctors in surgical fellowship program & final year medical students at two different universities (n=70)	Pre-post OSATS[5] to measure recorded laproscopic cholecystectomy surgical performance (pelvi trainer)	Change in OSAT score **Group 1**: (4.7 ± 3.3; $p < 0.001$) **Group 2**: (2.5 ± 4.3; $p = 0.028$) **Group 3**: 4.6 ± 3.5 ($p < 0.001$) **Group 4**: (0.8 ± 2.9; $p = 0.294$)	-Inclusion criteria described -substantial video content - stated homogenous sample - equally distributed - sample size and power calculation reported - Enrolment, camera assistance & evaluation blinded -OSATS (inter-rater reliability confirmed - blinded raters)

[5] Objective Structured Assessment of Technical Skills

Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
7. Smeekens et al. (2011) Holland 1C	**Group 1**: 3 externally developed program e-learning modules (2hr minimum) (n=19) **Group 2**: no training (n=19) **Content area**: Child abuse in ED	**Design**: Blinded pre-post test intervention RCT **Participants**: RNs in ED (n=38)	Pre and post case simulation to measure child abuse detection	Max 114 - mean/SD **combined groups 1 & 2 (n=25)**: *Pre-test:* 71/21 **Group 1 (n=13)**: *Pre-test:* not reported *Post-test:* 89/19 **Group 2 (n=12)** *Pre-test:* not reported *Post-test:* 71/17 (95% CI 2.9-33.3 *p* = 0.022)	- blinded SME panel with standardised assessment form - no sample size or power calculation reported - no explicit inclusion/exclusion reported no guiding instructional design framework discussed - high attrition, ITT not reported - **e-learning more effective than no training at all**

Table 3: Summary of papers excluded on methodological grounds

Author (Year) Country	Intervention Content area	Design Participants	Outcome measures
1. Chiu (2009) Taiwan	**Intervention**: **Group** 1: e-learning **Group 2**: instructor led video **Content area**: Neurological assessment	**Design**: Pre-post intervention RCT **Participants**: Registered nurses in Neurology (n=129)	Score verification unit to measure the use of Chinese version of the National Institute of Health Stroke Scale
2. Hutton et al (2010) England	**Intervention**: e-learning **Group 1**: e-learning **Group 2**: Practical laboratory based activity **Content area**: Medication dosage	**Design**: A multi-stage cross-over design. **Participants**: Early 3rd year nursing students (n=50) Initial convenience sample and then purposive	OSCE to medication skills
3. Latha (2011) India	**Group 1**: e-learning **Group 2**: Classroom instruction **Content area**: Cranial nerve assessment	**Design**: Pre-post intervention quasi-experimental design **Participants**: UG nursing students (n=64)	Observational checklist to measure Cranial nerve assessment skill
4. Marshall (2011) Ireland	**Intervention**: e-learning **Content area**: Ordering radiological examinations	**Design**: Pre-post intervention design (no control) **Participants**: Final year medical students (n=177)	Clinical vignettes evaluated by set marking criteria to measure improvement in quality of radiological examination orders
5. Postgate et al. (2009) U.K.	**Group 1**:e-learning - Gastro-intestinal (GI) trainees (n=14) **Group 2**: e-learning - Medical students (n=14) **Content area**: Endoscopy lesion recognition	**Design**: Pre-post test evaluation study **Participants**: Medical students & GI trainees (n=28)	60 question lesion recognition test module to measure change in performance among participants with different experience levels (module construct validity) - assess change in performance after intervention (module content validity)

Additional online material: Database search results

#	Query	Results
S27	**S5 AND S12 AND S23 AND S26**	**20**
S26	S24 OR S25	93,194
S25	patient outcome* n2 (behaviour* or behavior*)	139
S24	"clinical assessment"	93,060
S23	S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22	365,496
S22	theor* n3 (planned behavior* or planned behaviour*)	1,829
S21	behavio* intention*	2,134
S20	AB (quasi experimental or experimental)	31,472
S19	descriptive quantitative stud*	985
S18	AB intervention*	164,194
S17	"before and after stud*"	531
S16	AB trial*	99,926
S15	AB random*	121,339
S14	(MH "Random Sample+")	70,834
S13	(MH "Randomized Controlled Trials")	38,814
S12	S6 OR S7 OR S8 OR S9 OR S10 OR S11	16,551
S11	(MH "Internet/ED")	183
S10	(internet or web or online or distance or computer) n3 (educat* or learn* or instruct* or elearn* or e-learn*)	11,330
S9	(MH "Educational Technology")	1,308
S8	(MH "World Wide Web/ED")	31
S7	(MH "Education, Non-Traditional")	7,508
S6	(MH "Computer Assisted Instruction")	6,261

S5	S1 OR S2 OR S3 OR S4	1,152,528
S4	(health* or medical) n5 (profession* or personnel or staff or worker* or manpower or workforce)	138,404
S3	(clinician* or consultant* or dentist* or doctor* or family practition* or general practition* or gynecologist* or gynaecologist* or ematologist* or haematologist* or internist* or nurse* or obstetrician* or occupational therapist* or pediatrician* or paediatrician* or pharmacist* or physician* or physiotherapist* or psychiatrist* or psychologist* or radiologist* or surgeon* or surgery or therapist* or counselor* or counsellor* or neurologist* or optometrist* or paramedic* or social worker* or health professional* or health personnel or health care personnel or healthcare personnel or podiatrist* or midwife or midwives or radiographer*)	1,036,810
S2	(MH "Health Manpower+")	402,145
S1	(MH "Health Personnel+")	392,886

Database(s): MEDLINE 1946 to Present with Daily Update
Search Strategy:

#	Searches	Results
1	exp Health Personnel/	390084
2	Health Manpower/	11658
3	(clinician* or consultant* or dentist* or doctor* or family practition* or general practition* or gynecologist* or gynaecologist* or ematologist* or haematologist* or internist* or nurse* or obstetrician* or occupational therapist* or pediatrician* or paediatrician* or pharmacist* or physician* or physiotherapist* or psychiatrist* or psychologist* or radiologist* or surgeon* or surgery or therapist* or counselor* or counsellor* or neurologist* or optometrist* or paramedic* or social worker* or health professional* or health personnel or health care personnel or healthcare personnel or podiatrist* or midwife or midwives or radiographer*).mp.	2050013
4	((health* or medical) adj5 (profession* or personnel or staff or worker* or manpower or workforce)).mp.	284383
5	1 or 2 or 3 or 4	2208517
6	Computer-Assisted Instruction/	9947
7	Educational Technology/	1157
8	((internet or web or online or distance or computer) adj3 (educat* or learn* or instruct* or elearn* or e-learn*)).mp.	15754
9	6 or 7 or 8	16415
10	Randomized Controlled Trial/	405457

11	random*.ab.	687746
12	trial*.ab.	557981
13	"before and after stud*".mp.	1585
14	intervention*.ab.	525536
15	descriptive quantitative stud*.mp.	49
16	(quasi experimental or experimental).mp.	906788
17	behavio* intention*.mp.	1183
18	(theor* adj3 (planned behavior* or planned behaviour*)).mp.	1631
19	10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	2331805
20	(patient* adj2 outcome* adj2 (behaviour* or behavior*)).mp.	143
21	Clinical assessment*.mp.	18769
22	20 or 21	18912
23	5 and 9 and 19 and 22	5
24	**limit 23 to (english language and yr="2004 -Current")**	**4**

Database(s): Embase Classic+Embase 1947 to 2015 July 21
Search Strategy:

#	Searches	Results
1	exp health care personnel/	1084218
2	exp hospital personnel/	76871
3	exp medical personnel/	647194
4	health care manpower/	10549
5	(clinician* or consultant* or dentist* or doctor* or family practition* or general practition* or gynecologist* or gynaecologist* or ematologist* or haematologist* or internist* or nurse* or obstetrician* or occupational therapist* or pediatrician* or paediatrician* or pharmacist* or physician* or physiotherapist* or psychiatrist* or psychologist* or radiologist* or surgeon* or surgery or therapist* or counselor* or counsellor* or neurologist* or optometrist* or paramedic* or social worker* or health professional* or health personnel or health care personnel or healthcare personnel or podiatrist* or midwife or midwives or radiographer*).mp.	3589818

6	((health* or medical) adj5 (profession* or personnel or staff or worker* or manpower or workforce)).mp.	389640
7	1 or 2 or 3 or 4 or 5 or 6	3882095
8	Computer-Assisted Instruction.mp.	788
9	educational technology/	2489
10	((internet or web or online or distance or computer) adj3 (educat* or learn* or instruct* or elearn* or e-learn*)).mp.	10783
11	8 or 9 or 10	12851
12	randomized controlled trial/	380098
13	random*.ab.	987420
14	trial*.ab.	831966
15	"before and after stud*".mp.	2245
16	intervention*.ab.	788605
17	descriptive quantitative stud*.ab.	71
18	(quasi experimental or experimental).ab.	798816
19	behavio* intention*.mp.	1444
20	(theor* adj3 (planned behavior* or planned behaviour*)).mp.	2253
21	12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20	2869746
22	(patient* adj2 outcome* adj2 (behaviour* or behavior*)).mp.	189
23	Clinical assessment*.mp.	109776
24	22 or 23	109961
25	7 and 11 and 21 and 24	25
26	**limit 25 to (english language and yr="2004 -Current")**	**24**

Database(s): The Joanna Briggs Institute EBP Database - Current to July 15, 2015
Search Strategy:

#	Searches	Results

1	Health Manpower.mp. [mp=text, heading word, subject area node, title]	1
2	(clinician* or consultant* or dentist* or doctor* or family practition* or general practition* or gynecologist* or gynaecologist* or ematologist* or haematologist* or internist* or nurse* or obstetrician* or occupational therapist* or pediatrician* or paediatrician* or pharmacist* or physician* or physiotherapist* or psychiatrist* or psychologist* or radiologist* or surgeon* or surgery or therapist* or counselor* or counsellor* or neurologist* or optometrist* or paramedic* or social worker* or health professional* or health personnel or health care personnel or healthcare personnel or podiatrist* or midwife or midwives or radiographer*).mp. [mp=text, heading word, subject area node, title]	3679
3	((health* or medical) adj5 (profession* or personnel or staff or worker* or manpower or workforce)).mp. [mp=text, heading word, subject area node, title]	1744
4	1 or 2 or 3	3791
5	Computer-Assisted Instruction.mp. [mp=text, heading word, subject area node, title]	7
6	Educational Technology.mp. [mp=text, heading word, subject area node, title]	5
7	((internet or web or online or distance or computer) adj3 (educat* or learn* or instruct* or elearn* or e-learn*)).mp. [mp=text, heading word, subject area node, title]	60
8	5 or 6 or 7	60
9	(patient* adj2 outcome* adj2 (behaviour* or behavior*)).mp.	8
10	Clinical assessment*.mp.	148
11	9 or 10	155
12	**4 and 8 and 11**	**5**

Mosbys Index

No.	Results
#1	
	124
#1.7	
#1.3 AND #1.4 AND #1.5 AND #1.6	
	545,191
#1.6	
random* OR **trial*** OR **before** NEAR/2 **after** OR **intervention*** OR (**descriptive** AND **quantitative** AND ('**study**'/exp OR**study**)) OR **quasi** NEAR/1 **experimental** OR **behavio*** NEAR/1 **intention*** AND [2004-2015]/py	
	317,877
#1.5	
patient* AND **outcome*** AND (**behavior*** OR **behaviour***) OR (**clinical** AND **assessment***) AND [2004-2015]/py	
	4,764
#1.4	
'**computer**'/exp OR **computer** AND **assisted** AND **instruction** OR **educational** NEAR/1 **technology** OR (**internet** OR **web** OR**online** OR **distance** OR **computer**) NEAR/3 (**educate** OR **education** OR **educating** OR **educated** OR **learn** OR **learner** OR**learners** OR **learning** OR **instruct** OR **instruction** OR **instructor** OR **elearn** OR **elearning** OR **elearner** OR '**e learn**' OR '**e learner**' OR '**e learners**') AND [2004-2015]/py	
	307,344
#1.3	
#1.1 OR #1.2	
	295,826
#1.2	
gynecologist* OR **gynaecologist*** OR **ematologist*** OR **haematologist*** OR **internist*** OR **nurse*** OR **obstetrician*** OR**occupational** AND **therapist*** OR **pediatrician*** OR **paediatrician*** OR **pharmacist*** OR **physician*** OR **physiotherapist*** OR**psychiatrist*** OR **psychologist*** OR **radiologist*** OR **surgeon*** OR **therapist*** OR **counselor*** OR **counsellor*** OR**neurologist*** OR **optometrist*** OR **paramedic*** OR **social** AND **worker*** OR '**health**'/exp OR **health** AND **professional*** OR'**health**'/exp OR **health** AND ('**personnel**'/exp OR **personnel**) OR '**health**'/exp OR **health** AND **care** AND ('**personnel**'/exp OR**personnel**) OR '**healthcare**'/exp OR **healthcare** AND ('**personnel**'/exp OR **personnel**) OR **podiatrist*** OR '**midwife**'/exp OR**midwife** OR '**midwives**'/exp OR **midwives** OR **radiographer*** AND [2004-2015]/py	
	52,328
#1.1	

clinician* OR **consultant*** OR **dentist*** OR **doctor*** OR **family** AND **practition*** OR **general** AND **practition*** AND [2004-2015]/py

COCHRANE

- Cochrane Reviews – 1
- Other Reviews – 1
- Trials - 121

Clinician or consultant* or dentist* or doctor* or "family practition*" or "general practition*" or gynecologist* or gynaecologist* or ematologist* or haematologist* or internist* or nurse* or obstetrician* or "occupational therapist*" or pediatrician* or paediatrician* or pharmacist* or physician* or physiotherapist* or psychiatrist* or psychologist* or radiologist* or surgeon* or surgery or therapist* or counselor* or counsellor* or neurologist* or optometrist* or paramedic* or "social worker*" or "health professional*" or "health personnel" or "health care personnel" or "healthcare personnel" or podiatrist* or midwife or midwives or radiographer* in Title, Abstract, Keywords*

And

"computer assisted instruction" or "educational technology" or ((internet or web or online or distance or computer) near/3 (educat or learn* or instruct* or elearn* or e-learn*)) in Title, Abstract, Keywords*

And

(patient near/2 (outcome*) near/2 (behavior* or behaviour*)) or (clinical assessment*) in Title, Abstract, Keywords*

SCOPUS - 639

(TITLE-ABS-KEY(("computer assisted instruction" OR "educational technology" OR ((internet OR web OR online OR distance OR computer) W/3 (educat* OR learn* OR instruct* OR elearn* OR e-learn*))))

AND

TITLE-ABS-KEY((((patient* W/2 (outcome*) W/2 (behavior* OR behaviour*)) OR (clinical assessment*)))) AND TITLE-ABS-KEY((random* OR trial* OR "before and after stud*" OR intervention* OR "descriptive quantitative stud*" OR "quasi experimental" OR experimental OR "behavio* intention*" OR (theor* AND (planned behavior* OR planned behaviour*))))

AND

TITLE-ABS-KEY((clinician* OR consultant* OR dentist* OR doctor* OR "family practition*" OR "general practition*" OR gynecologist* OR gynaecologist* OR ematologist* OR haematologist* OR internist* OR nurse* OR obstetrician* OR "occupational therapist*" OR pediatrician* OR paediatrician* OR pharmacist* OR physician* OR physiotherapist* OR psychiatrist* OR psychologist* OR radiologist* OR surgeon* OR surgery OR therapist* OR counselor* OR counsellor* OR neurologist* OR optometrist* OR paramedic* OR "social worker*" OR "health professional*" OR "health personnel" OR "health care personnel" OR "healthcare personnel" OR podiatrist* OR midwife OR midwives OR radiographer)))

AND

(LIMIT-TO (LANGUAGE, "English"))

ERIC – 24

ab(clinician* OR consultant* OR dentist* OR doctor* OR "family practition*" OR "general practition*" OR gynecologist* OR gynaecologist* OR ematologist* OR haematologist* OR internist* OR nurse* OR obstetrician* OR "occupational therapist*" OR pediatrician* OR paediatrician* OR pharmacist* OR physician* OR physiotherapist* OR psychiatrist* OR psychologist* OR radiologist* OR surgeon* OR surgery OR therapist* OR counselor* OR counsellor* OR neurologist* OR optometrist* OR paramedic* OR "social worker*" OR "health professional*" OR "health personnel" OR "health care personnel" OR "healthcare personnel" OR podiatrist* OR midwife OR midwives OR radiographer*) AND ab("computer assisted instruction" OR "educational technology" OR ((internet OR web OR online OR distance OR computer) AND (educat* OR learn* OR instruct* OR elearn* OR e-learn*))) AND ab((patient* and outcome* OR clinical assessment*)) AND ab(random* OR trial* OR "before and after stud*" OR intervention* OR "descriptive quantitative stud*" OR "quasi experimental" OR experimental OR "behavio* intention*" OR (theor* AND (planned behavior* OR planned behaviour*)))

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