Exploring the use of asynchronous online discussion in health care education: A literature review

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Abstract

This paper highlights the different options associated with asynchronous online discussion (AOD) use in health care education which may have an impact on their effectiveness. The review was carried out following a search of specific databases, websites, key journals, references and key authors. All studies published between 2006 and 2012 that met specific inclusion/exclusion criteria were subject to quality appraisal. Fourteen studies met the quality appraisal criteria: six qualitative, four quasi-experimental, one observational and three mixed methods. Data extraction coupled with narrative synthesis enabled the description of options that emerged and exploration of the relationships within and between studies. Study design as well as methodological quality was mixed. However, several useful factors emerged which may impact on effectiveness. These include (a) the mode of e-moderation (b) provision of AOD for participants in the clinical setting to critically reflect, analyse and resolve clinical issues and (c) increased amount of time spent reading the AOD (but not the number of discussion "hits"). Research in this area appears to be in its infancy and one of the main recommendations is that further studies are required which focus on comparing the same type of AOD with and without a specific intervention in order to make any robust conclusions.

1. Introduction & background

Several systematic reviews on e-learning for the health professions show that it is just as effective as classroom learning (e.g. Cook et al., 2008; Lewis, Davis, Jenkins, & Tait, 2005). The question now is to ascertain which components of e-learning can lead to greater effectiveness. Cook et al. (2010a) have succeeded in this quest to some extent with a systematic review comparing different e-learning methods for health professionals. They concluded that the most effective are those that include interactivity, practice exercises, repetition and feedback. This review focuses on the interactive method of asynchronous online discussion (AOD).

1.1. AOD and associated pedagogy

AOD is a web-based conferencing system, which requires students to read and contribute to various discussion threads (Benfield, 2002). The teacher's role is to facilitate these discussions to enable learning i.e. e-moderating (Benfield, 2002; Salmon, 2011). The 'asynchronous' aspect enables students to work at their own pace at a time suitable to them. This is particularly advantageous for health professionals who have to juggle the competing demands of clinical practice with part-time study. The underlying pedagogy is referred to as constructivism (O'Connor, 2010) which appears to be taking “an influential lead” in the field of e-learning at the moment (Ford & Lott, 2012). Most of the literature related to learning through AOD in higher education appears to focus on social constructivism. This emphasises the learner taking an active role in the learning process rather than being a passive recipient of knowledge from the teacher (Minocha, 2009).

Moore (1989) was one of the first to describe the three modes of interaction in distance education as learner-content, learner–learner and learner–teacher interaction. It is now thought that without the latter two, e-learners are deprived of learning opportunities which promote critical thinking (Garrison & Cleveland-Innes, 2005); and competent practice needs health professionals who are critical thinkers and...
constantly questioning their practice (Ironside, 2004). Whilst there is evidence to show that analysing real incidents or events from the learners’ practice leads to the development of critical thinking or theoretical reasoning skills (Higgs & Jones, 2000; Mann, Gordon, & Macleod, 2009), the promotion of reflective practice via AOD appears to be in its infancy. However, there is some indication that the extra time and space of AOD encourages greater reflection on clinical practice (McAlpine, Lockerbie, Ramsay, & Beaman, 2002).

Salmon (2011) recommends that the teacher takes on the role of e-moderator (AOD facilitator) and to use a scaffolding approach to take students through the initial stages of (1) access and motivation (2) online socialisation (3) information exchange and (4) knowledge construction. The final stage of development is where they are deemed to be using the “constructivist approach to learning”. Other e-moderator approaches recommend combining AOD with instructivist methods of e-learning (e.g. Moule, 2007) or applying a specific framework for the exploration, analysis and resolution of critical incidents (e.g. Garrison, Anderson, & Archer, 2001).

The concept of ‘communities of practice’ is another relatively recent learning theory which builds on social constructivism and is often linked with AOD. It is the term given to “groups of people who share a concern or passion for something they do and learn how to do it better as they interact regularly” (Wenger, 2000). Practitioners can then continuously learn and modify their practice through these interactions with other practitioners. Brown (2001) argues that it is essential to develop a ‘community of practice’ first in order to facilitate learning through online education. The major advantage of AOD is that it can facilitate practitioners benefitting from ‘communities of practice’ without the restrictions of geographical location (Fitzsimmons, 2007).

1.2. What we know to date from other reviews of AOD

There appear to be no reviews to date which focus specifically on AOD use within the health professions. However, there have been a number of reviews on AOD use for learning generally. Hew, Cheung, & Ng (2010) focused their review of studies (from 1997 to 2007) on methods of motivating students and increasing their discussion contributions, even though there appears to be no conclusive evidence to show that increased discussion postings enhances learning. In an integrative review looking at both synchronous and AOD from 1985 to 2005, Luppincott (2007) found insufficient studies which explored their effects on learning to be able to generate any specific conclusions. Around the same time, Kay (2006) found several studies which challenged the assumption that taking part in AOD enhances learning, and only one study reporting a significant difference in learning. Similarly, Hammond (2005) in a review of case studies from 2000 to 2004, found that most research avoided directly linking AOD with learning but focused on learner perceptions of benefits and pitfalls. A description of 18 evaluative reports and case studies from 1996 to 2006 by Roehm and Bonnell (2009) adds some useful information on facilitating online discussions (both synchronous and asynchronous) but not what makes them more effective in terms of learning. In a review of both synchronous and AOD from 2000 to 2006, Johnson (2006) found three studies which demonstrated learning through AOD, and a further two studies where the postings demonstrated higher level thinking. It was concluded from these that (1) structured discussion is more successful in terms of higher order thinking than unstructured (2) learning is enhanced if postings are mandatory rather than a voluntary option (3) a combination of synchronous and AOD produces greater learning and student satisfaction.

1.3. The significance and original aims of this review

This review concentrates specifically on AOD for the health professions. The main reasons for this are (a) the needs of health professionals differ in that most are part-time and juggle the demands of study with clinical practice (b) AOD is increasingly being used for the health professions due to “increased clinical demands and decreased available time” (Cook, Levinson, & Garside, 2010b, p. 756), and (c) whilst several experts advise ways of making them more effective (Rovai, 2007; Salmon, 2011), there appear to be no reviews to date to show if they are actually effective (in terms of learning within the health professions).

In summary, whilst we know that AOD is being increasingly used instead of face-to-face discussions for learning with the health professions, what we do not know is which factors (if any) make them effective; therefore the original aim of this review was to find out: Which factors contribute to the effectiveness of asynchronous online discussion boards in the education of health professionals? The term ‘effectiveness’ is defined here as ‘enhanced learning either by accomplishment of academic learning outcomes or improved practice, or perceived effectiveness/personal improvement’. This definition ties in with the findings from a survey of e-learning within UK universities in 2010, which found that the two main drivers for implementing e-learning technologies are enhancing the quality of teaching and learning, and meeting student’s expectations (Browne et al., 2010).

The original objectives were to (a) describe the range of factors that promote the effectiveness of asynchronous discussion boards and (b) explore the properties of these factors to determine how these can be used more widely in practice to facilitate learning.

Whilst these original objectives could not be fully met (see Section 4), the review does provide some useful information on the different types of AODS and different possible elements to be considered when using AOD in health care education.

2. Methods

Although the gold standard for reviews is to consider only randomised controlled trials (RCTs), these appear to be rare within educational research. It is difficult to undertake RCTs in education due to both practical and ethical issues, particularly meeting student expectations/demands (Campbell, Gibsen, Hall, Richards, & Callery, 2008). Therefore, this present review includes quasi-experimental studies as well as all types of qualitative research and mixed method studies.

2.1. Database search

The search covered 11 databases covering health, education, psychology and behavioural sciences: CINAHL (Cumulative Index to Nursing and Allied Health Literature), MEDLINE (Medical Literature Analysis and Retrieval System), Eureka (Education Research Complete), ERIC (Education Information Resource Centre), PsyArtsArticles, PsychINFO, Psychology Behavioural Sciences Collection, Google Scholar, The NHS Centre for Reviews and Dissemination, ZETOC (Electronic Table of Contents) and EThOS (Electronic Thesis Online Service).
In addition to the database search, a manual search was made of the following websites: Digital Education Research Network, Society for Research into Higher Education, JISC, HEFCE. It was found that some authors used the word e-learning in the abstract when the actual study is about the use of AOD, or they used obscure titles which tended to be missed in the database search. This has been found before and the recommendation is that the most relevant journals be hand searched using the contents list (Hawker, Payne, Kerr, Hardey, & Powell, 2002). The following journals were found to contain a number of key articles on the subject of AOD and so were hand searched: Journal of Online Asynchronous Learning Networks, British Journal of Educational Technology, Quarterly Review of Distance Education, Computers & Education, Medical Teacher and Computers, Informatics, Nursing. Following the initial sifting and sorting phase, the reference lists of all selected studies were hand-searched for further citations. Any authors identified as specialising in the subject of online discussion boards were further searched by (a) an author search within all the databases outlined above and (b) putting the names into a general internet browser.

### 2.2. Search criteria

The following terms and compounds (*) were used for all database searching: “asynchronous discussion” OR “online discussion” OR “online bulletin board”. For the non-education databases, the following search criteria were added to eliminate studies on the use of discussion boards for service users: “learn” OR “education” OR “student”. For the education and non-health related databases, the following search criteria were added to ensure that studies were focused on health professionals: “health professional” OR “practicing” OR “medical” OR “nurs” OR “midwife” OR “allied health” OR “physiotherap” OR “occupational therap” OR “podiatr” OR “pharmac” OR “dentist” OR “physical therap” OR “radiotherap” OR “diagnostic imaging” OR “speech therap” OR “orthopt” OR “psychology students”. The following physical criteria were added to eliminate school children: “school” OR “kids” OR “children” OR “K1-18” OR “under-18 years”.1

### 2.3. Inclusion criteria

In an initial screening, 491 abstracts were sifted and sorted. Those that did not meet the inclusion/exclusion criteria and any duplicates were removed. The inclusion criteria included studies (a) involving learning for health professions (undergraduate, postgraduate or contributing in any way to their continual professional development) (b) carried out in developed countries (c) published in English (d) that resulted in ‘enhanced learning’ (e) involving asynchronous online discussion (f) published from 2006 onwards. The review was limited to studies produced from 2006 onwards because other reviews of e-learning methods have found limited research on the use of AODs prior to 2006 (e.g. Carroll, Booth, Papaioannou, Sutton, & Wong, 2009; Cook et al., 2008; Roehm & Bonnell, 2009). A total of 45 abstracts fully met the final inclusion criteria.

### 2.4. Quality appraisal

The final 45 papers identified for inclusion were sorted into three categories: qualitative, quantitative and mixed methods. Each paper was then individually appraised to determine the validity, reliability and relevance of the study using an adapted version of ReLIANT3 – a tool specifically developed for appraising educational research (Koufogiannakis, Booth, & Brettle, 2006). The ReLIANT tool does not include any questions relating to ethical approval. The reason put forward for this is that whilst we should be aware of the need for ethically acceptable practices, the following journal were found to contain a number of key articles on the subject of AOD and so were hand searched: Journal of Online Asynchronous Learning Networks, British Journal of Educational Technology, Quarterly Review of Distance Education, Computers & Education, Medical Teacher and Computers, Informatics, Nursing. Following the initial sifting and sorting phase, the reference lists of all selected studies were hand-searched for further citations. Any authors identified as specialising in the subject of online discussion boards were further searched by (a) an author search within all the databases outlined above and (b) putting the names into a general internet browser.

The ReLIANT tool is divided into four categories: Study design, educational relevance, results and context. Each question was scored as follows:

- **Study design**
  - Quantitative or mixed methods studies using one or more groups of people = 38
  - Quantitative or mixed methods studies using one group only = 36
  - Qualitative studies = 34

The final scores were then calculated as a percentage and graded as either:

- **A** Well conducted and reported (>75% overall score, with >50% in all 4 categories).
- **B** There are some concerns, but not severe enough to reduce the validity of the findings (>75% overall score, but <50% in one or more categories).
- **C** Serious concerns about design meaning the study may not be valid (<75% overall score, or <50% in first ‘design’ category).

In order to reduce bias, a selection of papers was scored independently by two separate reviewers and results/any disparities were discussed and agreed. 14 papers met the criteria in categories A and B.

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1. In the original protocol, the search terms “effect” OR “achieve” OR “accomplish” OR “outcome” or “success” were to be added if the search needed to be narrowed further. However, they were not required.
3. ReLIANT – Reader’s guide to the Literature on Interventions Addressing the Need for Education and Training.
2.5. Data extraction (Table 1)

Data from the final 14 papers was extracted using a data extraction proforma specifically created for this study, and included criteria recommended by the Best Evidence Medical Education Collaboration for the classification of learning outcomes in health education and Kirkpatrick's hierarchy of learning (BEME, 2012).

2.6. Data synthesis

A narrative synthesis approach was used following the guidance produced by Popay et al. (2006) which has been recommended for use with diverse study designs (Arai et al., 2007). It is also now included in guidance produced by the Centre for Reviews and Dissemination (CRD, 2009) and consists of the following four elements:

- Element 1 – Developing a theory of how the intervention works, why and for whom
- Element 2 – Developing a preliminary synthesis of findings of included studies
- Element 3 – Exploring relationships in the data
- Element 4 – Assessing the robustness of the synthesis

3. Results

The 14 selected studies consisted of six qualitative, five quantitative (four quasi-experimental and one observational) and three using a mixed methods approach. They were found from a wide variety of sources mostly from the US, UK and Canada. Seven (50%) were focused on practicing professionals, and seven focused on undergraduates of which four were on practice placement. There was an even mix of nursing (5) medical (5) and other health professions (6).

3.1. Initial theory (element 1)

Most studies (10) used a specific framework to develop the students' skills particularly those around reflective and critical thinking (Cain & Smith, 2009; Curran, Murphy, Abidi, Sinclair, & McGrath, 2009; Curtis, 2006; De Leng, Dolmans, Jobsis, Muijtjens, & Van der Vleuten, 2009; De Wever, Van Winckel, & Valcke, 2008; Moore-Cox, 2010; Plack, Dunfee, Rindflesch, & Driscoll, 2008; Plack, Driscoll, Marquez & Greenberg, 2010; Pulford, 2011; Romanov & Nevgi, 2007), although several consisted of discussion prompts only. In addition to this, 50% of the studies (7) focused on the use of individual student's experiences in the workplace/clinical setting to help relate theory to the practice setting (Brooks & Scott, 2006; Curran et al., 2009; De Leng, Dolmans, Jobsis, Muijtjens, & Van der Vleuten, 2009; De Wever et al., 2008; Moore-Cox, 2010; Plack et al., 2008, 2010). Therefore, an initial theory is that access to an AOD in the clinical setting, with a focus on sharing real experiences and using a specific framework for encouraging reflective and critical thinking, enhances learning.

3.2. Preliminary synthesis (element 2): including an overview of measures used and methodological quality

Dominant groups and clusters were determined by examining the data extraction table (Table 1). First, the studies were grouped according to the measure used. This enabled an initial comparative assessment of methodological quality. Second, the types of interventions explored by each study were grouped together, with some overlap. Studies were then grouped into those where students were based in the clinical setting and those where students were academically based. Finally, various clusters of AOD characteristics were determined (Table 2).

The first grouping found four different measures used to assess learning: content analysis, thematic analysis, assignment marks/test results and student perceptions of learning. The data is presented separately in terms of vote counting (Table 3a–d). However, it should not be used as a means with which to compare or summarise evidence (Hedges & Olkin, 1985 as cited in Rodgers et al., 2009). For example, whilst papers reporting qualitative data such as content analysis, should include lots of rich, low-inference data (Newton-Suter, 2012), the two quasi-experimental studies that also used the content analysis method, do not and would not be expected to report ‘rich’ qualitative data (see Table 3a).

3.2.1. Content analysis (Table 3a)

Eight studies used content analysis of discussion postings to measure learning and all used a recognised tool for this purpose. Content analysis is currently the most commonly employed method for evaluating AODs but there are at least 56 different coding schemes to choose from (Welzer-Ward, 2011). It is recommended that researchers choose one that has been validated or used elsewhere (De Wever et al., 2006). Five of the papers did so (Curtis, 2006; De Leng et al., 2009; De Wever et al., 2008; Moore-Cox, 2010; Plack et al., 2010). It is also highly recommended that more than one rater be used to reduce the risk of bias, and for statistical tests to be used to determine inter-rater reliability (De Wever et al., 2006) yet three studies did not do this (Curtis, 2006; Moore-Cox, 2010; Plack et al., 2008). However, one (Plack et al., 2008) explained that the inter-rater reliability was so high that it warranted reduction to just one rater for the rest of the study. At the other end of the scale, Moore-Cox (2010) was the teacher, researcher and rater which, while acknowledged by the author, does introduce the risk of bias. However, this is a PhD thesis paper utilising a phenomenological case study approach.

3.2.2. Thematic analysis (Table 3b)

Three studies used thematic analysis to measure learning (Chen, Stocker, Wang, Chung, & Chen, 2009; Plack et al., 2008, 2010). Two of these (Plack et al., 2008, 2010) used it as an addition to content analysis, producing particularly rich data. Both of these were highly controlled in terms of having more than one rater, statistical tests for inter-rater reliability and combining multiple sources of data. The remaining study (Chen et al., 2009) is less robust because there is no evidence of inter-rater reliability. However, the reader is led to believe that more than one rater is used simply because the rater is referred to as ‘we’ and a large volume of data was analysed – 423 discussion postings.
### Table 1
Characteristics of included studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Profession, sample size, &amp; design</th>
<th>Course</th>
<th>Type, length &amp; use of AOD</th>
<th>Intervention/factor being investigated</th>
<th>Measure of 'enhanced learning'</th>
<th>Data collection method &amp; type of analysis</th>
<th>Results</th>
<th>Author(s) conclusion</th>
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<tr>
<td>1. Brooks &amp; Scott (2006)</td>
<td>Midwives N = 96</td>
<td>Not a course.</td>
<td>AOD board: Web forums</td>
<td>Impact of organisational access to 'midwifery discussion forums' = part of larger project to 'enable nurses and midwives to incorporate knowledge into their daily through use of CML.</td>
<td>ADD postings demonstrating decision-making, leadership and collegiate support.</td>
<td>Data collected: Discussion postings Type of analysis: Thematic analysis with framework (Boyatzis, 1998) AOD = 193 messages. 178 (88%) coded as 'knowledge work'. 39 (20%) used tacit knowledge in raising an issue. (68 (34%) used tacit knowledge proposing resolutions/action.</td>
<td>If given an AOD facility to use in practice environment, midwives will function as 'knowledge workers'. i.e. &quot;they were able to critically reflect on their experiences of providing care and re-conceptualise those experiences into both 'proposals for change' and 'resolution of issues'.&quot;</td>
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<td>2. Cain &amp; Smith (2009)</td>
<td>Pharmacy students (Year 2) N = 124</td>
<td>Moral reasoning skills, in Law &amp; Ethics course</td>
<td>AOD board: Blackboard</td>
<td>Impact of a) strategy of dilemma discussions b) anonymity on moral reasoning skills. Given dilemmas to discuss over 5 weeks. Comparison between: 1. Face-to-face 2. ADD 3. AOD with anonymity 4. No discussion at all. Approx 11 per group.</td>
<td>Moral reasoning skills as demonstrated by DIT test.</td>
<td>Data collected: 1. Pre &amp; post Defining Issues Test scores 2. Participant questionnaires - demographic data Type of analysis: Differences between pre &amp; post DIT scores for each treatment group (paired samples t-test) Increases of AOD groups compared to other groups. ANOVA on gender &amp; age.</td>
<td>Both groups with ADD had significant increases in DIT score. No significant difference of AOD over face-to-face or no discussion at all. No significant difference between anonymity or non-anonymity.</td>
<td>Do not need face-to-face discussions to increase moral reasoning skills. The Galbraith &amp; Jones dilemma discussion strategy along with other strategies for promoting and retaining discussion (e.g. e-moderator &amp; guidelines) proved to be effective in AOD.</td>
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<td>3. Campbell et al. (2008)</td>
<td>Post-graduate nurses N = 114</td>
<td>Core Research methods</td>
<td>AOD board: WebCT 3.4</td>
<td>Associations between online activity &amp; educational attainment = secondary aim. (Main aim: re-capitulation between face-to-face with online discussion). Comparison of face-to-face (n=44) AOD (n=67)</td>
<td>Assignment marks on summative essay in form of a research proposal</td>
<td>Data collected: 1. No of discussion posts read &amp; posted 2. Assignment marks Type of analysis: Comparison of ADD use with assignment mark. Pearson's r test for association between variables &amp; discussion method. Kendall's Tau to measure correlation between pairs of interval variables.</td>
<td>The mean assignment mark for ADD significantly higher than face-to-face (60.8 : 54.4). Association between certain variables in AOD group but when adjusted, only mean assignment mark for PhD/MPH students was significant (6.6 higher) and those with increased non-discussion hits (2.84) programme was the most significant predictor of student performance.</td>
<td>Three 3 steps associated with higher student achievement on ADD (as opposed to I2F): 1. Increased frequency of access to web-based materials 2. Increased no of online messages read. 3. Increased number of contributions. <em>&quot;Thus, the more active students were in their use of learning materials, reading postings and in contributing to online discussions, the higher were their assignment marks. But after adjusting for other variables, the effect of the other variables, &quot;Being on the MPH/PhD</em></td>
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<td>5. Curran et al (2009)</td>
<td>Emergency clinicians (Nurses, physicians &amp; pharmacists) N = 187</td>
<td>Paediatric emergency care – clinically based</td>
<td>AOD board: Not specified Length: 20-22 months Usage: Voluntary 3 large group E-modified. Additional component linked to each of 12 online case-based topics/modules.</td>
<td>Impact of cross-site access: encourages sharing of expert practice knowledge.</td>
<td>Student perceptions of change in knowledge. Number of postings on information seeking &amp; sharing. Level 1/2a/2b/3</td>
<td>Data collection: -VLE user logs -Discussion postings -Student survey Type of analysis: Content analysis for information seeking &amp; sharing episodes – 15 related to treatment, 11 to diagnosis, 10 to management posts. Survey – 41/45 (89%) respondents reported that they already use knowledge gained through the network in their practice.</td>
<td>202 postings by 54 participants: 3 common behaviors emerged: 1. Establishing a clinical presence (87/202). 2. Information seeking (52/202). 3. Information sharing (63/202). Information seeking &amp; sharing episodes – 15 related to treatment, 11 to diagnosis, 10 to management posts. Survey – 41/45 (89%) respondents reported that they already use knowledge gained through the network in their practice.</td>
<td>Participants identified knowledge resources not accessible prior to AOD, particularly rural areas, so AOD “may serve as a possible solution to increase access to expert practice knowledge in areas where resources may be limited.” Results provide support for development of virtual communities of practice for rural and urban emergency clinicians.</td>
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<td>7. De Leng et al (2009)</td>
<td>Medical students (Yrs 5 &amp; 6) N = 8</td>
<td>Cardiovascular &amp; respiratory physiology – pediatric clinical setting</td>
<td>AOD board: Future Learning Management (FLM) Length: 3 weeks Usage: Obligatory 2 groups of 4 E-modernated. Weekly discussion topics – student generated issues from practice. Used as sole method of learning.</td>
<td>Impact of using ‘Practical Inquiry model of Cognitive Presence’ as framework for discussions.</td>
<td>Number of posts demonstrating critical thinking. Student &amp; facilitator perceptions of learning (critical thinking &amp; understanding of basic science concepts) Level 2b</td>
<td>Data collection: -Pre-test with CCTD? (for group comparability) -AOD activity -Discussion postings -Telephone interviews (students &amp; moderators). Data analysis: Content analysis using for evidence of critical thinking, using Practical Inquiry Model of Cognitive Presence – triggering event, exploration, integration, resolution. Last two categories indicate ‘critical thinking’ 2 x independent raters</td>
<td>1. Activity-Group 1 – 88 posts (76% students), Group 2 – 110 posts (86% students). (Note: remaining posts were moderator) Percentage of threads containing 5 or more messages (indication of student engagement in social activity) Group 1= 40%, Group 2=75% -Average viewings per student: Group 1=1-1.9 times for student posts, 1.6 times for moderator posts. Group 2= 1.8 times for student posts, 1.8 times for moderator posts. -Average postings per student: Group 1=16.8, Group 2= 23. 2. Content analysis: Group 1 = 20.9% integration, 6% resolution. Group 2 = 31.5% integration, 8.7% resolution Overall = 27% integration, 7.5% resolution. 3. Telephone interviews: Mostly focused on experiences, but students found the AOD increased their interest in pathophysiology. Moderators felt AOD improved students understanding of basic science concepts</td>
<td>1. Quantitative data point to substantial social activity. Data from interviews support this result. 2. Data: higher order (critical thinking) thinking is 36.5% disappointing but higher than other similar studies. 3. 3 weeks focusing on ‘verification &amp; solution’ of problems generated greater levels of critical thinking (33.3% postings on ‘integration’, 33.3% on ‘resolution’ that week). Group 2 higher (42% for each) probably because of moderator’s approach: ‘critical thinking same for both groups in pre-test’ Overall, “Garrison’s ‘Practice inquiry’ model plus moderator APPEARS to be a viable instrument for facilitation of online discussions about basic science subjects among small groups of students engaged in busy work placements at different training sites”.</td>
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### Table 1 (continued)

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<td>8. DeWever et al (2008)</td>
<td>Medical students (year 6) N = 49</td>
<td>Paediatric clinical rotation</td>
<td>AOD board: Web Crossing Length: 1 month Usage: Obligatory Groups of 4 - 5 E-moderated Discuss 4 clinical cases submitted by students. Sole method of learning.</td>
<td>Impact of role assignment: 1. Instructor as e-moderator 2. Student as e-moderator 3. Instructor vs e-moderator with developer of alternatives 4. Student as e-moderator with developer of alternatives.</td>
<td>Number of posts reflecting specific levels of social construction of knowledge. Level 2b</td>
<td>Data collection: Discussion postings Data analysis: Content analysis for level of social construction of knowledge using interaction analysis model (Gunawardena et al, 1997)</td>
<td>1522 message units analysed. 995 (69%) = low level of knowledge construction 444 (31%) = high level of knowledge construction Results given in odds ratios (OR), using first group of instructor as e-moderator with no developer of alternatives, as the reference category. - No difference between student-moderated &amp; instructor group with no developer of alternatives. - Developer of alternatives significantly reduced rate of higher level knowledge construction in instructor-moderator group (OR = 0.58) and significantly increased rate of higher level knowledge construction in student-moderator group (OR = 1.28) .Students assigned role of moderator are more likely to write contributions reflecting a high level of knowledge construction (OR &gt;2.5) but no significant difference for those assigned role as developers of alternatives.</td>
<td>Most messages (69%) at low level of knowledge construction = similar to previous studies. Students not used to level 4 and 5 stages of learning generally, or if they are, they are not used to writing it down. No difference between student &amp; instructor moderation probably because 6th year medical students. Higher level of knowledge construction where student has both roles &amp; lower level of knowledge construction where instructor is moderator and a student is a developer of alternatives possible because students behave differently in presence of an instructor. &quot;It seems that the autonomy students experience when the instructor is not moderating the discussion stimulates them more to engage in mutual interchange and in-depth discussions, to search for dissonance and inconsistencies, and to go into negotiation.&quot; More research required.</td>
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| 9. Markewitz (2007) | Medical laboratory professional s N = 30 | The Pre-Analytical Process | AOD board: Moodle derivative Length: 5 weeks Usage: Obligatory 2 groups (15 each) E-moderator Question & answer (via email for non-AOD group) | Impact of student-student interaction through AOD. A. AOD (permit more to chat & email with other students) B. No AOD (not chat or email access to other students) | Students approach to learning i.e. deep or surface. Moodle quiz test with 20 MCQs based on course learning outcomes. Level 2b | Data collection -Pre-lab post assessment using revised 2-factor Study Process Questionnaire -Moodle platform tracking data - Test scores - Comments from voluntary AOD. Data analysis: Comparison of questionnaire & test scores using independent samples t-tests, ANALYSE, Mann-Whitney U & Spearman's r. | Higher test scores in group A (84 vs.77, p<0.01) but not significant. Chat not used at all. Group A interacted more with teacher & content than group B. Deep approach to learning as measured pre-post self-assessment questionnaire marks (out of 50). Group A: 34.6 - 36.3, Group B: 33.2 - 33.2, but not significant (p=0.380). Post-study forum comments - 5 entries, mainly from group B stating how they missed the interaction. | Probably not best way of testing learning because MCQ test = low-level learning. Increases in Group A content-related interactions found to be due to time on AOD. Taking this out – there was no difference. Therefore, spending more time on AOD for same marks? However, rehearse test only test low level learning. Group B interacted with instructor more - to be expected. No significant difference between groups in approaches to learning, although mildly positive effect for deep learning in group A and moderately negative change in surface learning for Group B. Comments that students prefer to have more student-student interactions more prevalent i.e. preference even though it doesn’t affect results. Results “hampered” by small group size and short time frame. However, Group A did have higher test scores and moved towards deep learning even though not statistically significant. |

| 10. Moore-Cox (2010) | Registered nurses N = 14 | Nursing administration [management] | AOD board: Angel Learning Management Suite Length: 2 x 31 week ‘terminar’ Usages: Obligatory 1 large group E-moderated Weekly discussion prompts. Postings graded. | Role socialisation: How does it take place via AOD, enabling students to move into new managerial roles. | Number of posts demonstrating evidence of role socialisation | Data collection: Discussion postings Interviews (9 months post-course) Data analysis: Discourse analysis using Gee's schema (examines use of language) | Socialisation process occurred in 3 ways: 1. Sharing observations about the practice of nurse administrator. 2. Experiencing with role of nurse administrator (putting self on administrator’s ‘side of fence’). 3. Evaluative reflecting about the role change to nurse administrator. The preparation & research required for the AOD helped them learn and the AOD was a socialising factor. | AOD provides a valuable place for students to engage in professional role socialisation. Normally – this happens in classroom by teacher being role model i.e. they have functioned in the role that they are teaching about. |
Table 1 (continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Profession, sample size, &amp; design</th>
<th>Course</th>
<th>Type, length &amp; use of AOD</th>
<th>Intervention/factor being investigated</th>
<th>Measure of 'enhanced learning'</th>
<th>Data collection method &amp; type of analysis</th>
<th>Results</th>
<th>Author(s) conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Plack et al (2008)</td>
<td>Physical therapist students (final year) N = 7</td>
<td>Clinical placement ~ Acute Rehabilitation</td>
<td>AOD board: Blackboard Length: 8 weeks Usage: Obligatory E-mediated (peer or instructor) Weekly submission of critical incident by students followed by 4-week discussion.</td>
<td>1. Impact of use as virtual action learning sets on reflection &amp; higher order thinking. 2. Impact of facilitation by peer or mentor</td>
<td>Number of postings and essay content showing reflection &amp; higher order thinking. Student perceptions of what they have learned.</td>
<td>Data collection: - Discussion postings - Student reflective essays.</td>
<td>97 student entries. 1. Impact on reflection &amp; higher order thinking. Reflection: Reflection-on-action = 89.7 (92.4%), Reflection-for-action = 29.7 (29.6%) Higher order thinking: Data gathering = 90.7 (93.5%). Data analysis = 86.7 (89.2%). Conclusion drawing = 61 (62.9%). 2. Peer &amp; mentor facilitated groups - Chi-square tests analysed differences for 3 types of reflection = no significant differences between peer or mentor facilitated groups (p = 0.022 = 0.96, 1.799 p = 0.13, 0.13). b) Higher order thinking = significantly greater proportion of data gathering &amp; data analysis in mentor facilitated groups (14.47 p = 0.003, 4.625 p = 0.005) no difference in conclusion drawing (1.048 = 0.3). 3. Reflective essays = 3 themes: Reflective practice must be a conscious, active, analytical process. Reflective practice facilitates broader and deeper thinking and offers insights into patient management. 3. VAQ sets enhance collaborative learning.</td>
<td>1. Higher reflection-on-action demonstrates students were taking time to reflect &amp; analyze on situation in more detail. 29.6% for reflection-on-action demonstrates they are developing plan for approaching situation next day or in future. 62.9% conclusion drawing = evidence that students reached Bloom's higher order thinking. 2. Higher proportion of data gathering &amp; analysis in mentor-facilitated group suggest that a major role of the critical instructor is to create an environment in which the student has the ability to reflect on the situation, gather all the facts, and think it through before drawing a conclusion. Less advice giving in mentor-facilitated group = better problem-solving rather relying on others. Qualitative differences seemed to parallel the quantitative differences.</td>
</tr>
<tr>
<td>13. Pufford (2011)</td>
<td>Psychology students (year 1) N = 166</td>
<td>Statistics &amp; report-writing modules</td>
<td>AOD board: Blackboard Length: 2 weeks Usage: Voluntary 1 large group E-mediated Question &amp; answer format. 2 weeks prior to assignment hand-in date.</td>
<td>Impact of voluntary access: to 2-week AOD prior to assignment.</td>
<td>Assignment ability to structure a lab report, report relevant literature &amp; analyse data using SPSS.</td>
<td>Data collection: - AOD tracking data. No of questions asked &amp; no of questions read. - Assignment grades Data analysis: Comparison of postings with assignment grade using p-value, &amp; ANOVA</td>
<td>128 people used AOD. 2988 hits Average number of messages read = 32. 12 questions asked - mostly answered by tutor. Total of 60 posts. Module 1 (no AOD) grades = 57.89% Module 2 (AOD) grades = 56.25% 2 x 4 ANOVA statistically significant (p = 0.001).</td>
<td>Students who read the discussion board the most improved their grades the most. Students who chose not to use the discussion board maintained the same grades as before. Those who did improved their grades.</td>
</tr>
</tbody>
</table>
3.2.3. AOD usage & test score/assignment mark (Table 3c)

Five studies compared AOD usage (number of messages read and posted) through pre-test and post-test score differences (Cain & Smith, 2009; Markewitz, 2007; Romanov & Nevgi, 2007) or an overall assignment mark (Campbell et al., 2008; Chen et al., 2009). All used appropriate statistical tests to measure the differences between pre & post scores or the differences between groups. The only issue is that of teacher/researcher bias which was either present or the absence of which could not be ascertained.

3.2.4. Students perceptions of learning (Table 3d)

Three studies measured students’ perceptions of learning either via interviews (De Leng et al., 2009; Moore-Cox, 2010) or questionnaires (Curran et al., 2009). All used structured methods and the type of questions were stated. The characteristics of respondents reflected those of the overall sample in all cases. The small sample in Moore-Cox’s (2010) phenomenological study reflects the fact that the study was focused on socialisation into a new professional role and all four participants selected were in that new professional role.

3.3. Relationships between the studies (element 3)

A concept map and further textual descriptions were also produced.

3.3.1. Grouping 1: intervention

3.3.1.1. E-moderation. The majority of studies (12) used e-moderated AOD. Five quasi-experimental studies compared differences between pre and post test scores/assignment marks (Cain & Smith, 2009; Markewitz, 2007; Pulford, 2011), and between AOD and non-AOD groups (Campbell et al., 2008; Romanov & Nevgi, 2007). All of these demonstrated small differences in learning. The difference in marks pre & post AOD were significant in two of these studies, from 1.64%, \( p = 0.006 \) (Pulford, 2011) to 5.4/95, \( p = 0.015 \) (Cain & Smith, 2009) but insignificant for the third, 1.7%, \( p = 0.396 \) (Markewitz, 2007). The two studies showing significant differences in post-only marks between groups without AOD and AOD with e-moderation ranged from 3%, \( p = 0.007 \) (Romanov & Nevgi, 2007) to 6.4%, \( p = 0.002 \) (Campbell et al., 2008). A major limitation of all five comparative studies is the lack of a control group containing AOD without e-moderation.

Five qualitative studies (Curtis, 2006; De Leng et al., 2009; De Wever et al., 2008; Plack et al., 2008, 2010) analysed discussion postings for reflective or critical thinking and had highly variable results ranging from 22% (Curtis, 2006) to 92.4% (Plack et al., 2008) for reflection, and from 31% (De Wever et al., 2008) to 62.9% (Plack et al., 2008) for critical thinking. However, all five studies demonstrated an effect on reflective/critical thinking skills. The remaining two studies with e-moderation consisted of one qualitative study measuring only information seeking and sharing skills (Curran et al., 2009), and one unpublished PhD study which simply described the process of socialisation into a new professional role, where this occurs and confirmed that it does happen with e-moderated AOD (Moore-Cox, 2010).

The type of e-moderation fell into three main categories:

1. Specific discussion frameworks (Cain & Smith, 2009; De Leng et al., 2009)
2. Submission and discussion of real clinical scenarios (De Leng et al., 2009; De Wever et al., 2008; Plack et al., 2008, 2010).
3. Posing or answering questions on a specific topic (Campbell et al., 2008; Curran et al., 2009; Curtis, 2006; Markewitz, 2007; Moore-Cox, 2010; Pulford, 2011; Romanov & Nevgi, 2007)

Only two studies explored the use of specific frameworks for guiding discussions. The use of a specific dilemma discussion strategy (Cain & Smith, 2009) increased learning about moral reasoning skills in two AOD groups of pharmacy students [DIT test scores: Grp 1 – 38.7 to 42.4,


3.3.1.3. Amount of online activity. Three studies linked the amount of online activity with effectiveness. Two demonstrated increased learning with increased messages read, \( p = 0.045 \) (Campbell et al., 2008); \( p < 0.001 \) (Pullford, 2011). However, a limitation of both is that the time spent on the AOD board was used as a measure of read messages, which may not necessarily be the case. Similarly, it seems that video watchers increased their AOD board usage and both together increased marks (Romanov & Nevgi, 2007) but without a control group of video watchers-without-AOD, this cannot be proved. All we can surmise is that videos increase AOD board usage, but not that increased usage increases marks. Interestingly, for all three studies, there was no significant association between the number of messages posted and exam marks.

3.3.1.4. Critical thinking. The least used was the AOD board that had no link to formal education but was provided for use as a 'community of practice' [44/96 participated]. It still resulted in 88% reflective posts (defined as greater 'knowledge work') and 34% re-conceptualising these experiences into change proposals or resolution of issues (Brooks & Scott, 2006). Interestingly, both AOD boards that offered no e-moderation also resulted in greater 'knowledge work' (Brooks & Scott, 2006), self-reflection and learning (Chen et al., 2009). Overall, offering an AOD board for use on a voluntary basis appears to enhance learning for those that use it, and practicing health professionals appear not to need discussion prompts in order to do so.

\[ p = 0.038; \text{Grp} 2 \sim 38.33 \text{to} 43.7, p = 0.015; \] and the Garrison's Practice Inquiry model helped produce 34.5% student postings [16–23 postings per student] involving critical/higher order thinking (De Leng et al., 2009). Both findings are small.

Four studies found that getting students to submit clinical scenarios for discussion helped to increase skills in reflection and critical thinking in varying degrees, as measured by the number and quality of discussion posts:

- Reflective posts: 5.2% reflection-in-action, 92.4% reflection-on-action, 29.6% reflection-for-action (Plack et al., 2008), 44/70 (Plack et al., 2010).
- Critical thinking: 34.5% (De Leng et al., 2009), 31% (De Wever et al., 2008), 62.9% (Plack et al., 2008), 12/70 (Plack et al., 2010).

Two of these groups were described formally as 'virtual action learning sets' (Plack et al., 2008, 2010).

In contrast, seven studies showed that simply posing or answering questions on the course subject helped to increase reflective thinking [238/1080 reflective postings] (Curtis, 2006), information seeking and sharing [115/202 postings] (Curran et al., 2009), socialising into a new professional role (Moore-Cox, 2010). IT skills [pre & post score difference = 3, \( p = 0.007 \)] (Romanov & Nevgi, 2007) and report/research writing skills [grade difference between AOD and non-AOD = 6.4%, \( p = 0.002 \)] (Campbell et al., 2008); pre & post grade difference 1.64%, \( p = 0.006 \) (Plack et al., 2010), although one study (Markewitz, 2007) showed a non significant increase in lab report-writing skills between AOD and non-AOD [1.7%, \( p = 0.396 \)].

And finally, one study (Romanov & Nevgi, 2007) showed that using video clips as discussion prompts improved AOD usage and implies that both methods together helped to improve IT skills for medical decision-making [exam mark increase 3%, \( p = 0.007 \)] although the cause-and-effect link between both variables is not ascertained. It could be the case that students who watch video clips more often achieve higher marks, with or without AOD.

In conclusion, the heterogeneity of study design alongside the different types of e-moderation used makes it difficult to draw robust conclusions within this subgroup. No studies compared AOD with and without e-moderation so it is impossible to ascertain which e-moderation method is more effective. Also, in three of the studies, students were awarded grades for discussion contributions which certainly may have affected the results (De Wever et al., 2008; Moore-Cox, 2010; Romanov & Nevgi, 2007). In addition to this, the two remaining studies which used AOD without e-moderation also demonstrated learning through 'knowledge work' posts = 88% (Brooks & Scott, 2006) and self-regulatory learning (Chen et al., 2009). However, despite the heterogeneity, twelve studies do show generally that AOD with e-moderation improves learning, particularly those which use real clinical scenarios to improve the number of posts demonstrating reflective and critical thinking. Those that use specific AOD discussion frameworks or question-and-answer format have less impact but are still effective.

### Table 2

<table>
<thead>
<tr>
<th>Measure</th>
<th>1. Intervention (focus of study)</th>
<th>2. Setting or context (emerging factor)</th>
<th>3. AOD usage (emerging factors)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Measure</th>
<th>4. Setting or context (emerging factor)</th>
<th>5. AOD usage (emerging factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Usage</td>
<td>Group size</td>
</tr>
</tbody>
</table>

p = 0.038; Grp 2–38.33 to 43.7, p = 0.015; and the Garrison's Practice Inquiry model helped produce 34.5% student postings [16–23 postings per student] involving critical/higher order thinking (De Leng et al., 2009). Both findings are small.
3.3.1.4. Student as e-moderator. Three studies experimented with the role of the student as an e-moderator i.e. peer-facilitation (De Weyer et al., 2008; Plack et al., 2008, 2010). De Weyer et al.’s (2008) study demonstrated no significant difference between having an instructor or a student as an e-moderator. However, when a 'developer of alternatives' was added together with a student as an e-moderator, the two roles together significantly increased the rate of higher level knowledge construction [OR = 1.58] yet it was significantly reduced when the instructor was the moderator with a 'developer of alternatives' [OR = 0.50]. The authors claim this could be because the students have greater autonomy when not in the 'presence' of the instructor. The student moderators were also more likely to demonstrate a much higher level of thinking in their postings [OR = 2.58]. This suggests that rotating the role of the student as moderator in AOD tasks may be advantageous. However, more research is clearly required as this is only one study, and students were not randomly assigned, although their roles were rotated.

Plack et al.’s (2010) qualitative study clearly shows that reflection does happen in peer-facilitated AOD with 44/70 reflective posts and 12/70 demonstrating critical reflection. In contrast, an earlier comparative study by Plack et al. (2008) shows no difference between peer and mentor facilitated AOD in terms of reflective thinking.

<table>
<thead>
<tr>
<th>Study</th>
<th>Recognised tool</th>
<th>Validated tool</th>
<th>&gt;1 rater</th>
<th>Inter-rater reliability</th>
<th>Independent researcher</th>
<th>Positive or negative</th>
<th>Rich data</th>
<th>Further relevant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Curran et al. (2009)</td>
<td>√ only for 1 post type</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>Can’t tell</td>
<td>+</td>
<td>Med</td>
<td>Only one rater (identified by author as limitation). Content analysis model had also been used as framework for guiding discussions.</td>
</tr>
<tr>
<td>6. Curtis et al. (2006)</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>X</td>
<td>Can’t tell</td>
<td>+</td>
<td>High</td>
<td>Content analysis model had also been used as framework for guiding discussions.</td>
</tr>
<tr>
<td>7. De Leng (2009)</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>X</td>
<td>Can’t tell</td>
<td>+</td>
<td>Low</td>
<td>Content analysis model had also been used as framework for guiding discussions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Themes presented</th>
<th>Saturation</th>
<th>&gt;1 rater</th>
<th>Inter-rater reliability</th>
<th>Independent researcher</th>
<th>Positive or negative</th>
<th>Rich data</th>
<th>Further relevant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Plack et al. (2008)</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>+</td>
<td>High</td>
<td>Content analysis of essays only for students perceptions of learning</td>
<td></td>
</tr>
<tr>
<td>12. Plack et al. (2010)</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>+</td>
<td>High</td>
<td>Carried out thematic analysis and content analysis (see previous table) on same data</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Pre &amp; Post tool</th>
<th>Validated test for pre-post</th>
<th>Statistical test for pre-post</th>
<th>Control group</th>
<th>Statistical test – between groups</th>
<th>Independent researcher</th>
<th>Positive or negative</th>
<th>Further relevant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Cann and Smith (2009)</td>
<td>√</td>
<td>√</td>
<td>4 (n – 31 each)</td>
<td>X</td>
<td>(x 2)</td>
<td>X</td>
<td>Q1+ Q2 &amp; 3-</td>
<td>Chi-square test for differences in frequencies of reflection &amp; thinking.</td>
</tr>
<tr>
<td>3. Campbell et al. (2008)</td>
<td>X</td>
<td>NA</td>
<td>2 (n – 67, n = 44)</td>
<td>Can’t tell</td>
<td>Q1+ Q2-/+</td>
<td>X</td>
<td>Positive or not significant</td>
<td></td>
</tr>
<tr>
<td>9. Markewitz (2007)</td>
<td>√</td>
<td>√</td>
<td>2 (n – 15 each)</td>
<td>√</td>
<td>X</td>
<td>X</td>
<td>Positive or not significant</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of questions stated</th>
<th>Structured Response rate</th>
<th>Respondents’ characteristics reflect overall sample</th>
<th>Independent researcher</th>
<th>Further relevant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Curran et al. (2009)</td>
<td>Individual questionnaires</td>
<td>√</td>
<td>57%</td>
<td>√</td>
<td>Can’t tell</td>
</tr>
<tr>
<td>7. De Leng (2009)</td>
<td>Individual tel. interviews</td>
<td>√</td>
<td>100%</td>
<td>√</td>
<td>Can’t tell</td>
</tr>
<tr>
<td>10. Moore-Cox (2010)</td>
<td>In-depth interview</td>
<td>√</td>
<td>4/14 selected</td>
<td>√</td>
<td>X</td>
</tr>
</tbody>
</table>
Overall, the results from these three studies are contradictory so it is difficult to draw conclusions in terms of appointing students as e-moderators. The role appears to be effective but not more effective than instructors/mentors (De Wever et al., 2008; Plack et al., 2008). However, the three studies do indicate that the student moderator role is not detrimental to learning, and the concept of introducing an additional student role as a ‘developer of alternatives’ appears worthy of further research.

3.3.1.5. Anonymity. One study compared the use of anonymous posts with non-anonymous posts, finding no significant difference in learning (Cain & Smith, 2009).

3.3.2. Grouping 2: setting or context
3.3.2.1. Clinical/practice context. Seven studies focused on using the AOD for linking learning and clinical practice. Three of these focused on the use of AOD whilst participants were working in practice as part of their continuing professional development (Brooks & Scott, 2006; Curran et al., 2009; Moore-Cox, 2010). The remaining four focused on AOD usage by students whilst on clinical placements (De Leng et al., 2009; De Wever et al., 2008; Plack et al., 2008, 2010). All seven studies analysed the discussion postings for reflective and/or critical thinking to demonstrate learning. All focused on students sharing and learning from their clinical experiences and most with the assistance of an e-moderator (Curran et al., 2009; De Leng et al., 2009; De Wever et al., 2008; Moore-Cox, 2010; Plack et al., 2008, 2010). One study simply used the AOD facility for the sharing and learning of experiences without e-moderation or input from anyone else (Brooks & Scott, 2006) yet still demonstrated some success with 44/96 using it, 88% messages demonstrating ‘knowledge work’ with 34% messages focussing on change/resolution of clinical issues. All the studies had positive outcomes in terms of enabling learning through reflection and/or critical thinking i.e. linking theory to practice. However, it could be argued that three of them (De Leng, 2009; Moore-Cox, 2010; Plack et al., 2008) used samples too small for generalisation.

One phenomenological case study illustrated the new phenomenon of using AOD for socialisation into a new professional role. This was focused on nurses becoming nurse managers (Moore-Cox, 2010) but interestingly another qualitative study also identified role identification from a gender/ethnicity perspective (Chen et al., 2009) as an AOD board used by medical students on placement (Plack et al., 2010). The former concludes that AOD can be used to facilitate other role transitions such as preceptorship or advanced practitioner programmes.

The quantitative data from six studies in this sub-group show a variation of between 31% and 88% of postings with reflective thinking and between 34% and 62.9% for critical thinking:

- Reflective thinking: 88% (Brooks & Scott, 2006), 52–63/202 (Curran et al., 2009), 31% (De Wever et al., 2008) 5.2% reflection-in-action, 92.4% reflection-on-action, 29.6% reflection-for-action (Plack et al., 2008), 44/70 (Plack et al., 2010).
- Critical thinking: 34% (Brooks & Scott, 2006), 34.5% (DeLeng et al., 2009), 62.9% (Plack et al., 2008).

3.3.2.2. Non-clinical context. Seven studies focused on AOD usage based in the non-clinical setting. Five of these measured the ability to write research/lab reports (Campbell et al., 2008; Pulford, 2011) or pass a test measuring their factual knowledge (Cain & Smith, 2009; Markewitz, 2007; Romanov & Nevgi, 2007). The remaining two focused on reflective thinking around the students own experiences (Chen et al., 2009; Curtis, 2006). This is in sharp contrast to those based in the clinical setting where all were focused on reflective/critical thinking and the main measure was the content of discussion posts. In other words, studies of AODs in the clinical setting tend to focus on learning from experiences whilst most of the AODs in the educational setting tend to focus on learning in preparation for experiences. Four studies of AOD in the non-clinical context had significantly positive results with regards to learning, although they were small. Pre and post scores in one study (Cain & Smith, 2009) rose by 3.7 [p = 0.038] and 5.4 [p = 0.015] marks and the other three studies comparing grades of students between AOD and no-AOD groups showed increases ranging from 1.64%, p = 0.006 (Pulford, 2011) to 6.4%, p = 0.002 (Campbell et al., 2008), although the latter was ‘biased’ due to PhD/MPhil students choosing the AOD group. Only one study (Markewitz, 2007) showed no significant difference in marks for the AOD within a non-clinical context. The qualitative studies similarly showed some learning in terms of transition of responsibility and self-reflection (Chen et al., 2009) but not in particularly large amounts in one study which had 238 reflective postings out of 1080 (Curtis, 2006).

In summary, it seems that using AOD in the non-clinical context enhances learning mostly via assignment marks/test scores but they are not all statistically significant and all are small increases. The qualitative studies similarly demonstrate some learning in terms of self-regulatory skills (Chen et al., 2009) and reflective postings (Curtis, 2006) but results are small.

3.3.3. Grouping 3: AOD usage
3.3.3.1. Length of AOD. Four studies fell into the category of ‘short-term’ AODs of 2–4 weeks in length (De Leng et al., 2009; De Wever et al., 2008; Pulford, 2011; Romanov & Nevgi, 2007). Interestingly, two focused on developing critical thinking which one would normally expect to take longer than 3–4 weeks (DeLeng et al., 2009). Both resulted in a third of students demonstrating critical thinking or a higher level of knowledge construction [34.5% and 31%]. The remaining two studies in this ‘short-term’ category focused on assignment marks (Pulford, 2011) and exam scores (Romanov & Nevgi, 2007). Both indicated an improvement albeit a small one, 1.64%; p = 0.006 (Pulford, 2011) and 3, p = 0.007 (Romanov & Nevgi, 2007).

Five studies explored ‘medium-term’ AODs of 1–2 months (Cain & Smith, 2009; Campbell et al., 2008; Markewitz, 2007; Plack et al., 2008, 2010). Whilst three of these measured learning through assignment marks/test scores (Cain & Smith, 2009; Campbell et al., 2008; Markewitz, 2007), the two studies by Plack focused on the attainment of reflective/critical thinking skills (Plack et al., 2008, 2010). Both of these appeared to achieve better results with 92.4% reflection-on-action, 29.6% reflection-for-action, 62.9% critical thinking (Plack et al., 2008) and 44/70 reflection 1.2/70 critical reflection (Plack et al., 2010), compared to the shorter AODs. Two of the three quasi-experimental/mixed method studies also indicate better results than the shorter AODs in terms of greater increases between pre & post test scores [3.7, p = 0.38 and 5, p = 0.015] (Cain & Smith, 2009) and between AOD and non-AOD groups [6.4%, p = 0.002] (Campbell et al., 2008). (Although, the latter increase of 6.4% was biased due to mostly PhD/MPhil students choosing the AOD group). The small increase in marks of 1.7 in the third study (Markewitz, 2007) was not significant.
The main strength of this synthesis lies in the application of recommended evidence-based tools in a rigorous and systematic manner. However, the methodology does have some limitations. The identification and grouping of main themes has an element of subjectivity, although the themes appear obvious from the data extraction table. The themes identified from the textual narrative descriptions5 also relied to some extent on an element of personal judgement, although the synthesis process has ensured that the diversity of study design and methodologies were made explicit. For example, Table 3a–d give a detailed overview of the methodological quality or ‘best evidence synthesis’ (Popay et al., 2006), and include possible sources of bias from the studies such as teacher/researcher bias.

Discrepancies and uncertainties in findings are discussed and areas where future research is needed are highlighted. For example, the persistence on using control groups without an AOD instead of an AOD without the intervention was identified as a major source of uncertainty with regards to making inferences from the results about the effectiveness of the intervention/factor.

Overall, the use of specific tools and techniques which have been heavily scrutinised for their use in enabling transparency and reproducibility (Arai et al., 2007; Lucas, Baird, Arai, Law, & Roberts, 2007; Popay et al., 2006; Rodgers et al., 2009) has helped ensure that this synthesis process itself is transparent and reproducible.

4. Discussion

All studies in the review had positive outcomes in terms of demonstrating learning through AOD, although they were all were small except for Plack et al.’s (2008) study. All the quantitative results relevant to the review research question were significant except for Markewitz’s (2007) study.

The majority of studies in this review (12/14) used e-moderated AOD, all with positive learning outcomes of varying degrees. At first, this appears to be a similar result to Johnson’s review,4 in that structured (e-moderated) AODs are more effective than unstructured (no e-moderation) (Johnson, 2006). However, a major weakness of all the comparative studies is that the control group was no-AOD rather than a non-moderated-AOD. This means the assertion that moderation is better than no moderation (Johnson, 2006; Salmon, 2011) cannot be made with this review. In addition, the two AODs without moderation (unstructured) also showed similar positive learning outcomes.

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5 Not included but available from author upon request.

6 Johnson’s review was a) non-systematic b) included both synchronous and AODs and c) focused on general education students not health professionals.
Although the e-moderated discussions were divided into those using a discussion framework (2/12), clinical scenarios (4/12) and question & answer format (6/12), none used the scaffolding approach recommended by Salmon (2011) which was considered to be widely accepted by the author following the initial literature review. The initial stages of access, motivation and online socialisation were not considered in any of the studies. Most commenced with an instructional approach. In a comparison of four different AOD models used in the non-health profession setting, Darabi, Arrastia, Nelson, Cornille, and Liang (2011) conclude that the most successful in terms of learning, are those which use a scaffolding approach ensuring learners become familiar with the material and process first, followed by the use of a framework/model of practice inquiry which includes the stages of resolution and consensus. Both studies in this review which used a framework/model had positive outcomes, as did those that did not use a framework; but one wonders if the outcomes of all studies (of which the majority were small) would have been even better if a scaffolding approach had been used.

Half of the AODs reviewed were with participants based in the practice setting. All of these analysed discussion postings as a measure of learning outcome, rather than the learning by individual students or as a percentage of the group. One could argue that content analysis is not necessarily an appropriate measure of learning, although it appears from an initial foray into the associated literature, that no-one has produced such an argument. On the contrary, it is a recommended method of assessing learning through AOD (Darabi et al., 2011; De Wever, 2006; Weltzer-Ward, 2011). Yet it is not usual to measure the general content of a face-to-face classroom discussion for evidence of learning. However, this perhaps adds weight to the notion of using smaller groups when using such measures. One would assume that discussion in small groups would have to involve all members. All four studies in this review, which used clinical scenarios as the basis for moderated discussions, used smaller groups (3–5) and demonstrated positive results. This smaller group size contrasts with empirical evidence of e-learning in general education which points to between 20 and 25 per group as being the optimum online class size to “maximise student cognitive development” (Meredith, 2008).

The emphasis of using AOD for reflective and critical thinking (7/14) ties in with the current research and thinking on the importance of reflecting and analysing real experiences to develop clinical reasoning skills essential for clinical practice (Higgs & Jones, 2000). However, educational strategies in general (without AOD) for promoting reflective practice in the health professions are still in their infancy (Mann et al., 2009). The time provided for AOD seems to vary widely, but when put into sub-groups, the two AOD boards which were used over a period of 1–2 months generated a greater number of reflective/critical thinking postings compared to the AOD boards of 4 weeks or less. Also, all AOD boards of >2 months, were focused on learning from experiences, and those that focused on learning through test results or assignment grades used short or medium-term AOD boards. It could therefore be surmised that as an educator, if I want to use AOD to help students pass exams or get higher grades in assignments, I can achieve this via an AOD board of 2–8 weeks. However, if I wish to generate student postings which demonstrate reflective and critical thinking skills in greater percentages, perhaps it would be better to use an AOD board of at least 4 weeks in length. This finding is similar to that of a recent meta-analysis of all e-learning methods by Cook et al. (2010b) which found that time explains 25% of variation in knowledge outcomes. It concludes that the concept of time with e-learning is the same as classroom learning i.e. “that the longer one studies, the more one learns.” (p. 765), and reflective practice needs time (Mann et al., 2009).

There is no evidence in this review that increasing the number of AOD ‘hits’ leads to increased learning. The three studies which explored this comparison found that the amount of time spent on the AOD (assumed to be spent reading messages) contributes to learning in terms of increased assignment/exam marks (Campbell et al., 2008; Pulford, 2011; Romanov & Nevgi, 2007). This begs the question as to why so much focus is placed on increasing the number of discussion hits as a measure of AOD success (Hew et al., 2010; Wright, Scherb, & Forsyth, 2011) including one in this review (Romano & Nevgi, 2007). There is also no evidence here to show that peer facilitation has any advantage over instructor facilitation. Again, only three studies explored the difference, which simply acknowledges the recent calls for more research in this area (Ng, Cheung, & Hewt, 2012; Smet, Keer, & Valke, 2008).

Only one study explored anonymity. Some claim that using real clinical incidents/scenarios from the practice area may warrant anonymity to aid students in terms of being open and honest online (Bryson, 2011; Mann et al., 2009). The study in this review, revealed no difference although it was based on the use of simulated scenarios. Confidentiality issues should also be considered (Cutcliffe, 2000; Dimond, 1998, 2002). It could be argued that with the increasing popularity of AOD for reflective/critical thinking based on real clinical scenarios, there is perhaps a sense of urgency for further research in this area.

4.1. Heterogeneity

The reviews were a mixture of study design and interventions with multiple conflicting variables, all of which diminishes the strength of the positive findings. There were also a wide variety of methods used for measuring enhanced learning such as pre & post DIT test scores, MCQ quizzes, lab reports, reflective essays, content and/or thematic analysis of discussion postings (all using different content analysis tools) as well as the different types of learning being measured such as moral reasoning skills, reflection, critical thinking, IT skills and research proposal writing skills. This has made it too difficult to extrapolate exactly what works from the 14 studies.

4.2. Sensitivity analysis

Two studies stand out as markedly different from the others in terms of results. The first is Plack et al.’s (2008) study where the content analysis reveals up to 62.9% critical thinking discussion posts compared with all the other studies which generally reveal much lower results – the highest being 34.5%. The second is Markewiz’s (2007) study which although it shows positive results for learning similar to the other quasi-experimental studies but the results were insignificant after extensive statistical testing. These differences have been noted in all sub-group analyses, but the results have not been discounted because the overall sample is so small and heterogeneous that no firm conclusions can be made anyway with or without their inclusion.

4.3. Strengths and limitations of the review

The main strength of this review is the use of rigorous review methodology. Also, the focus on health professions has highlighted the potential for AOD in linking theory to clinical practice. This is something that may not have emerged had the scope of the review been wider...
to include non-health professions; which was perhaps an unwarranted criticism of Cook, Garside, Levinson, Dupras, & Montori’s (2010c) review of e-learning methods for health professionals (Dexter & Dornan, 2010). The quality of study design and results in all included papers is considered to be a strength in this review. Most of the qualitative and case studies used valid thematic and content analysis tools with evidence of inter-rater reliability, whilst most of the quantitative studies used extensive and appropriate statistical analyses of results.

One limitation is that no randomised controlled trials were identified, which are considered the gold standard for research in health care (Centre for Reviews and Dissemination, 2009) and by some for educational research (Hutchinson & Styles, 2010). Whilst it is acknowledged that RCTs are difficult to apply in the educational setting (Campbell et al., 2008), there were some ‘skewed’ results in the quasi-experimental studies due to students being able to choose groups with or without AOD. Whilst all authors acknowledged this (with some making statistical adjustments accordingly) it would without doubt have had an effect on overall results.

Another major limitation of this review is that none of the comparative studies used an AOD-without-intervention control group. Therefore little credence can be given to the findings in relation to which factors contribute to the effectiveness of AODs. And finally, because of rigorous quality assessment, 22 relevant studies were excluded from the data analysis and synthesis, which may have contributed to the richness of the extracted themes. There is also the possibility that although detailed electronic and hand searches were carried out in a systematic and controlled manner, there is still a possibility that some papers were missed. It is also possible that some papers were misclassified during the sifting and sorting phase due to misleading abstracts.

In addition to the above limitations, a number of further inclusion criteria may have helped to reduce the heterogeneity of studies, such as specifying the duration of modules using AOD or the group size. Whilst this may have restricted the final number of studies even further (and richness of data), fewer variations in the studies may have enabled specific factors to be identified which increase the effectiveness of AODs in health care education.

### 4.4. How this review could be improved

This review could be improved by adding further inclusion criteria to compare like with like in order to come to more robust conclusions. It could also be improved by having two or three people undertake the sifting and sorting, quality appraisal, data extraction and grouping process to reduce the possibility of bias. This was not possible, but much of the bias was reduced through regular meetings, discussions and agreement between two individuals at each stage of the process.

### 5. Conclusion

Many factors/options have emerged that may have an effect on learning (Table 4) but the heterogeneity of study design, type of intervention and measure of learning, makes it difficult to generalise these findings. Whilst the overall results are positive, the lack of controls (i.e. AOD without the intervention) and the general small increases in learning mean that the results in terms of effectiveness are not particularly robust. However, there are numerous implications for future research, simply because research on AOD use in health care education is still in its infancy. One main recommendation has to be that comparative studies include a control group consisting of AOD without the intervention. Examples include voluntary vs obligatory use of AOD, moderated vs non-moderated or AOD alone vs AOD as part of a wider course. As Dexter & Dornan (2010) pointed out, with e-learning now becoming the ‘norm’, it seems superfluous to be comparing AOD with face-to-face or non-discussion.

Lots of new concepts have also emerged which warrant further research including the use of a ‘developer of alternatives’, the use of video clips, and the notion of ‘socialisation’ into a new professional role. In addition to this, the role of anonymity and issues of confidentiality also need to be explored in greater depth; especially as the focus on using real clinical scenarios as a way of developing critical/thinking skills appears to be becoming a popular way of using AOD.

In summary, this review has gone some way in terms of identifying factors or options that may help to improve learning via AOD, but reveals no robust evidence in terms of which ones actually do.

### References
