

The use of social-networking sites in medical education

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Abstract

Background: A social-network site is a dedicated website or application which enables users to communicate with each other and share information, comments, messages, videos and images.

Aims: This review aimed to ascertain if “social-networking sites have been used successfully in medical education to deliver educational material”, and whether “healthcare professionals, and students, are engaging with social-networking sites for educational purposes”.

Method: A systematic-review was undertaken using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Eight databases were searched with pre-defined search terms, limits and inclusion criteria. Data was extracted into a piloted data-table prior to the narrative-synthesis of the Quality, Utility, Extent, Strength, Target and Setting of the evidence.

Results: 1047 articles were identified. Nine articles were reviewed with the majority assessing learner satisfaction. Higher outcome measures were rarely investigated. Educators used Facebook, Twitter, and a custom-made website, MedicineAfrica to achieve their objectives.

Conclusions: Social-networking sites have been employed without problems of professionalism, and received positive feedback from learners. However, there is no solid evidence base within the literature that social-networking is equally or more effective than other media available for educational purposes.

Background

A social-network is a form of social-media that is a dedicated website or application which in addition to text-based communication enables users to communicate with each other and share information, comments, messages, videos, images, etc. Social-media can be classified into six categories: blogs and micro-blogs (e.g. Twitter), collaborative projects (e.g. Wikipedia), content communities (e.g. YouTube), virtual social worlds (e.g. Second Life), virtual game worlds (e.g. World of Warcraft) and social-networking sites (e.g. Facebook), (Kaplan & Haenlein 2010). Facebook, which was created in February 2004, is the most popular social-networking site in the world, with 845 million monthly active users reported at the end of 2011 (Facebook-Newsroom 2012). Some established Virtual Learning Environments (VLEs) incorporate social-media formats into their structure. There are many potential benefits of using such social-networking sites in medical education. For example, these sites could provide useful technical support and interfaces for student collaboration, student-generated content, student–student communication and the personalization and socialization of student work (Gray et al. 2010).

But, has any work been carried out to assess if medical educators have used these sites effectively in implementing learning interventions? Best Evidence Medical Education (BEME) is the implementation, by teachers of methods and

Practice points

- Social-networking sites have been used for educational purposes in different health disciplines, at different training levels and across different continents.
- Feedback from students was positive regarding the use of social-networking sites.
- There is evidence of students using social-networking sites organically for educational purposes.
- None of the articles found in this review reported any problems of professionalism.
- There is no solid evidence base within the literature that social-networking is equally or more effective than other media available for educational purposes.

approaches to education based on the best evidence available. Without such evidence ideas and practices that have no sound evidential basis can become widely developed, employed and promoted despite having very little evidential basis that they are effective (Harden et al. 1999).

Aims

This review aimed to test the following two hypotheses: “Social-networking sites have been used successfully in medical education to deliver educational material”, and

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“healthcare professionals, and students, are engaging with social-networking sites for educational purposes”.

Methods

To test our hypothesis we aimed to find descriptions of interventions that tested good outcome measures with high levels of evidence. A systematic-review was therefore undertaken using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al. 2009).

Search strategy

Using the methods described by Haig and Dozier (2003), the databases Medline, Embase (Appendix 2), PsycINFO, Educational Resources Information Centre (ERIC), CINAHL, the Cochrane library, the British Education Index (BIE) and the Research and Development Resource Base in Continuing Medical Education on the Internet (RDRBWEB), were all searched from 01 January 2002 to 10 January 2012. This start date was chosen as it represents the year of conception of Friendster®, the first widely used social-networking site. Secondary searches were performed by visually scanning the reference lists from relevant studies. Authors of included studies were contacted in an attempt to identify any missing published or unpublished studies.

The searches were performed independently by two researchers (PC and MM) and any consensus disagreements regarding studies to include were settled by the third reviewer (RP). Inclusion and exclusion criteria were agreed prior to searching the above databases. The first author (PC) was responsible for managing references using EndNote.

Search terms

(Social media OR social network OR social networking OR Facebook OR Friendster OR Twitter OR MySpace OR Bebo) AND (Medical education OR education, medical OR education, nursing OR education, pharmacy OR students, health occupations OR students, nursing OR students, pharmacy OR students, medical OR students, dental OR resident) AND (Online OR web OR website OR internet OR education, distance).

The final Boolean search string (online etc) was used as “social network” is a MeSH (Medical Subject Heading) referring to social support and not web-based social-media. Excluding this final search string significantly reduced the sensitivity of the search.

Inclusion criteria

- (1) Study participants were in undergraduate or postgraduate studies in the health domain
- (2) The study aimed to assess:
 - (a) The implementation of a social-networking site as an intervention in healthcare education
 - (b) The use of social-networking sites by students for educational purposes

- (3) Papers that were research based and not opinion only
- (4) All study designs
- (5) The study outcome measured any of Kirkpatrick’s hierarchy of educational evaluation
- (6) The study was published between January 2002 and January 2012
- (7) All languages were included (foreign languages documented as present but excluded from appraisal)

Study selection

Two stages of study selection were performed: (i) an initial screening of titles and abstracts against the inclusion criteria; (ii) screening of the full papers identified as having the potential of inclusion.

Data extraction

Data was extracted, for each individual study, into a piloted, non-standardised data-table (Appendix 1) by the primary author (PC) and independently checked by the second author (MM) for accuracy and completeness. Extraction included subheadings from the BEME “QUESTS” (Quality, Utility, Extent, Strength, Target, Setting of evidence) acronym (Harden et al. 1999). This data was then combined into data tables (available online). Study authors were contacted when missing or additional data was required. Articles in non-English languages were documented as present but data not extracted.

Outcome measures

Target/outcome measures were classified in accordance with Hammick’s modified Kirkpatrick hierarchy (Hammick 2000) as adopted by the BEME collaboration for systematic reviews: Level 1 – Learners’ reaction (i.e. satisfaction); 2a – Modification of attitudes/perceptions; 2b – Acquisition of knowledge/skills; 3 – Change in behaviour; 4a – Change in organizational practice; 4b – Benefits to patients/clients.

Levels of evidence

The quality of the evidence was appraised and classified using the BEME Level of evidence in medical education (Harden et al. 1999): Level 1 – Evidence based on professional judgement: the beliefs and values of experienced teachers; 2 – Evidence based on educational principles; 3 – Evidence based on professional experience; 4 – Evidence based on case studies; 5 – Evidence based on cohort studies and related methods; 6 – Evidence based on randomized controlled trials.

Strength of evidence

The strength of the evidence found was graded using Hammick’s (2010) grading of strength of evidence for BEME: Grade 1 – No clear conclusions can be drawn. Not significant; 2 – Results ambiguous, but there appears to be a trend; 3 – Conclusions can probably be based on the results; 4 – Results are clear and very likely to be true; 5 – Results are unequivocal.

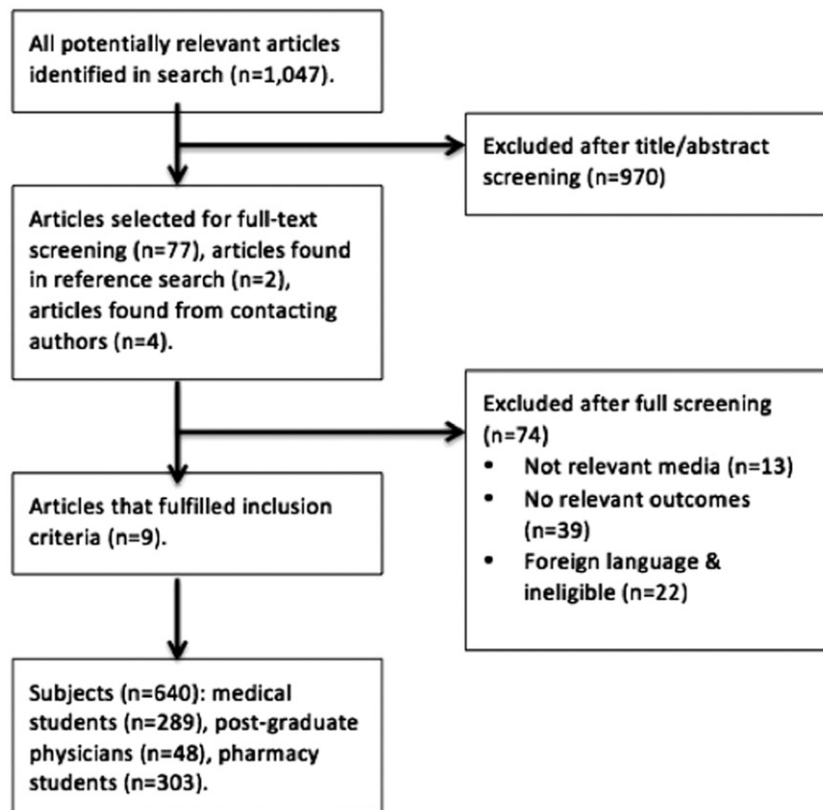


Figure 1. Study selection process.

Results

The search identified 1047 citations (Figure 1), and 77 articles were reviewed in full. Two further articles were identified from reference lists. There was 91% initial agreement on inclusion decisions, with the third reviewer (RP) providing arbitration on seven articles. The authors of the included articles were contacted and a further four studies were identified, of which two previously unpublished studies were included. Twenty-two articles were published in a foreign language. Screening of the translated abstracts revealed that none of these studies would have been appropriate for inclusion in this review.

There were nine articles that fulfilled all of the inclusion criteria (Table 1, Appendix 3): Two articles, by Bowen et al. (2012) and Keynejad et al. (2013) were unpublished at the time of review but have been subsequently published. In order to answer the hypothesis, the remainder of this section will employ the BEME QUESTS method, in a modified order, to form a narrative-synthesis of the Quality, Utility, Extent, Strength, Target and Setting of the evidence.

Setting

Five papers were from the discipline of medicine and were undertaken in Australia, Peru, United Kingdom and Somaliland. Of these two were undergraduate, one was postgraduate and two were mixed. Four papers were from the discipline of pharmacy and were all performed in the USA. Of these two were for undergraduate and two for postgraduate students.

Four papers by Bowen et al. (2012), Finlayson et al. (2010), Keynejad et al. (2013) and Zolfo et al. (2010), involved investigators from a different nation to the subjects. This has the potential to introduce cultural bias, but it is also interesting for educators hoping to use social-networking for distance learning in resource poor countries.

There was a poor description of demographics by authors. Regarding the age of participants, only four authors gave information (Gray et al. 2010; Zolfo et al. 2010; Cain & Policastri 2011; Keynejad et al. 2013). The participants in three papers had mean ages in the twenties. Only Zolfo et al. (2010) described a group of older participants (median age 48.5).

The papers described a mix of blended and purely distance-learning. All four pharmacy-education papers described using social-networking for delivering blended learning. All five medical papers used purely distance-learning methods. These case-studies provide a heterogeneous mix of examples where social-networking has been used.

Utility of the evidence

Six of the papers described using free web-based resources: Facebook and Twitter. Using free web-based software should be of interest to educators, especially those wanting to implement distance-learning modules in resource-poor countries. Three papers, by Bowen et al. (2012), Finlayson et al. (2010) and Keynejad et al. (2013), described the use of a custom-made website MedicineAfrica (<http://www.medicineafrica.com/>). This website supports undergraduates in low-

Table 1. Setting, media and participants.

Citation	Setting and social-network	Participants
Bowen et al. (2012)	Somaliland. MedicineAfrica.com, Pure distance learning.	35 participants: 11 second year interns, 17 first year interns and 7 final year medical students. 15 (43%) were female.
Cain and Policastro (2011)	USA. Facebook. Blended learning.	128 third year undergraduate pharmacy students. <i>74 (58%) female, 114 (89%) Caucasian, mean age 24.</i>
Estus (2010)	USA. Facebook. Blended learning.	30 third year <i>postgraduate</i> pharmacy students.
Finlayson et al. (2010)	UK & Somaliland. MedicineAfrica.com Pure distance learning.	40 (UK) & 13 (Somaliland) fourth-year undergraduate medical students.
Fox and Varadarajan (2011)	USA. Twitter. Blended learning.	143 <i>2nd year postgraduate pharmacy students.</i>
Gray et al. (2010)	Australia. Facebook. 4 Case-studies of organic, student led e-learning.	1223 undergraduate medical students (years 1, 2, 5 & 6) Median age 21, 52.2% female. 6 students for focus groups, five male, one female.
Keynejad et al. (2013)	UK & Somaliland. MedicineAfrica. Pure distance learning.	24 (UK) & 20 (Somaliland): third, fourth & fifth year, psychiatry, undergraduate medical students. Mean age 24 years.
Vincent and Weber (2011) ¹⁷	USA. Facebook. <i>Blended learning.</i>	30 <i>undergraduate doctors of pharmacy students</i> enrolled in elective course.
Zolfo et al. (2010)	Peru. Facebook. Pure distance learning. Mandatory use of a smart-phone.	20 practicing, post-graduate, physicians working in HIV medicine. Median age 48.5 years. <i>8 (40%) female</i>

Information in italics gained from contacting authors.

income countries and is based on social-networking concepts in order to recreate the clinical bedside teaching experience. All papers, except Zolfo et al. (2010), described the use of social-networking websites via personal computers. Zolfo employed smart-phones to engage physicians in HIV clinics in Peru.

The interventions used in each paper were variable (heterogeneous) and because of the highly specific nature of the content, format and participants found in each would be difficult for other educators to know if using similar interventions in another environment with different students would be effective. However, together, these case-studies provide evidence of social-networking sites being used for educational purposes from four different continents and from two different disciplines for both undergraduate and postgraduate studies.

Target (Outcome measures)

To appraise the outcome measures, we used Hammick's modified Kirkpatrick hierarchy (Hammick 2000). In all nine papers the authors assessed satisfaction (level 1): four papers used solely a survey, with five papers describing the use of a survey and a focus-group. In addition to learner satisfaction, one paper (Cain & Policastro 2011) described assessing acquisition of knowledge (level 2b). This was done by adding bonus questions into examinations and found that scores were higher in those participants who had engaged with their Facebook group.

Gray et al. (2010) reports four case studies where Facebook has been used organically/informally by students. Organic/informal use is initiated by students themselves to address

individual learning needs. Though this study is limited in the sense that the investigators were unable to assess a specific outcome measure, it highlights that students are initiating and engaging in using social-networking when investigators are not watching (Gray et al. 2010).

Quality

All nine articles in this review were of level 4 (evidence based on case-studies) of Harden's continuum of evidence in BEME (Harden et al. 1999). None of the papers used a control group at project conception. Cain and Policastro (2011) did create a quasi-experimental control group made up of subjects who did not enrol in their Facebook group during a blended learning pharmacy module. However, comparing these groups will be limited by confounders, e.g. did the Facebook users score higher because higher-caliber students engaged with the group, etc. As there was not an appropriate, randomized, control group, it is difficult to know the exact cause for these statistically higher exam scores.

None of the studies adequately described their data-collection methods, omitting a description of the data-collection instrument, method of data-collection and whether the instrument was properly developed, piloted and/or tested. Only two papers, those by Estus (2010) and Gray et al. (2010), adequately described steps to establish the validity, reliability and generalizability of their findings.

Standardization, piloting and the method of data-collection are all important when undertaking surveys to ensure validity (Choi & Pak 2005). The ideal would be to deliver an anonymous, paper-based, standardized and piloted survey

questionnaire to a random sample of students and gaining a high response-rate of completion. None of the articles met this ideal. None were randomized, eight were anonymous, three were paper-based, four standardized and four piloted. The response rate varied from 40% to 93%. Considering all these findings one therefore has to raise questions regarding the internal validity of these papers, with all being subject to sampling and recall bias. All these papers used satisfaction questionnaires and are therefore subject to social-desirability bias. This is the tendency to report answers in a manner that will be viewed favorably by others, including investigators. Gray et al. (2010) found evidence for this, in that students under-reported their use of social-networking sites for educational purposes.

Extent – What is the extent of the evidence?

Together these nine papers describe 640 subjects engaged in social-networking, across two disciplines, in four continents. Due to the heterogeneity it was not possible to combine the data into a meta-analysis. There were two themes commonly running through the papers: firstly, satisfaction with social-networking, and secondly, the extent of engagement with social networking.

Regarding satisfaction, eight papers reported positive satisfaction amongst learners. Five of these were directly related to the use of social-networking. The remaining three received tangential positive feedback, e.g. “being able to study independent of time constraints” (Zolfo et al. 2010), “it was better than official learning platform” (Gray et al. 2010) or “it was better than using email” (Finlayson et al. 2010). Interestingly two papers within pharmacy, by Estus (2010) and Vincent and Weber (2010), had very similar subjects and methods, yet had very conflicting satisfaction results. Estus (2010) received very positive feedback with 93% of subjects finding the activity valuable. Vincent and Weber (2010), on the other hand, reports very negative feedback from learners with the authors abandoning the module because of high drop-out rates from the module. 91% of those students who dropped-out reported that Facebook is what they liked least about the module (Vincent & Weber 2010).

Regarding engagement with social-networking, all nine papers report case-studies of students engaging with social-networking sites. Only two papers reported the activity of students within the social-networking sites employed. Cain and Policastro (2011) found that the majority (52%) of students read less than 25% of posts, despite high satisfaction with using Facebook. Fox and Varadarajan (2011) reports a high level of posts made by students, however it needs to be borne in mind that it was mandatory for students to make 10 posts during the module. Three papers reported previous Facebook use. Zolfo et al. (2010) reports that 20% of practicing Peruvian post-graduate physicians had used Facebook compared to 86% and 100% of undergraduate students in Gray et al. (2010) and Estus’ (2010) papers, respectively. Gray et al. (2010) was the only author to describe previous use of social-networking for educational purposes, with 25% of students reporting that they had used social-networking for educational purposes.

Issues of professionalism have been raised regarding the use of social-networking sites for educational purposes. None of the articles reported any issues in this area. We contacted the authors and none reported that there had been any issues regarding professionalism. One author, Bowen et al. (2012), reported a tendency by interns to post identifiable patient information that may be considered unprofessional in the UK but appeared culturally acceptable in Somaliland. Within the social-networking arm of the MedicineAfrica (Bowen et al. 2012) website there were no issues regarding professionalism.

Strength – How strong is the evidence?

Eight papers were descriptive and did not employ statistical measures. Cain and Policastro (2011) appropriately used an independent *t*-test, in a quasi-experimental fashion, to compare the examination scores of those students who did and did not use the Facebook group. Cain and Policastro found a significant ($p < 0.001$) increase in the scores of those students who were members of the optional Facebook group.

However, lack of statistical significance does not mean that the other eight papers are not significant. The strength of the evidence was graded using Hammick’s grading of evidence for BEME. Due to the methodologies employed, the strength was generally poor (levels 1–3) and none of the papers were unequivocal.

Discussion

In exploring the relationships within and between studies, this systematic review aimed to answer two important questions. The first question is whether social-networking sites have been used successfully in medical education to deliver educational material. Success would be describing an intervention that had resulted in a change high on the Kirkpatrick hierarchy (e.g. a change in behaviour or practice) as proved by a study of high quality and strength (e.g. a randomised control trial). This however takes an idealistic view of medical educational research. Though this review describes studies with outcome measures low on the Kirkpatrick hierarchy, it does reveal eight examples where social-networking was well received by students, with only one receiving negative feedback. The very nature of social-networks makes it difficult to “deliver” educational material as the content is not didactic and relies on the collaborative engagement of participants.

Secondly, we asked if healthcare professionals, and students, have engaged with Social-networking sites for educational purposes. Certainly studies reported positive engagement with educator led social-networking in different medical disciplines, at different levels of training and in different continents. These give an interesting “snap-shot” of current uses of social-networking by educators. Importantly, for educators with concerns regarding professionalism, no significant issues of this type were raised.

In this review, all papers except one were descriptive in nature. Descriptive studies often represent the first scientific “toe in the water” in new areas of inquiry (Grimes & Schulz 2002). Considering that social-networking sites are a new phenomena, being widely used for only the last decade it is

not surprising that at this stage researching educators are only using descriptive studies to answer questions such as “who, what, why, when and where”. It has been argued that there are problems of measurement and causation in educational research that are not found in other medical fields, and that this may have been the case for researchers investigating the use of social-networking in medical education (Harden et al. 1999).

This is the first review regarding this important subject and it was undertaken in a systematic manner. Bias in data extraction was minimised by a second author verifying the data extracted and the authors of individual papers being sent the data-extraction table for amendment and approval. Regarding its robustness: there is likely to be publication bias as no search was performed of the grey literature, though two unpublished articles were found by contacting included authors. We have shown that only one paper out of nine reported negative findings. This could reflect publication bias with educators only reporting positive outcomes. Social-networking is a recent advancement in web technology and therefore the results are incredibly time-dependent, with new advancements becoming available with increasing frequency.

Conclusions

We have described nine case-studies where social-networking has been employed and positive feedback was received in eight of these without any problems of medical professionalism. Medical educators can therefore be confident in using these resources with their students. However, as educators we not only want to know if students enjoy our material but also whether it is effective in changing knowledge, skills and behaviours. In this respect, these studies did not reveal if social-networking is equally or more effective than other media available for educational purposes.

Declaration of interest: Authors report no conflicts of interest. No funding was sought or gained for undertaking this project.

Glossary

Social-media: “Social Media is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content”

Kaplan A, Haenlein M. 2010. Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons* 53:59–68.

Social network: A form of social-media which is a dedicated website or application which in addition to text-based communication enables users to communicate with each other and share information, comments, messages, videos, images, etc.

Kaplan A, Haenlein M. 2010. Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons* 53:59–68.

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Appendix 1: Data extraction table

Citation
 Author, Journal, Year, Pages
 Social media-used:
 Bebo, Facebook, Friendster, MySpace, Twitter OR Other (state media)
 Study design
 Aims/objectives of the study
 Recruitment procedure for subjects
 Intervention used
 Methodological design used to measure outcome
 Control group
 Yes or no

Q-Quality of the (educational) research

BEME level of evidence (1–6)
 Area and Questions
 Background
 Is the research free of theoretical views already held by the authors?
 If the evidence is based on cited papers, are those papers researched based rather than theory only?
 Are the researchers independent?
 Sample
 Is it large enough for the purpose?
 Could we safely say something about the general case on the basis of this sample?
 Is there a reasonable response rate?
 Is the sample biased in any way?
 Data collection
 Do you know how the data were collected?
 Is the data collection instrument properly described?
 Was the data collection instrument properly developed and piloted or tested?
 Data analysis
 Is the way the data were analysed properly described so that you could do it in the same way?
 Validity, reliability and generalizability
 Did the study try to establish the validity of the data and findings?
 Did the study try to establish the reliability of the data and findings?
 Is the likely generalizability of the study discussed?
 Conclusions
 1. Are the conclusions reached actually born out by the data?
 2. Do the recommendations actually follow on from the findings?
 3. Does the research justify the conclusions? E.g. small numbers in a qualitative study should not merit general conclusions for action.

U – Utility of the evidence

Area and Questions
 1. Can the intervention be transplanted to another situation without adaptation? (external validity)
 2. Are the findings technology dependent (e.g. hardware, software)?
 3. Will number of students affect utility?

E – Extent of the evidence (key results)

1. Unit of assessment/analysis
 2. Key results of study analysis
 3. Additional outcomes (e.g. costs etc)

S – Strength of the evidence

1. Statistical techniques used
 2. Were statistical techniques appropriate?

T-Target or outcome measures (as determined by Kirkpatrick's level of learning.

1. Modified Kirkpatrick's level of learning
 2. How was the outcome measure measured?

S-Setting and participants

1. Country where research primarily performed
 2. Health-care field
 3. Educational level of participants
 4. Total number of participants enrolled
 5. Number of participants included in analysis
 6. Number of withdrawals, exclusions
 7. Age (mean with SD if possible)
 8. Gender of participants
 9. Ethnicity of participants

Appendix 2: Example search strategy (EMBASE)

#1. (social media or social network or social networking or Facebook or Friendster or twitter or MySpace or bebo).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]

Result - 5798

#2. (medical education or education, medical or education, nursing or education, pharmacy or students, health occupations or students, nursing or students, pharmacy or students, medical or students, dental or resident).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]

Result – 209,480

#3. (Online or web or website or internet or education, distance).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]

Result – 127,149

limit 3 to yr="2002-2012"

Result - 100300

4. #1 and #2 and #3

Result – 73 Advanced

Appendix 3: Data Tables

Table A1. Data extraction – Setting, utility, target outcomes and quality of the research.

Citation	S – Setting, media and participants	U – Utility of the evidence	T – Target or outcome measures (Modified Kirkpatrick's)	Q – Quality of the research
Bowen et al. (2012)	Somaliand. MedicineAfrica. Distance learning. 35 participants: 11 2 nd year interns, 17 1 st year interns and 7 final year medical students. 15 (43%) were female.	Custom made website, therefore limited external validity.	Level 1 (survey and focus-groups)	BEME level 4. Observational, descriptive study: Case study (<i>n</i> = 249), focus groups (<i>n</i> = 35) and <i>piloted, standardised, anonymous, paper-based survey</i> (<i>n</i> = 27). No control group.
Cain and Policastro (2011)	USA. Facebook. Blended learning. 128 3 rd year undergraduate pharmacy students. 74 (58%) female, 114 (89%) <i>Caucasian, mean age 24</i> .	Limited external validity due to specific nature of module delivery.	Level 2b (examination results) and level 1 (survey and focus-group).	BEME level 4. Mixed methods: i. Observational, descriptive case-study (<i>n</i> = 100), ii. Observational, descriptive study (<i>non-standardised, piloted, anonymous, paper, survey</i> (<i>n</i> = 128) and focus group (<i>n</i> = 5)). iii. Analytical, cross-sectional, study (<i>n</i> = 128) of examination results (quasi-experimental control group).
Estus (2010)	USA. Facebook. Blended learning. 30 3 rd year <i>postgraduate</i> pharmacy students.	Simple study design therefore good external validity.	Level 1 (survey)	BEME level 4. Observational, descriptive study: Case study (<i>n</i> = 30) and <i>non-standardised, anonymous, survey</i> (<i>n</i> = 28, 93% response rate). No control group.
Finlayson et al. (2010)	UK & Somaliand. MedicineAfrica. Distance learning. 40 (UK) & 13 (Somaliand) fourth-year undergraduate medical students.	Custom made website, therefore limited external validity.	Level 1 (survey and focus-groups)	BEME level 4. Observational, descriptive study: Case study (<i>n</i> = 53), <i>focus groups</i> (<i>n</i> = 2-10) and <i>piloted, non-standardised, survey</i> (<i>n</i> = 16). No control group.
Fox and Varadarajan (2011)	USA. Twitter. Blended learning. 143 2 nd year <i>postgraduate</i> pharmacy students.	Limited external validity due to specific nature of module delivery.	Level 1 (survey)	BEME level 4. Observational, descriptive study: Case study (<i>n</i> = 143) and <i>non-standardised, anonymous, electronic survey</i> (<i>n</i> = 131, 92% response rate). No control group.
Gray et al. (2010)	Australia. Facebook. 4 Case-studies of organic, student led e-learning. 1223 undergraduate medical students (years 1, 2, 5 & 6) Median age 21, 52.2% female. 6 students for focus groups, five male, one female.	Indirect utility for educators as all four case-studies were organically created by students and not by educators.	Level 1 (survey and focus-groups)	BEME level 4. Mixed observational, descriptive methods: i. <i>Standardised, anonymous, paper, survey</i> (<i>n</i> = 759, response rate 62.1%), ii. structured interviews (<i>n</i> = 6). iii. case-series of four groups (<i>n</i> = 140, 30, 10 & 5). No control group.

Keynejad et al. (2013)	UK & Somaliland, MedicineAfrica. Distance learning. 24 (UK) & 20 (Somaliland): 3 rd , 4 th & 5 th year, psychiatry, undergraduate medical students. Mean age 24 years.	Custom made website, therefore limited external validity.	Level 1 (survey).	BEEME level 4. Observational, descriptive study: Case study ($n = 44$) <i>piloted, standardised, anonymous, electronic-survey</i> . 98 questionnaires completed (57 by UK, 41 by Somaliland), during module. No control group.
Vincent and Weber (2011)	USA. Facebook. <i>Blended learning</i> . 30 <i>undergraduate doctors of pharmacy</i> students enrolled in elective course.	Limited external validity due to specific course design.	Level 1 (survey)	BEEME level 4. Observational, descriptive study: Case study ($n = 30$) and <i>non-standardised, anonymous, online</i> survey of subjects who dropped out ($n = 12$, response rate 40%). No control group.
Zolfo et al. (2010)	Peru. Facebook. Distance learning. Mandatory use of a smart-phone. 20 practicing, post-graduate, physicians working in HIV medicine. Median age 48.5 years. 8 (40%) female.	Limited external validity. Hardware dependent as subjects used smart-phones.	Level 1 (survey and focus-group)	BEEME level 4. Observational, descriptive study: Case study ($n = 20$) and standardised, <i>anonymous, survey</i> ($n = 18$, 90% response rate). No control group.

Information in italics gained from contacting authors.

Table A2. Data extraction – Extent and strength of the research.

Citation	E - Extent of the evidence (key results)	S – Strength of the evidence (Hammick grade of evidence)
Bowen et al. (2012)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. Cases appraised on a 1-5 "star-rating". Mean star rating = 4.4. 2. 19 (76%) of 25 subjects agreed or strongly agreed that "the clinical teaching in the past year has improved my clinical practice". <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 3. All subjects had access to computers and were computer and Internet literate. 4. 126 tutorials, encompassing 102 cases and 778 medical images, delivered over 16 months, covering 6 medical specialities. 249 users registered on the site. 5. 3 (12%) of 25 agreed or strongly agreed with "I regularly share cases with other users over the internet". 	Descriptive analysis. No statistical analysis performed. (Grade 3)
Cain and Policastri (2011)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. 77% ($n = 77$) regarded the activity as being very or somewhat valuable. 2. Survey and focus-group highlighted positivity regarding uniqueness of the project. <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 3. 52% ($n = 52$) read 25% or less of the posts. 25% ($n = 25$) read 75% or more of the posts <p>Other:</p> <ol style="list-style-type: none"> 4. An independent t-test revealed a significant increase in exam scores in participants who engaged with the Facebook group. 5. Focus group revealed that it was paramount that the activity was optional to maintain students' interest in the activity. 	Statistically significant increase in examination scores in Facebook participants (independent t-test, $p < 0001$) compared to non-participants. (Grade 3)
Estus (2010)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. 93% ($n = 26$) of respondents agreed or strongly agreed that the Facebook activities were valuable. <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 2. 96% ($n = 29$) of subjects checked their personal Facebook account several times weekly compared to 24% ($n = 7$) for the module (academic) Facebook group. 3. All 30 subjects already had Facebook accounts and actively engaged. <p>Other:</p> <ol style="list-style-type: none"> 4. Stimulated discussion regarding appropriateness of content posted on their own Facebook profile. 	Descriptive analysis. No statistical analysis performed. (Grade 3)
Finlayson et al. (2010)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 6. 75% ($n = 12$) of UK students reported that using the website was better than just working by email. 7. Students demonstrated a strong preference of clinical bedside teaching over didactic teaching and static information resources. <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 8. Developed into a weekly teaching session rotating between different specialities. <p>Other:</p> <ol style="list-style-type: none"> 9. Collaboration between different nations strengthened partnerships in which both parties benefited. 	Descriptive analysis. No statistical analysis performed. (Grade 2)
Fox and Varadarajan (2011)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. 82% indicated that Twitter facilitated sharing of ideas among the class 2. 71% indicated that Twitter distracted them from course discussions and prevented them from taking notes as thoroughly as they wanted <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 3. 1775 tweets made by 143 students during the module. 4. Only 2% ($n = 3$) did not complete the 10 tweets "required" during the module. <p>Other:</p> <ol style="list-style-type: none"> 5. 81% indicated that it allowed them to express an opinion when they would not have otherwise done so in class. 	Descriptive analysis. No statistical analysis performed (Grade 3)

(continued)

Table A2. Continued.

Citation	E - Extent of the evidence (key results)	S - Strength of the evidence (Hammick grade of evidence)
Gray et al. (2010)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. Facebook was more appealing than the students' university Learning Platform as it was simpler and easier to use. <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 2. 87.0% ($n = 660$) had used Facebook. 90.5% ($n = 687$) accessed it weekly or more often. 25% ($n = 194$) had used Facebook for educational purposes. <p>Other:</p> <ol style="list-style-type: none"> 3. Students under-reported their use of Facebook for educational purposes. 4. All case studies were student led 5. No educators were invited to join the groups. 6. Facebook features, aimed at socialising, could distract students from studying. 	Descriptive analysis. No statistical analysis performed. (Grade 3)
Keynejad et al. (2013)	<p>Learner satisfaction (on 5 point scale):</p> <ol style="list-style-type: none"> 1. "how much did you enjoy today's session?" – mean 4.23 2. "how much did you find this session academically helpful?" – mean 3.48 <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 3. * of 24 pairs who completed at least one session, * completed the expected 10 sessions. <p>Other:</p> <ol style="list-style-type: none"> 4. 63% of respondents reported knowledge of psychiatry as the most significant thing gained. 	Descriptive analysis. No statistical analysis performed. (Grade 3)
Vincent and Weber (2011)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. 91% ($n = 11$) listed Facebook as one of the aspects they liked least about the elective. 2. Students commented that Facebook was for enjoyment and not homework <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 3. 73% ($n = 22$) dropped out of this elective course delivered via Facebook. 45% <i>listed the use of Facebook as a reason for dropping out.</i> 	Descriptive analysis. No statistical analysis performed. (Grade 1)
Zolfo et al. (2010)	<p>Learner satisfaction:</p> <ol style="list-style-type: none"> 1. 94.4% ($n = 17$) indicated that access to the educational content without a computer was an added value. 2. 88.6% ($n = 16$) gave positive feedback regarding the freedom to plan educational activities according to their personal agenda. 3. 88.9% ($n = 8$) of the iPhone respondents found it easy to access Facebook via mobile. <p>Engaging with social-networking:</p> <ol style="list-style-type: none"> 4. 20% of subjects had previously used Facebook. 	Descriptive analysis. No statistical analysis performed. (Grade 2)

Information in italics gained from contacting authors.