SUBMITTED 1 FEB 21
REVISION REQ. 18 MAR 21 REVISION RECD. 16 APR 21
ACCEPTED 24 MAY 21
ONLINE-FIRST: AUGUST 2021
DOI: https://doi.org/10.18295/squmj.8.2021.114

Can Medical Students Evaluate Medical Websites?

A mixed-methods study from Oman

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Abstract

Objectives: Medical students and practitioners need to evaluate medical information found on the Internet. Most current medical students are familiar with the Internet, but their ability to evaluate material may require additional skills. We aimed to discover the extent to which medical students can evaluate medical websites, criteria used, factors affecting their abilities, and whether a teaching intervention could rectify problems. ***Methods*:** A class of 181 undergraduate medical students evaluated an unreliable medically-related website, received a teaching intervention on web site evaluation criteria, and re-evaluated the same site. ***Results*:** A total of 149 (82.3%) students participated. Students spent a mean of 4.69 hours per day on the Internet; there were no significant correlations between demographic indicators and Internet time. On Likert Scales of 1-10, students' scores ranged from 5-6, with no significant differences between the pre- and post-evaluations, except increased polarisation away from the mean. Qualitative comments indicated an awareness of relevant criteria, but an overall inability to critically apply them. ***Conclusion*:** The results indicate that one cannot make a blanket statement about medical students' ability to evaluate medical websites, in spite of technological familiarity. The indications are that website

evaluation should be viewed primarily from the information perspective, and that critical thinking ability may play a major role. Because of these overriding factors, short interventions are unlikely to have an impact, and other educational strategies should be developed. These are necessary to ensure that medical students can function independently as life-long learners and medical professionals.

Keywords: Internet; Students, Medical; Oman

Advances in Knowledge

- Medical and Basic Sciences' students at SQU do not appear to have the skills required for appropriately evaluating the trustworthiness and value of medically-related information.
- A single intervention that identifies and teaches criteria has mixed results.
- Part of the reason for the mixed results may be due to a lack of critical reasoning skills that should have been developed during schooling.

Application to Patient Care

- Healthcare professionals need to keep abreast of new information so that they may deliver high-quality healthcare.
- Currently, without traditional knowledge gate-keepers, healthcare professionals must rely on their own ability to appropriately critically evaluate new information.
- The inability among Medical and Basic Sciences' students to perform this evaluation alerts us to the need for some form of systematic training in order to develop these evaluation skills.

Introduction

In the 21st century, the Internet is an essential source of medical information for medical practitioners, students and patients.[1-5]

The problem with the Internet, however, is that it contains *so much* information, and distinguishing good (e.g. accurate, evidence-based and appropriate) from bad (e.g. inaccurate, unsubstantiated or inappropriate) is time-consuming and difficult.[6]

Before the Internet, medical practitioners and students relied on librarians as information gate-keepers; for Internet information, many human gate-keepers have been removed. Physicians rely on medical search engines (e.g. PubMed) or broader search systems (e.g. EBSCOHost) to perform gate-keeping, and most medical practitioners mainly use general search engines like Google.[7,8] These physicians then need to critically appraise and evaluate information they have found.[8]

Experienced physicians can rely on their own medical expertise and experience to determine information accuracy, but information changes, and medical students and newly-qualified physicians do not always have the required knowledge and expertise.[9,10] Medical educators are concerned about medical students' ability to critically analyse and review literature.[8,11,12] Studies of these skills frequently focus on theoretical aspects, and not on students' applying these skills.[10,12] Development of these skills requires the ability to critically evaluate and appraise literature[13] and the need to teach these skills has been recognised since at least 2009 by the UK's General Medical Council.[14]

Students' familiarity with computers and the Internet may not translate into their being able to appropriately handle information from the Internet. Just as knowing how to read and write does not necessarily mean knowing how to read and write for *academic* and medical *research* purposes, knowing how to use the Internet does not necessarily mean knowing how to use it for academic, research or medical work: other skills may be needed. Even if students are familiar with the technology, one should not assume they are able to reliably evaluate websites, so that they can quickly filter out unreliable sites for themselves.

There is no set of internationally-recognised website evaluation criteria.[8] Although there is the HONCode system (https://www.hon.ch/HONcode/) and several guides, a widely-cited and popular system is Jim Kapoun's five criteria: *Accuracy*, *Authority*, *Objectivity*, *Currency* and *Coverage*.[15] Kapoun's criteria cover most issues of concern on any website (indeed, any document), and form a simple and short list ideal for introducing students to the required skills for Internet information evaluation.

Given that the literature above has identified the need to understand and develop medical students' ability to critically analyse textual information, and so much of their information is unfiltered from the Internet, this study attempts to answer three research questions: (1) Prior to any teaching, to what extent can undergraduate medical students evaluate the quality of a medically-related site, and on what criteria do they base their evaluation? (2) Is their evaluation related to prior computer or other experience? (3) After receiving basic instruction on web-site evaluation, how would this new knowledge affect their ability to evaluate the same website?

Methods

This mixed-method study was conducted at Sultan Qaboos University (SQU), Oman from September to December 2018, among the 181 Medical and Basic Medical Sciences' students taking the Medical Informatics I course. Students were taught in three sections, on three consecutive days, by the same teacher, in the same venue, using the same notes and methods.

As part of their Medical and Basic Medical Sciences' undergraduate degrees, students complete a semester-long Medical Informatics course. Highlighting and teaching website evaluation basics is a part of the course. These students have usually come straight from school, and may have attended a foundation year at the university which included computer literacy. Some are in their first semester, and others are in their third.

A US-based, health-related website was used. The sites' identity was disclosed for ethics approval, and is available upon request.

The site is publicly-visible, containing health-related information with superficial indicators of authenticity: the name is the "Global [medical procedure] Institute", it offers access to text-books with medical titles, the topics on the site are medically-related, it claims to contain open and uncensored information on these medical topics, and the "About us" link describes the Institute's history.

Closer inspection reveals problems: The site contains no physical address, no identity nor qualifications of the site's authors or owners, and it is a publishing house. On the "About Us"

page, only when clicking on a single "Disclaimer" link, one finds that the information on the site is for "educational and informational purposes only" and is not to be taken as medical advice, that all data on the site should be verified, that the site is not endorsed by "the American Academy of Pediatrics, the FDA, CDC or any other federal, state or 'official' organization", and does not carry HONCode or any similar certification. Finally, the disclaimer's last line says that the site's authors are not medical practitioners. All this information is buried away from the front page.

No medical knowledge is required to determine the site's information reliability.

We created an electronic questionnaire for the students to complete (See Appendix 1) anonymously through their Learning Management System (LMS). In addition to students' demographic data, the questionnaire was based partially on previous research that had examined students' ability to create mobile apps,[16] and asked about previous IT and health sciences' education and training (in the questionnaire, we included examples), experience as a programmer, electronic device usage, and hours per day on the Internet. We felt that asking about a broad spectrum of experience would allow us to identify any experiential subtleties that may impact on students' ability to evaluate the site.

For students' perception of the website, we asked three Likert Scale questions (0-10) on the site's trustworthiness, whether they would recommend the site to a patient, and the site's overall quality. Finally, a free-text question asked for the reasons and criteria behind the answers to the questions regarding the site's quality.

The overall process followed the standard, established format of pre-test, single intervention (with practice) and post-test commonly performed in clinical and non-clinical medical education and training interventions.[17,18,19]

The process was as follows: (1) Students were directed to the website, and explored it for 10-15 minutes. (2) Students completed the anonymous (using temporary identifications) questionnaire, including a consent form. (3) The teacher didactically taught the students Kapoun's evaluation

criteria.[15] This took approximately 45 minutes, and focused on his criteria and related questions, as given by Kapoun (p. 523). The students were given notes so that they could refer to them during the evaluations described below. (4) Students worked in pairs or threes evaluating a different website on which to practice their new skills (they chose a site from a list that excluded the site listed in Step 1 above). (5) After feedback and discussion about their practice websites, the students re-evaluated the original website, and completed the second questionnaire, which asked only for the identifying code and the same site evaluation questions.

Comparisons were performed on the data to track any changes in students' perceptions between pre- and post-teaching.

Data were included only if students completed both the pre-and post-evaluation questionnaire and consistently identified themselves with their temporary usernames.

Quantitative raw data were captured into Microsoft Excel 2016 by one researcher [*Initials redacted for reviewing purposes*] and statistical tests performed. A second researcher [*Initials redacted for reviewing purposes*] independently performed the same statistical tests with SPSS (Ver. 25). The results were inspected and verified by all researchers.

Quantitative data were normally distributed (Kolmogorov-Smirnov test). Means, standard deviations and frequencies were calculated. For significant differences regarding age, ANOVAs were conducted. In order to evaluate pre- and post-testing, t-tests for dependent samples were used. For correlations, Pearson correlations were run. Associations between variables (based on information from the literature) and differences regarding the evaluations were tested. A difference was considered statistically significant at $P < 0.05$.

Qualitative data were themed by one researcher [*Initials redacted for reviewing purposes*] with QDA Miner Lite (Ver. 2.0.6) using Kapoun's five criteria: *Accuracy*, *Authority*, *Objectivity*, *Currency* and *Coverage*. The comments were subjectively classified as "Negative" or "Positive", based upon the attitude expressed. Themes and raw data were inspected and verified by the other researchers. As many students also referred directly to whether or not they would

recommend the page to patients, this theme was added. Finally, students made more general comments on design and security, so an *Other* theme was added.

Ethics approval for the study was obtained from [Institution Redacted for Reviewing purposes].

Results

Of the 181 registered students, 149 (82.3%) completed the study.

Of the 149 students, 70 (47.0%) were female, 69 (46.3%) were male, and 10 (6.7%) did not indicate their gender. The sample's gender proportions were not statistically different from the class population's (p = 0.100). Age ranged from 17 – 21 years (Mean 18.86 years (SD 0.80)).

To answer Research Question 2, we gathered information about students' prior training: 12 (8.1%) had health-related, 23 (15.4%) had IT-related, and 29 (19.55%) had programming experience.

On average, students spent 4.69 hours on the Internet per day. Table 1 shows the data in more detail.

These figures are typical of international student usage, as a 2018 EDUCAUSE study found that 40% of students spent 3-4 hours a day working online.[20]

There was no correlation between hours spent on the Internet and age (r=0.079, p=.340) or gender (p=.513).

On average, students spent 22.35% of their Internet time on health-related searches. There were no significant differences of hours on the Internet based on age or gender (Mmale = 19.00 (SD = 0.77); Mfemale = 18.7 (SD = 0.83, p = .069).

To answer Research Questions 1 and 3, we obtained students' pre- and post- intervention Likert Scale scores, and reasons for their scores. Table 2 shows students' evaluation pre- and post-intervention mean results, and differences.

Two important details stand out in these figures: Firstly, on the Likert scale of 1-10, students rated the sites slightly above average. Secondly, there was no significant change for ratings between the pre- and post-intervention.

These means, however, hide important information on the results' distribution. Figure 1 shows students did not merely give the same answers pre- and post-intervention, and there was a tendency towards score polarisation, with shifts in score increases and decreases.

Table 3 shows how many students provide higher scores, lower scores and same scores, and we see this polarisation again.

This indicates that, while many students adjusted their ratings correctly after the intervention, many changed their ratings in the opposite direction. This polarisation is obscured by the nominal shift in the mean scores.

To answer Research Question 2, we tested for associations between the other variables and the scores allocated for these questions.

No demographic or activity variables (age, gender, amount of IT training, health training, hours on the Internet, or usage of the Internet for health-related searches) was associated with any scores (all $p > .05$).

As the qualitative data were themed according to Kapoun's criteria, the data have been laid out in that format.

Table 4 and Table 5 shows the number of Pre- and Post- comments and examples for each theme.

Under "Other," students had 54 negative and 46 positive comments, many of which were unspecific comments about its being good quality or bad quality or unattractive, not secure, boring or indications that it was merely personal opinion.

In addition, 15 students commented that they did not have the knowledge or expertise to comment properly on the site.

In total, students had 134 (53.2%) negative comments and 118 (46.8%) positive comments. Of these, 80 (59.7%) of the negative comments and 72 (61.0%) of the positive comments aligned with Kapoun's criteria or were aimed at the site's value to patients.

Under "Other," students had 40 negative and 47 positive comments. In total, students had 245 (54.20%) negative comments and 207 (45.80%) positive comments. Of these, 205 (83.7%) of the negative comments and 160 (77.3%) of the positive comments aligned with Kapoun's criteria or were aimed at the site's value to patients.

Discussion

This study examined medical students' ability to evaluate websites, particularly as they would be expected to do so in the absence of traditional librarian gate-keepers. Students evaluated a website, received a teaching intervention, and then re-evaluated that same website. We could not find examples of a comparative exercise in the literature. The closest were those that test students on reputable or well-controlled sites (e.g. Tannery *et al.*[21]), or in which students self-select a broad range of sites and comment on them (e.g. Ghezzi *et al.*[8]). In our case, we chose a highly questionable website to determine whether or not the students could identify the problems. The choice of a single site (rather than multiple) allowed a more comprehensive view of the site across the full sample of students. While the broad results indicate a positive view of the site, a more detailed evaluation of the data reveals other subtleties, and indicates that universal statements on current medical students' ability to evaluate websites should be treated carefully.

The three research questions:

Prior to any teaching, to what extent can undergraduate medical students evaluate the quality of a medically-related site, and on what criteria do they base their evaluation?

Although students had more negative than positive comments, their overall rating was positive. Figure 1a shows this positive tendency, but it also shows a disparity across the student population, a mixed ability, and that one cannot make a blanket statement about their evaluation ability.

The high percentage of alignment between student comments and Kapoun's criteria is encouraging; discouraging, however, is the high number of positive comments: this indicates that, even though students are aware of the criteria, their ability to match the case to the criteria is not optimum.

These results extend researchers' arguments that these skills are necessary for medical students;[10-13] our research demonstrates the extent to which these skills are lacking among these students.

Is their evaluation related to prior computer or other experience?

Previous studies have shown an association between familiarity with one technology leading to ease of use with another technology.[16,22-24] In this study, we found no association between familiarity with the technology and ability to evaluate web pages, or to improve in that ability. This matches the argument that teaching students the mechancis of using acadmeic and medical search engines is part of the solution only; "the problem remains on how to educate students to critically evaluate information obtained using popular search engines."[8]

As there was no correlation between health-related training and evaluation scores, it is apparent that these have no bearing on students' ability to evaluate websites.

After receiving basic instruction on web-site evaluation, how would this new knowledge affect their ability to evaluate the same website?

Looking at mean scores only, it appears the teaching event had no impact; the polarisation, however, indicates that the criteria are not necessarily being correctly applied.

So, the answer to this question is that students demonstrated a greater awareness of the criteria taught, and, while many applied the criteria correctly, many applied the criteria incorrectly.

This situation appears to echo a common complaint from clinical teachers that many students are able to rattle off rote-learnt lists of conditions, but, when faced with a patient, are unable to match the patient to the lists and arrive at a diagnosis. This indicates that broader critical thinking skills need to be considered, and these are derived within a broader educational and sociological context.

On reflection, the lack of association between technological prowess level and website evaluation may not be entirely surprising. As noted in the Introduction, the reason is that the skillsets required for each may be different, and we would be mistaken if we considered a web page only as a technological entity rather than information requiring critical thought and evaluation.

Whether one uses Kapoun's criteria or any other system, we are considering critical evaluation of information, and the required skills for this have little to do with technology familiarity: these have to do with critical insights, reasoning and evaluation skills. An examination of students' critical thinking skills may, indeed, point to the reasons behind students' poor evaluation ability.

A 2003 United Nations (UN) Report on development in the Arab World reported a severe lack of critical thinking skills among school-leaving Omanis.[25] Since then, Oman higher education institutions have attempted to measure and address problems. Unfortunately, follow-up studies indicate Omani university students' critical thinking, interpretation and evaluation scores are significantly below international standards.[26-28]

As evidenced from the literature cited in the Introduction, critical thinking and critical appraisal skills are essential for medical students, cannot be assumed, and need to be developed.[10,11,13] In this study, the causes of the poor critical thinking skills are likely to be from a poor schooling system: the UN report argues: "the curricula taught in Arab countries seem to encourage submission, obedience, subordination and compliance, rather than free critical thinking. In many cases, the contents of these curricula do not stimulate students to criticise political or social axioms. Instead, they smother their independent tendencies and creativity".[25] Echoing Dickens' *Hard Times*, the report goes on to say: "Generally speaking, the assigned curricula, starting from preliminary school or even before, embody a concept that views education as an industrial production process, where curricula and their content serve as moulds into which fresh minds are supposed to be poured…. Students can do little but memorise, recite and perfect rote learning".[25]

So, when considering medical students' ability to evaluate a web page, the results of this study point to the influence of factors much wider than knowledge, and certainly in need of correction on a more profound level than can be accomplished by a single intervention. Further research, assessing critical thinking skills and the relationship to this evaluative ability would be required for a more definitive understanding of these factors.

The main limitation to the study is that it was conducted in a single year on one group of students, and there is no knowledge about the long-term impact of the teaching, which could be studied in follow-up research.

Conclusion

This study has found that these undergraduate medical students' ability to evaluate the quality of health-related websites is mixed. Further, prior exposure to, and use of, the technology has no bearing on this ability. A single intervention has limited and mixed impact, possibly as a result of poor prior critical thinking skills. Given that medical students and health professionals increasingly rely upon websites and other information sources that are unfiltered through quality control, it is recommended that training and practice of the required skills be reinforced.

Conflict of Interest

The authors declare no conflicts of interest.

Funding

No funding was received for this study.

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Table 1: Hours spent on the Internet Per Day

Hours	n	Percentage
< 1	1	0.67
1-2	17	11.41
3-4	65	43.62
5-6	37	24.83
7-8	20	13.42
9-10	6	4.03
11-12	3	2.01
TOTAL	**149**	**100.00**

Table 2: Pre- and Post-Intervention Means N=149

Questions	Pre-Intervention		Post-Intervention		Difference
	Mean	SD	Mean	SD	*P*
How trustworthy would you judge the webpage?	5.60	2.50	5.45	2.98	0.471
How likely would you recommend this webpage to a patient?	5.28	2.60	4.95	2.82	0.105
How would you judge the quality of the webpage?	5.30	2.50	5.36	2.79	0.757

Table 3: Changes in scores N=149

Questions	Lower		Equal		Higher	
	n	%	n	%	n	%
How trustworthy would you judge the webpage?	59	39.6	43	28.9	47	31.5
How likely would you recommend this webpage to a patient?	62	41.6	48	25.5	39	32.9
How would you judge the quality of the webpage?	60	40.3	37	24.8	52	34.9

Table 4: Theme, Rating (Negative or Positive), Number of Comments and Examples *before* the teaching intervention

Theme	**Rating**	**n**	**Examples (No language editing applied)**
Accuracy	Negative	12	*[N]ot all information in the site are correct. some information need more statistics [#60]*
	Positive	2	*[T]he article and studies help to have more accuracy [#15]*
Authority	Negative	22	*They have not mentioned their level of education or the field they are working in.[#95]*
	Positive	27	*The web page has a lot of references where you know that the information are true and right and know from where they got the information.[#5]*
Objectivity	Negative	11	*[T]he website uses false information to promotes the sales of his book .... the reason for that website is not to help further the medical research domain but for commercial reasons. [#59]*
	Positive	0	
Currency	Negative	6	*The articles are old. So, its information may had changed and not updated. [#65]*
	Positive	0	
Coverage	Negative	3	*It is true that this website have a large information about vaccination but that does not mean that it have everything we need to know [#55]*
	Positive	11	*[I]t gives access to pdf's that help a person with their inquiry and provides alternatives for your problem.[#101]*
Approp. Pts	Negative	26	*Some patient will misunderstand the information because the do not havr enough knowledge [#149]*
	Positive	32	*[T]his webpage is useful and make the patient life more easily because it has the necessary information and data for make the right decision [#30]*

Table 5: Theme, Rating (Negative or Positive), Number of Comments and examples *after* the teaching intervention

Theme	Rating	n	Examples (No language editing applied)
Accuracy	Negative	23	*First point is the accuracy .. the site promotes false information [#59]*
	Positive	29	*[V]ery good website with a high accuracy. [#14]*
Authority	Negative	63	*[I]t does not provide secure information, from trust sources [#109]*
	Positive	59	*[A]ll the information have a reference and copy right which varify information. [#89]*
Objectivity	Negative	54	*[I]t is looks like an advertisement [#50]*
	Positive	12	*This website is a good website because it is accurate and objective [#85]*
Currency	Negative	27	*[N]o updated studies, most of them are old. [#32]*
	Positive	17	*[I]t was updated recently [#17]*
Coverage	Negative	21	*[T]he coverage looks incomplete, there are no sources given. [#1]*
	Positive	24	*[T]here are sources for additional information. [#25]*
Approp. Pts	Negative	17	*I will not prefer to recommend it for my patients, as it contain some difficult articles.[#132]*
	Positive	19	*It covered most of the information so it can [be] rated as a good website. I recommend this website for the patients. [#85]*

Figure 1a: Pre-Intervention

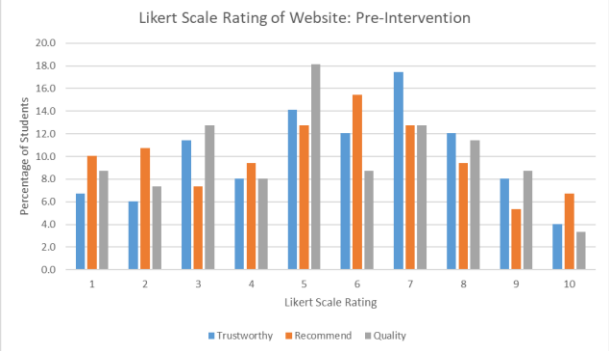

Figure 1b: Post-Intervention

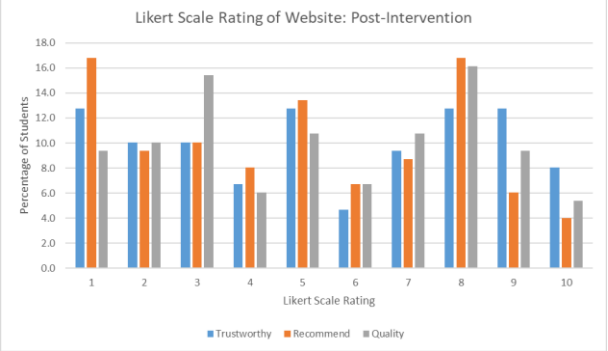

Figure 1: Pre-and post-intervention distribution of scores.