Web-based Learning: Sound Educational Method or Hype? A Review of the Evaluation Literature

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The first reports of Web-based medical education appear in 1992,[1] building on 30 years of computer-assisted instruction. Proponents claimed computer-assisted instruction is superior to text-based, lecture, and traditional educational methods for reasons that include control by the learner over content, time, and place of learning[2]; enhancement of learning, reasoning, and efficiency[3,4]; and cost savings.[5] Many studies that reported advantages contained methodologic flaws[6] and reported advantages unrelated to computer-specific features.[7]

Web-based learning (WBL) represents a further evolution of computer-assisted instruction. Technical advantages of WBL include universal accessibility, ease in updating content, and hyperlink functions that permit cross-referencing to other resources.[8] These technical advances, specifically hyperlink and searching capabilities, fit the constructivist learning theory, where learners search out and create their own knowledge bases. However, as was evident with computer-assisted instruction, potential advantages may not translate into significant improvements in educational outcomes. With the widespread adoption of WBL, it is critical that medical educators have evidence regarding its performance as a learning medium. This paper reviews the medical, dental, and nursing WBL evaluation literature to: (1) identify which facets of WBL have been evaluated, (2) describe the evaluation strategies used, (3) synthesize the findings, and (4) discuss educational implications and future research directions.

Method

We searched Medline and ERIC for "Computer-assisted Instruction" and "Internet or World Wide Web" and "Education, continuing or Education, dental, or Education, medical, or Education, nursing" from 1966 to January 2002, limited to English language.

Having selected articles from their abstracts, two authors independently applied the criteria in Figure 1 to classify each article as descriptive or evaluative. If the abstract was unavailable or lacked sufficient information, the article was reviewed. When the two authors disagreed, the third author broke the tie.

We categorized the WBL articles by evaluation domains. Where possible, we divided studies into those evaluating features specific to the Web medium versus those specific to educational content.

We determined percentages of descriptive and evaluative studies, identified evaluation domains, described evaluation strategies, and synthesized the findings. The small number of studies and heterogeneity of study designs and participants precluded combining the data by meta-analysis.

Results and Discussion

We identified 206 WBL papers between 1992 and 2001 in Medline and ERIC. As shown in Figure 1, 76 met our criteria for inclusion, 41 (59%) being descriptive and 35 (46%) evaluative. The two authors agreed on this classification for 71 of 76 papers (kappa = 0.869, $p < .001$). In the five case of disagreement, the third author classified one study as descriptive and four as evaluative.

From the 35 evaluation papers, we identified four domains: knowledge gains, learner attitudes, learning efficiency, and program cost. We divided studies of learner attitudes into those evaluating Web-specific and content-specific attributes. We could not similarly divide studies measuring knowledge gains due to multiple confounding educational influences in all but two studies.[9,10] Table 1 depicts the evaluation domains, keywords used to describe the focus of the investigation, and the number of studies in each category.

Domain 1: Studies Evaluating Knowledge Gains

Twenty studies evaluated knowledge gains with WBL interventions. Eighteen measured changes in multiple-choice test scores; one used a written case analysis; and one, a multiple-choice test plus a standardized patient interview. Research methods included pretest/posttest self-controlled studies, self-selected controlled studies, assigned (non-randomized) controlled studies, assigned crossover trials, and randomized controlled trials. The most common research design was a pretest/posttest self-controlled study, but there were several randomized controlled trials (see Appendix Table A). The pretest/posttest studies provided strong evidence that WBL interventions resulted in knowledge gains in medical students, practicing physicians, and dentists.[11–15] However, studies without a control group cannot separate Web-specific from content-specific learning gains.

Studies where a WBL group and a control group received identical educational content allowed identification of learning gains attributable specifically to the Web medium. Studies that met this criterion demonstrated no difference in knowledge gains between groups.[16–19]

As the research designs strengthened, results confirmed WBL was comparable but not superior to other educational methods. One assigned crossover study showed no difference in scores between the WBL and slide/tape groups.[10] In randomized controlled trials, authors found WBL superior to no educational method[20,21] and equivalent to text-based methods.[9] Of three studies of traditional courses with and without Web enhancement, one reported enhanced learning and two did not.[22–24] In summary, WBL improved posttest scores on multiple-choice tests but did not outperform other educational methods.

Domain 2: Learners' Attitudes

We categorized studies of learners' attitudes into Web-specific and content-specific. Web-specific studies were (1) comparisons between WBL and other methods, (2) predictors of satisfaction with technology, (3) patterns of Web use, and (4) Web-specific enhancements of self-directed learning or learning stimulation (see Appendix Table B). Content-specific studies were evaluations of (1) courses, (2) predictors of satisfaction with courses, and (3) self-reported changes in effectiveness of learning and confidence (see Appendix Table C).

Web-specific attributes

1. Do learners prefer WBL to other educational methods? Several studies assessed learners' preference for WBL and their desire to use WBL again (see Appendix Table B). Most learners planned to use WBL again[12,15,21] and preferred WBL to continuing medical education conferences, lectures, video, audiotapes, journals, or textbooks.[17,23] One study compared WBL with slide/tape and reported that 71% of students preferred the WBL.[10] A randomized controlled trial reported higher satisfaction with WBL compared with print materials, on a scale of 5 to 20 (means: WBL = 17, text = 15, $p <$

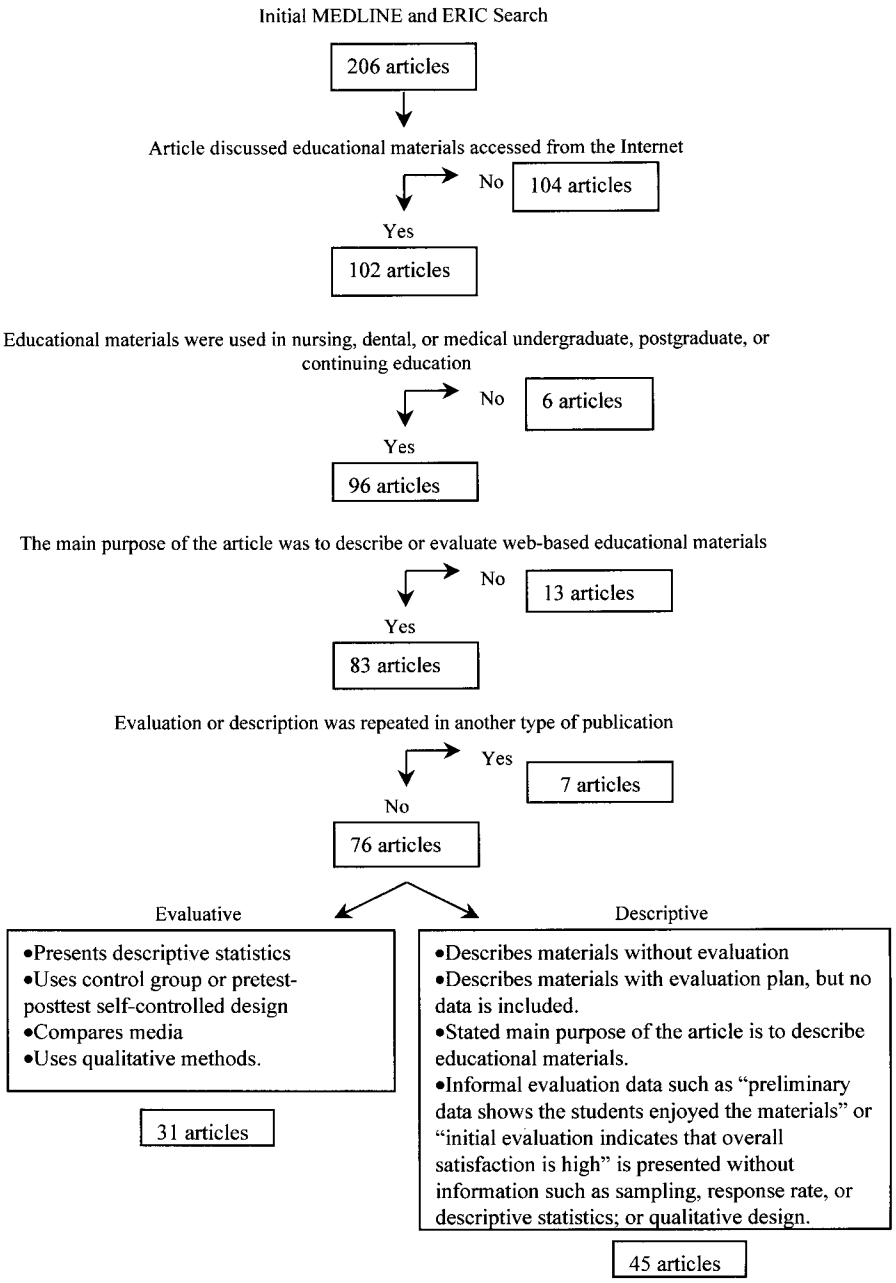

Figure 1. Literature review and selection of articles for review.

.001).[9] Many of these studies introduced selection bias by recruiting participants over the Internet. Nonetheless, two strong studies demonstrate preferences for WBL over slide/tape and text-based materials.[9,10]

2. What predicts learners' satisfaction with Web technology? Properties specific to WBL include Web-site accessibility, navigation, and attractiveness. Studies that evaluated these features universally reported high learner satisfaction.[10,12,16,21,23,26,29] The main predictor of satisfaction with WBL was download speed. One cross-sectional observational study reported that students who perceived fast download time gave above-average course ratings more often than did students who perceived slow download time (OR 4.25), and concluded that download speed was as important to learners' satisfaction as content.[30] Four additional articles reported slow download speed as WBL's major disadvantage and most significant barrier to learning for graduate nursing, dental, radiology, and medical students.[10,24,27,31]

3. How do learners react to asynchronous interactions with faculty and peers? There are positive and negative reports of the asynchronous interactions with instructors and peers typical of WBL.[21,32,33] One study of a Web-based nursing course reported that learners were more likely to work together and felt more comfortable disagreeing with the instructor or asking awkward questions.[34] However, a qualitative study reported equal numbers of positive and negative comments regarding asynchronous interaction with instructors.[21] There is insufficient evidence to determine when asynchronous communication benefits or adversely affects learning.

4. What is known about patterns of Web use in WBL? Patterns of Web use were determined from learners' self-reports or from server statistics. Information from server statistics indicated higher

Table 1. Keywords and Numbers of Studies in Evaluation Domains of 31 Web-based Learning Studies

Evaluation Domain	Keywords	No. of Studies*
Learner satisfaction		
Media specific	Easy to follow, easy to use, easy to access, navigate, user-friendly interface, availability, attractive design	9
	Learner satisfaction of WBL method	2
	Attitude toward learning, attitude toward computer learning, reaction to online learning	5
	Wanted WBL in future, would use method again, preferred means of learning	9
	Predictors of student satisfaction with online course	2
	Utilization of Internet materials	4
	Interactivity and communication	4
	Self-directed learning	2
Non–media specific	Self-reported competency, self-efficacy, confidence	6
	Overall rating of course or module	8
Knowledge gains	Exam scores	19
	Performance with standardized patients	1
	Written case analysis	1
Learning efficiency	Score gain per unit of study time	1
	Perception of efficiency	1
Cost	Direct and indirect costs	1

*Numbers do not add up to 31 as many studies evaluated WBL in multiple domains.

use immediately before an examination and up to a 20% discrepancy from self-reported use.[35] Self-reported use varied extensively between studies, with little clarification or explanation.[27,36,37] For example, in one randomized controlled trial, 72% of the Web-based group reported never using the Web materials, citing lack of time as the major barrier.[27]

5. Does WBL enhance or stimulate learning or encourage learners to look for answers? There are mixed reports on WBL in these areas. In one study, only 50% of learners believed the Web-based experience enhanced their learning.[24] Another study reported increased stimulation to learn in a WBL program versus a traditional course. However, this study was limited by a high crossover between groups—70% of WBL students also chose to attend lectures.[18] A third study of nursing students reported that 85% of graduate and 28% of undergraduate students would search for answers personally rather than asking an instructor because of how the course used the Web.[34] This suggests that WBL may stimulate learning differently depending on educational level. It is unclear whether WBL outperforms other media by enhancing or stimulating learning or encouraging learners to seek out answers.

Content-specific features

1. How do learners rate WBL courses? Many authors reported positive evaluations of WBL programs,[13,26,31] but most studies comparing WBL with other methods found similarly high ratings for both modalities.[17,27,32] However, one randomized controlled trial reported higher overall evaluations from students in the WBL group compared with a text-based group.[9]

2. Which design features predict satisfaction with an educational course? In a correlation model, sound instructional technique was the only variable that contributed to the variance in students' satisfaction with their learning in a WBL course.[38] Variables without effect included previous experience with WBL, self-rated competence with technology, frequency of communication between classes, learners' age, remote group size, technology, and course management. The authors concluded that sound pedagogy is more important that technology in determining learners' satisfaction.

3. Do WBL programs improve learners' confidence? Studies that evaluated learners' self-reported confidence or competence reported improvements after any structured educational intervention. WBL programs achieved changes similar to those attained with other methods.[11,13,15,21,28,37] There is strong evidence that well-designed WBL programs can improve learners' confidence, similarly to other educational methods.

Domain 3: Studies Evaluating Efficiency of Learning

Only two studies evaluated changes in learning efficiency. One well-designed randomized controlled trial comparing WBL with text-based learning reported that learners achieved equivalent test scores with shorter study times using WBL materials (27 minutes versus 38.5 minutes). The authors calculated efficiency scores (median improvement in score per hour with 95% confidence interval) of 8.6 (7.1–11.7) for WBL and 6.7 (5.9–8.1) for text-based learning ($p = .04$).[9] However, the second study reported conflicting findings, with only ten of 32 students perceiving that WBL was more efficient than studying a textbook.[31] Learning efficiency needs further study in well-designed trials.

Domain 4: Studies Evaluating Costs of WBL Programs

Only one 1995 retrospective study evaluated the cost of WBL. The authors calculated lower direct and indirect (distribution) costs for WBL compared with text. However, they did not consider the educational design costs for either modality and assumed that hardware, software, and other equipment were available, and that the institution had a commitment to technology.[39] Based on one paper, cost saving in the printing and distribution of materials is a potential advantage of WBL, but further study is needed to determine whether lower distribution costs offset the costs of technical support, and whether WBL saves or costs money in terms of faculty time.

Limitations

This study reviewed only medical, dental, and nursing literature, although there are many publications on WBL in other higher education fields. The authors limited the search to these health professions because they share similar undergraduate, postgraduate, and continuing educational methods as well as many content areas that differ from those in other types of higher education. With the trend towards interdisciplinary education, many future WBL programs will target multiple health professions. Nevertheless, this wide variety of learners at varying educational levels in different health professions might possess different motivations or learning biases that could confound the results of our review. Another potential weakness of the review is missed studies. There is no Medline heading for WBL. Instead, the authors searched using the keywords "Internet" or "World Wide Web," which may have decreased the number of studies located.

Conclusions

Despite the rush to embrace WBL, it does not address all the challenges of medical education. It is a valuable addition to our educational armory, but it does not replace traditional methods such as text, lectures, small-group discussion, or problem-based learning. Educators still must define WBL's unique educational contribution. Evaluation of WBL is in its infancy. Although most learners welcome WBL (provided that download speed is fast), and give high

satisfaction ratings, there is no evidence that students learn more from Web-based programs than by traditional methods. Students may learn more efficiently, but there is minimal information about the relative costs of WBL programs. Finally, curriculum development and instructional design are no less important for Web-based educational interventions than for other media. Educators must recognize that poorly designed educational programs or materials are not improved by being presented on a Web page.

Educational Implications

Medical educators must use well-designed curricula regardless of the method of delivery. We did not find Web-based programs to be superior to traditional methods in terms of gains in learning or learners' satisfaction. We recommend that educators tailor their teaching media to learners' needs rather than assume that WBL is intrinsically superior. When designing a Web-based educational program, educators should create materials that load quickly from all types of Internet connections.

Directions for Future Research

Research into WBL is in the early stages and many research questions remain unanswered. Which learners benefit most from WBL? Can WBL increase learning efficiency? Are there cost savings compared with other educational methods? Does WBL enhance knowledge using other evaluation methods besides multiple-choice tests? How can interactions between learners and instructors be fostered and preserved with WBL? Does WBL as a second modality add to the educational experience? Finally, investigators may wish to design trials that compare the strengths and weaknesses of educational methods rather than establish the superiority of one medium over another. Such trials would clarify the most appropriate uses of WBL in medical education.

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Appendix Table A. Studies Evaluating Knowledge Gains with WBL Interventions, Classified by Study Design

Author	Participants	Intervention	Findings*	Outcome
Studies using a pretest–posttest self-controlled design				
Engel, 1997	Medical students, 3rd year (41)	Subjects given WBL materials	Pretest—3.7 Posttest—6.4 $p < .0001$; ES NR	Significant improvement after WBL intervention
Francis, 2000	Dentists (23)	Subjects given WBL materials	Improvement Pretest–Posttest $p = .0001$; ES NR	Significant improvement after WBL intervention
Harris, 2001	Physicians (354)	Subjects given WBL materials	Pretest—52% Posttest—88% $p < .001$; ES NR	Significant improvement after WBL intervention
Krontz, 2000	Physicians, pathology (643)	Subjects given WBL materials	Improved grading (11.9% avg.) on 15/20 images	Significant improvement after WBL intervention
Sakowski, 2001	Medical students	Subjects given WBL materials	Pretest—47% Posttest—83.3% $p < .001$; ES NR	Significant improvement after WBL intervention
Studies using a self-selected, controlled design				
Fulkerson, 1999	Medical students, 4th year (16)	Subjects chose WBL or on-site neurology course	WBL—NR Traditional—NR p—not significant	No difference in exam scores
Woo, 2000	Nursing students (97)	Subjects chose classroom or WBL course	WBL—91.4, 94.2 Class—93.1, 95.2 = 0.3, 0.4 ES NR	No difference in exam scores
Studies using an assigned (non-randomized), controlled design				
Cho, 1998	Nursing students (30)	Subjects assigned to WBL or traditional course	Improvement in achievement score	WBL students had significantly higher exam scores
Fleetwood, 2000	Medical students (173)	Subjects assigned to WBL or small group	Exam scores not significantly different	Mixed results on exam scores and standardized patient evaluation
Schaad, 1999	Medical students (about 500)	Course changed from lecture to WBL and small group	WBL/small group—91.6 Lecture—87.2 p NR; ES > .80	WBL/small group outperformed lecture
Yucha, 2000	Nursing students	14 subjects assigned to WBL 163 historical controls	WBL—79.1 Traditional—79.7 F = 1.524 (ns) ES NR	No difference in exam scores
Study using an assigned crossover design				
Ludlow, 2000	Dental students (74)	Learners used Web or slide/tape (S/T) materials	Web—97.2, 96.5 S/T—95.5, 98.6 $p = .8, .1$; ES NR	No difference in exam scores
Studies using a randomized, controlled design				
Balcezak, 1998	Medicine residents (34)	Learners given WBL or no intervention	WBL—81% None—62% $p < .001$; ES NR	WBL group outperformed no-intervention group
Baumlin, 2000	Medical students, 4th year (100)	Learners given WBL or no intervention	WBL—72.8% None—62.8% $p = .058$; ES NR	No difference in exam scores
Bell, 2000	Residents (158)	Learners given WBL or text materials	WBL—15, 12 Text—14.5, 11 $p > .2$; ES NR	No difference in scores posttest or 6 months later
Chan, 1999	Physicians, family practice (23)	Learners given WBL or WBL + small group	Exam scores not significantly different	No difference in exam scores
Curran, 2000	Physicians	Learners given WBL or no intervention	WBL higher than no-intervention $p < .05$; ES NR	WBL group outperformed no intervention group
Lipman, 2001	Medical students, 2nd year (127)	Learners given classroom or WBL + classroom	WBL—3.0 WBL/classroom—2.6 $p < .005$ ES NR	WBL/classroom group outperformed Web-only group
Mehta, 1998	Medical students, 2nd year	Learners given classroom or WBL + classroom	Exam scores not significantly different	No difference in exam scores

*ES = effect size, NR = not reported, (ns) = not significant.

Appendix Table B. Web-based Learning Studies Reporting Evaluation of Media-specific Attributes

Author	Subjects (N)	Study Design	Key Finding
Studies reporting easy to follow, use, access, or navigate; user-friendly interface, availability, attractive design, convenient			
Agius, 1998	Mixed students (14)	Non-comparative, non-controlled	Easy to follow, easy to get started, and easy to follow the hypertext links
Baumlin, 2000	Medical students, 4th year (100)	Non-comparative, non-controlled*	Useful, easy to use and access, evaluated by the 28% assigned to Web who accessed materials only
Cho, 1998	Nursing students (30)	Non-randomized, non-controlled*	92% very satisfied with user interface design
Curran, 2000	Physicians	Non-comparative, non-controlled*	Attractive Web pages and well-organized layout; easy to navigate
Fleetwood, 2000	Medical students (173)	Non-comparative, non-controlled*	Easy to use, interesting
Francis, 2000	Dentists (23)	Non-comparative, non-controlled*	Easy to navigate, attractive design
Hashiba, 2000	Medical students	Non-comparative, non-controlled	On a five-point Likert scale between excellent (5) and bad (1) subjects rated the WBL module 3.7 for readability, 3.6 for clearness, and 2.8 for quality of sound
Ludlow, 2000	Dental students (74)	Non-randomized, cross-over	Students preferred Web materials to slide/tape materials for ease of use, locating material, availability, and image quality, $p < .001$
Perryer, 2000	Dentists (50)	Non-randomized, non-controlled	34/50 (68%) of practicing dentists found the Web interface easy to use
Studies reporting learner satisfaction with WBL			
Bell, 2000	Residents (158)	Randomized, controlled	More satisfied with WBL than printed materials, $p < .001$
Letterie, 1996	Residents (24)	Non-comparative, non-controlled	Overall resident satisfaction of 4.5 on scale of 1 (lowest) to 5 (highest)
Studies reporting attitudes toward WBL, reaction to online learning			
Cho, 1998	Nursing students (30)	Non-randomized, controlled	More positive attitude scores towards computers and Internet and towards learning experience for learners in the WBL module vs. controls, $p < .10$ and $p < .05$, respectively
Levine, 1999	Medical students	Non-randomized, non-controlled	Increasing positive attitudes toward educational technology
Mehta, 1998	Medical students, 2nd year	Randomized, controlled (control group used WBL before survey)	44% of the control group and 53% of the experimental group believed the Web modules enhanced their learning
Sakowski, 2001	Medical students, 3rd year	Non-randomized, non-controlled	88% of students found the Web-based materials an effective method of learning
Yucha, 2000	Nursing students (14)	Non-randomized, controlled	Most master's nursing students felt they had learned less than they would have in a traditional classroom
Studies reporting learners wanted WBL in future, would use method again, preferred means of learning			
Cho, 1998	Nursing students (30)	Non-randomized, controlled	50% preferred WBL, 14.29% preferred traditional learning, and 39.79% ranked WBL and traditional learning equally
Curran, 2000	Physicians	Non-randomized, non-controlled*	Would use WBL for CME again; compares favorably with other available methods
Horsch, 2000	Medical students (32)	Non-comparative	81% of students stated they had more fun learning with WBL than with a textbook
Francis, 2000	Dentists (23)	Non-randomized, non-controlled	76% would use WBL again for continuing education
Ludlow, 2000	Dental students (74)	Randomized, cross-over	71% preferred WBL over slide/tape
Mehta, 1998	Medical students, 2nd year	Randomized, controlled	70% of learners exposed to WBL prior to a classroom experience wanted to see more material on the Web, as opposed to 50% of learners exposed to WBL after the classroom experience
Perryer, 2000	Dentists (50)	Non-randomized, non-controlled	80%, 84%, 98%, and 86% preferred WBL to video, books, audiotapes, and journals
Sakowski, 2001	Medical students, 3rd year	Non-randomized, non-controlled	88% of students surveyed stated they were more likely to use WBL in future after the experience

Appendix Table B continues

APPENDIX TABLE B. *Continued*

Author	Subjects (N)	Study Design	Key Finding
Yucha, 2000	Nursing students (14)	Non-randomized, controlled	12 or 13 master's nursing students did not want to take another Web-based course
Studies reporting predictors of student satisfaction with online course			
DeBourgh, 1999	Graduate nursing students	Correlation study	Of 5 learner and 3 instructional attributes, only instructor rating contributed to variance in student satisfaction
Sekikawa, 2000	Residents (24)	Cross-section, observational	Odds ratio of above average rating for those reporting fast speed of access vs. slow was 4.25 (2.03–8.91; $p = .001$)
Studies reporting utilization of Internet materials			
Baumlin, 2000	Medical students, 4th year (100)	Randomized, controlled	72% of WBL group did not access the Web, 77% cited lack of time as the reason
Letterie, 1996	Residents (24)	Non-comparative, non-controlled	95% of subjects reported using materials
McNulty, 2000	Medical students	Correlation analysis	Student use coincided with timing of course exams; student self-reported use varied 10–20% from server statistics; prior computer skills not related to use
Stillman, 1999	Nursing students (88)	Non-randomized, non-controlled	80% of subjects accessed materials
Studies reporting interactivity and communication			
Curran, 2000	Physicians	Non-randomized, non-controlled*	"Provides interactivity" at 4.14 on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree)
	Physicians	Qualitative interviews	Delayed interaction seen as positive in 16 comments and negative in 13 comments
Rose, 2000	Graduate nursing students (52)	Non-randomized, controlled	No difference in ratings of communication with faculty (4.50, 4.18) or classmates (3.83, 3.43) on a five-point Likert scale between students in an online and a traditional course
Thiele, 1999	Nursing students: 13 graduate, 58 undergraduate	Non-randomized, non-controlled	Undergraduate and graduate nursing students were more likely to work with other students (60%, 85%), were comfortable disagreeing with instructor (60%, 92%), and more comfortable asking awkward questions (55%, 77%) due to Web communication
Thornam, 2001	Graduate nursing students	Non-randomized, controlled	Subjects in online course perceived less interactivity than those in traditional course (no p values given)
Studies reporting self-directed learning or stimulation			
Thiele, 1999	Nursing students: 13 graduate, 58 undergraduate	Non-randomized, non-controlled	28% and 85% of undergraduate and graduate nursing students stated they were more likely to search for answers instead of asking instructor because of the way the course uses the Web
Woo, 2000	Graduate nursing students (97)	Controlled, non-randomized	Graduate nursing students in an online course reported significantly higher learning stimulation that those in the traditional course ($n = 97$, $p = .04$)

*Study design was comparative or controlled for other measures, but not for the measure described in this table.

Appendix Table C. Web-based Learning Studies Reporting Evaluation of Educational Design Features

Author	Subjects (*n*)	Study Design	Findings
Studies reporting self-reported competency, self-efficacy, confidence, preparation			
Curran, 2000	Physicians	Pretest–posttest self-controlled	Improved self-reported competency in dermatologic office procedures after WBL intervention, $p < .05$
Engel, 1997	Medical students, 3rd year (43)	Pretest–posttest self-controlled	Self-efficacy scores increased after WBL intervention compared with before, $p < .0001$
Fleetwood, 2000	Medical students (173)	Controlled, non-randomized	WBL felt more prepared to deal with legal issues of confidentiality, $p = .0014$
Harris, 2001	Physicians (354)	Pre-test–Posttest self-controlled	Self-reported confidence in distinguishing pigmented lesions and providing appropriate care improved after WBL intervention compared with before, $p < .001$
Sakowski, 2001	Medical students, 3rd year	Controlled, non-randomized	Confidence in managing clinical issues was higher after WBL compared with before ($p < .001$), but was not significant when compared with a separate control group
Stillman, 1999	Nursing students (88)	Non-randomized, non-controlled	69 of 88 stated the WBL materials helped them prepare for the exam; 24 of 88 commented that their skills improved due to the module in an open-ended format
Studies reporting overall rating of course or module			
Agius, 1998	Mixed students (14)	Non-comparative	12 of 13 rated the program as very good (2) or good (3) on a 5-point Likert scale
Baumlin, 2000	Medical students, 4th year (100)	Randomized, controlled	No difference between overall course ratings of WBL and traditional students, $p = .23$
Bell, 2000	Residents (158)	Randomized, controlled	Residents were more satisfied with WBL over text-based; $n = 162$; $p < .001$
Harris, 2001	Physicians (354)	Non-comparative	309 physicians rated the program 4.83 on a five-point scale with 5 as most favorable
Fleetwood, 2000	Medical students (173)	Controlled, non-randomized	WBL students rated the course slightly better
Horsch, 2000	Medical students (32)	Non-comparative	32 medical students rated the materials 1.9 on a scale from 1 (very good) to 5 (very bad)
Rose, 2000	Graduate nursing students (52)	Non-randomized, controlled	No difference between overall course ratings of 52 graduate nursing students in an online and a traditional course
Woo, 2000	Graduate nursing students (97)	Controlled, non-randomized	No difference between overall course ratings of 97 graduate nursing students in an online and a traditional course ($p = .36$)