JMIR Medical Education

Impact Factor (2024): 3.2
Volume 2 (2016), Issue 1 ISSN 2369-3762 Editor-in-Chief: Blake J. Lesselroth, MD, MBI, FACP, FAMIA

Contents

Original Papers

Short Paper

Original Paper

Branding Asklepios and the Traditional and Variant Serpent Symbol Display Among Health Professional Schools in the United States, Puerto Rico, and Canada: A Cross-Sectional Survey

Claus Hamann[1*], MD, MS; MaryKate Martelon[2*], MPH

[1]Eastern Maine Healthcare Systems, Beacon Health, Brewer, ME, United States
[2]Massachusetts Department of Public Health, Boston, MA, United States
[*]all authors contributed equally

Corresponding Author:
Claus Hamann, MD, MS
Eastern Maine Healthcare Systems
Beacon Health
797 Wilson St.
Brewer, ME, 04412
United States
Phone: 1 617 538 5142
Fax: 1 207 989 1096
Email: chamann@emhs.org

Abstract

Background: History supports the staff and single serpent, the asklepian, as the symbol of healing and medicine, yet its confusion with the caduceus (a winged staff with two snakes wrapped around it) persists. No population-based information on serpent symbol use exists.

Objective: To determine the prevalence of asklepian and caduceus display among Internet images of medical and health professional schools' emblems, and to compare asklepian and caduceus display between medical and health professional schools, examining the effects of school longevity and geographic location on symbol display.

Methods: This cross-sectional survey examined Internet websites and Google Images associated with medical and other health professional schools in the United States, Puerto Rico, and Canada from 2013 to 2015. The primary outcome was display of a traditional or variant asklepian or caduceus among current and past emblems in Google Images. Odds ratios (ORs) and 95% confidence intervals for the comparison of medical versus other health professional schools were calculated by logistic regression. Differences among schools' longevity were assessed with Student's *t*-tests and linear regression.

Results: Among images of current and past emblems of 482 schools—159 medical schools and 323 health professional schools—107 (22.2%) emblems displayed only the traditional, and 205 (42.5%) any, asklepian. Adjusting for geographic region and longevity, medical schools were 59% less likely than health professional schools to display the traditional asklepian (OR 0.41, 95% CI 0.24-0.71, *P*=.001), and were 7.7 times more likely than health professional schools to display the traditional caduceus. Medical schools were 8% less likely than health professional schools to display any asklepian (OR 0.92, 95% CI 0.62-1.38, *P*=.70), and were 3.3 times more likely than health professional schools to display any caduceus.

Conclusions: Schools' preference of the asklepian over the caduceus confirmed historical origins. Less asklepian and more caduceus display by medical schools suggests an educational opportunity for the medical profession to define for itself and the public the correct symbol of an interdisciplinary mission of healing.

(JMIR Medical Education 2016;2(1):e6) doi:10.2196/mededu.5515

KEYWORDS

caduceus; emblems; insigne; insignia; history of medicine; history; humanities; Asklepios; Asclepius; medical symbol

Introduction

For more than two millennia, the single serpent of Epidauros and staff of Asklepios—a combination named the asklepian [1]—have symbolized healing and medicine in the Greco-Roman tradition (see Figure 1, a-c, for photos of these symbols [2]). For two centuries, the Sumerian-derived caduceus of Hermes (ie, Mercury) [3], the messenger god (a winged staff with two snakes wrapped around it, see Figure 1, d), has been displayed by many health-related organizations as a quasi-symbol of health care since its use by a nineteenth-century medical publisher [1]. This symbol substitution was accelerated by adoption of the caduceus as an insigne for noncombatant officers of the US Army Medical Corps in 1902 [4] despite the Corps' use of the asklepian since 1818 [5]. *Le caducée* has been used to describe the single serpent entwining fascicles [6] and the asklepian has been misnamed "the medical caduceus" [1,7]. The US error, explained in 1917 [5], has been discussed in at least 30 articles for a century [8]. Confusion as to the correct symbol for healing, medicine, and health care persists in both professional and popular usage.

The distinctive meanings of these mythological symbols are well described. The traditional, pruned branch-like staff of Asklepios and its single entwined serpent each represent healing and restoration through regeneration: new twigs growing from a pruned branch and the snake shedding its former skin [9]. Hippocrates was known as an Asclepiad [10] and graduands invoke Asklepios in the traditional Hippocratic oath [11]. The caduceus of Hermes, a smooth, winged, herald's wand with two entwined serpents, is associated with communication, wisdom, peace, commerce, alchemy, thievery, and tangentially with healing [6].

Medical and kindred health professional schools—where initial exposure to these symbols occurs—are among the "professional medical organizations...more likely to use the staff of Aesculapius" [6], though selection criteria, analytic method, and calculations were not described by the author. A detailed pictorial history of the asklepian [12] and a survey [13] provided only qualitative support for preference of the asklepian over the caduceus by medical and health organizations.

To the authors' knowledge, only one other study has examined the display of these symbols. Among the 10 leading medical colleges in India, 1 displayed the asklepian, 6 used the caduceus, and 3 used neither [14]. To inform current and future use of these symbols by medical and health professional schools, other health care organizations, and the public, this study asks the following questions: Do schools display the asklepian more than the caduceus? Do medical schools display either symbol more than do health professional schools? Do school longevity or geographic location influence display of either symbol?

Figure 1. Asklepian from a Roman Aesculapian temple and caduceus from a Florentine sculpture. (a) Tiber Island, Rome 2004 [2]. The arrow indicates the travertine ship's prow, which is seen in (b,c); (b,c) Asklepian carved into the travertine ship's prow from the 1st century BCE at the site of an Aesculapian temple [2], 300 m from the current-day Ospedale Fatebenefratelli (photo by author, 2008); (d) Bronze by Gianbologna, Mercurio (Mercury, the Roman name for Hermes), 1580, Museo Nazionale del Bargello, Florence, Italy (excerpt of photo by author, 2013).

Figure 2. a [28], d [31], e [32] traditional asklepians; b [29], c [30], i [36] variant asklepians; f [33] traditional caduceus; g [34] variant caduceus; h [35] double-helix in emblem; j [37], k [38] change in AAMC emblem.

Methods

From November 2013 to January 2015, we compared Internet displays of asklepians and caducei among emblems of all accredited American, Puerto Rican, and Canadian allopathic medical schools [15] to those of all accredited schools of osteopathic, podiatric, and veterinary medicine, and of dentistry, optometry, and pharmacy [16-25]. The primary outcome was the display of a traditional, or any variant of a traditional, asklepian or caduceus among Google Images [26] of current or past emblems associated with a school, its departments, or organizations. We also examined the display of symbols in each school's current emblem on its home page.

The primary author (CH) searched Google Images, which ranks images according to keywords, richness of text descriptions, and website links for each image [26]. Images were searched up to the "Show more results" line at the bottom of the webpage. This strategy included, on average, the first 398 images (SD 3.3) based on a 1% random sample. Each home page of all medical and health professional schools in the respective directories was also accessed via the link provided in the directory or via the school's name entered in the Google Web search field. To obtain images (ie, screenshots) of emblems, each name was entered in the Google Images search field. Sites displaying either symbol were again accessed between November 2014 and January 2015 to verify active display; Google Image search [27] was conducted for inactive Web addresses. For all schools, the same emblems displayed on home pages were also found in searches for images.

Examples of traditional and variant asklepians and caducei are shown in Figure 2, a-k [28-38]. We defined the traditional asklepian as the display of the branch-like staff and a single serpent (see Figure 2, a), regardless of serpent chirality, number of coils, or ornamentation. Dentistry's emblem is the dental cautery—equivalent of the asklepian staff [39]—with entwined single serpent. Additional features of dentistry's emblem are the berries and leaves that represent temporary and permanent teeth, respectively, and the Greek letters omicron, odont (ie, tooth), and delta (ie, dentistry) (see Figure 2, d). For pharmacy, the asklepian equivalent was defined as a display of the bowl of Hygieia, a daughter of Asklepios [40], with an entwined single serpent [41] (see Figure 2, e). We defined the traditional caduceus as two mirror-image serpents entwining a smooth, winged wand (see Figure 2, f), regardless of the number of coils or ornamentation. In addition to the traditional asklepian and caduceus, we designated two asklepian variants (see Figure 2, b, c, and i) and one caduceus variant (see Figure 2, g and j), according to staff and wand features described in Multimedia Appendix 1. Author agreement on traditional and variant symbols was reliable at a kappa [42] of .91.

We defined each medical and health professional school's major US census region [43] as follows: Puerto Rican schools were grouped into the South region; British Columbia and Alberta were grouped into the West region; Saskatchewan and Manitoba were grouped into the Midwest region; and the remaining Canadian provinces were grouped into the Northeast region. School longevity was defined as the founding year subtracted from 2014. Each school's founding year was identified from its home page under the *About Us/History* tab or by entering the school's name and the words "founded in" in the Google Web search field.

Current and past emblems from images and current emblems from home pages were analyzed independently. Odds ratios (ORs) (95% CI) for asklepian versus caduceus display and for interaction effects of geographic region and longevity on the relationship between school type and symbol display were calculated by logistic regression. School longevity was normally distributed and calculated as mean (SD). Differences among schools' longevity were assessed with Student's *t*-tests and linear regression. Statistical significance was asserted at <.05; all statistical tests were two-tailed. Analyses were performed with Stata version 13.1 (StataCorp LP, College Station, TX). The institutional review board of Mercy Medical Center, Springfield, MA, waived review of this study.

Results

Among images of current and past emblems of 482 schools—159 medical schools (33.0%) and 323 health professional schools (67.0%)—107 (22.2%) displayed traditional asklepians and 205 (42.5%) displayed any asklepian (see Table 1). A total of 18 of the 482 schools (3.7%) displayed the traditional caduceus; 25 (5.2%) displayed any caduceus. A total of 249 schools (51.7%) displayed neither symbol.

Adjusting for geographic region and longevity, medical schools were 59% less likely than health professional schools to display traditional asklepians (OR 0.41, 95% CI 0.24-0.71, *P*=.001) (see Table 2, *Current and past emblems in Google Images*), yet were 7.7 times more likely than health professional schools to display the traditional caduceus (95% CI 2.50-23.80, *P*<.001). Medical schools were 8% less likely than health professional schools to display any asklepian (OR 0.92, 95% CI 0.62-1.38, *P*=.70), yet were 3.3 times more likely than health professional schools to display any caduceus (95% CI 1.43-7.75, *P*=.005).

In a secondary analysis of home pages, 36 current emblems of all 482 schools (7.5%) displayed traditional asklepians, and 77 (16.0%) displayed any asklepian (see Table 3). A total of 7 of the 482 schools (1.5%) displayed the traditional caduceus and 8 (1.7%) displayed any caduceus.

Adjusting for geographic region and longevity, medical schools were 62% less likely than health professional schools to display traditional asklepians in current home page emblems—a statistically nonsignificant result (adjusted OR 0.38, 95% CI 0.14-1.02, *P*=.06; see Table 2). The higher odds of caduceus display by medical schools were also not significant.

For all schools in the United States or Puerto Rico compared to Canada, there were no significant differences in the display of asklepian versus caduceus (data not shown). Multimedia Appendices 2 and 3 contain the hyperlinked emblems of all schools displaying the asklepian, caduceus, and variants.

Table 1. Display of asklepians and caducei among current and past emblems in Google Images for US and Canadian medical and other health professional schools in 2014.

Schools	Longevity[a], mean (SD, range)	Traditional asklepian, n (%)	Traditional or variant asklepian, n (%)	Traditional caduceus, n (%)	Traditional or variant caduceus, n (%)	Neither/ both, n (%)
All schools (n=482)	75.8 (58.5, 1-249)	107(22.2)	205 (42.5)	18 (3.7)	25 (5.2)	252 (52.3)
Medical schools						
All (n=159)	98.5(61.3, 1-249)	21 (13.2)	65 (40.9)	14 (8.8)	16(10.1)	78 (49.1)[b]
US[c](n=137), PR[d](n=4)	97.7(62.0, 1-249)	18 (12.8)	54 (38.3)	14 (9.9)	16 (11.3)	71 (50.4)
Canada (n=18)	104.5 (58.1, 9-185)	3 (17)	11 (61)	0 (0)	0 (0)	7 (39)
Medical schools: region						
Northeast (n=44)	119.9 (72.8, 1-249)	6 (14)	20 (45)	3 (7)	3 (7)	21 (48)
Midwest (n=33)	97.9 (53.2, 1-178)	4 (12)	14 (42)	2 (6)	2 (6)	17 (52)
South (n=56)	87.9 (58.8, 2-207)	8 (14)	22 (39)	7 (13)	7 (13)	27 (48)
West (n=26)	86.0 (47.0, 6-195)	3 (12)	9 (35)	2 (8)	4 (15)	13 (50)
Other health professional schools: all types						
All (n=323)	65.8 (53.5, 1-193)	86(26.6)	140(43.3)	4 (1.2)	9 (2.8)	174 (53.9)[e]
US (n=287), PR (n=3)	65.1 (53.8, 1-193)	81 (27.9)	130 (44.8)	3(1.0)	7 (2.4)	153 (52.8)
Canada (n=33)	71.8 (44.0, 5-154)	5 (15)	10 (30)	1 (3)	2 (6)	21 (64)
Other health professional schools: region						
Northeast (n=78)	74.3 (55.3, 1-193)	10 (13)	19 (24)	1 (1)	1 (1)	58 (74)
Midwest (n=75)	86.9(49.3, 1-164)	19 (25)	33 (44)	1 (1)	4 (5)	38 (51)
South (n=106)	51.7 (46.7, 1-173)	36 (34.0)	54 (50.9)	0 (0)	1 (0.9)	51 (48.1)
West (n=64)	53.9 (46.1, 1-144)	21 (33)	34 (53)	2 (3)	3 (5)	27 (42)
Other health professional schools: osteopathic medicine						
All (n=40)	32.3 (33.6, 1-122)	16 (40)	25 (63)	1 (3)	1 (3)	14 (35)
US (n=34)	33.1 (36.2, 1-122)	16 (47)	25 (74)	0 (0)	0 (0)	9 (26)
Canada (n=6)	27.5 (11.7, 11-33)	0 (0)	0 (0)	1 (17)	1 (17)	5 (83)
Other health professional schools: veterinary medicine						
All (n=35)	82.5 (45.5, 16-162)	19 (54)	28 (80)	0 (0)	0 (0)	7 (20)
US (n=30)	82.8 (45.0, 16-162)	17 (57)	24 (80)	0 (0)	0 (0)	6 (20)
Canada (n=5)	81.0 (58.3, 28-152)	2 (40)	4 (80)	0 (0)	0 (0)	1 (20)
Other health professional schools: podiatric medicine						
All (n=10)	60.9 (47.2, 5-119)	2 (20)	6 (60)	0 (0)	0 (0)	4 (40)
US (n=9)	66.6 (47.1, 5-119)	2 (22)	6 (67)	0 (0)	0 (0)	3 (33)
Canada (n=1)	10.0 (N/A[f])	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)
Other health professional schools: dentistry						
All (n=74)	80.7 (47.9, 1-174)	18 (24)	33 (45)	1 (1)	2 (2)	39 (53)
US (n=64), PR (n=1)	80.2 (49.7, 1-174)	18 (28)	30 (46)	1 (2)	1 (2)	34 (52)
Canada (n=9)	83.8 (40.5, 43-139)	0 (0)	3 (33)	0 (0)	1 (11)	5 (56)

Schools	Longevity[a], mean (SD, range)	Traditional asklepian, n (%)	Traditional or variant asklepian, n (%)	Traditional caduceus, n (%)	Traditional or variant caduceus, n (%)	Neither/ both, n (%)
Other health professional schools: pharmacy						
All (n=141)	64.0 (55.5, 1-193)	29 (20.6)	44 (31.2)	2 (1.4)	4 (2.8)	93 (66.0)
US (n=130), PR (n=1)	62.2 (55.8, 1-193)	26 (19.8)	41 (31.3)	2 (1.5)	4 (3.1)	86 (65.6)
Canada (n=10)	88.6 (49.0, 5-154)	3 (30)	3 (30)	0 (0)	0 (0)	7 (70)
Other health professional schools: optometry						
All (n=23)	65.4 (46.5, 1-168)	2 (9)	4 (17)	0 (0)	2 (9)	17 (74)
US (n=20), PR (n=1)	64.5 (47.7, 1-168)	2 (10)	4 (19)	0 (0)	2 (10)	15 (71)
Canada (n=2)	75.5 (51.1, 47-104)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)

[a]Number of years since founding: t =-6.21; P<.001.

[b]Includes 3 medical schools (1.9%: the United States) displaying both symbols.

[c]US: the United States.

[d]PR: Puerto Rico.

[e]Includes 2 health professional schools (0.6%: dentistry and pharmacy, both in the United States) displaying both symbols.

[f]N/A: not applicable.

Table 2. Adjusted analysis of asklepian and caduceus in the emblems of US, Puerto Rican, and Canadian medical versus other health professional schools in 2014.

Symbols	Traditional asklepian	Traditional or variant (any) asklepian	Traditional caduceus	Traditional or variant (any) caduceus
Current and past emblems in Google Images				
Total, n	107	205	18	25
Adjusted OR[a,b]	0.41	0.92	7.70	3.32
95% CI	0.24-0.71	0.62-1.38	2.50-23.80	1.43-7.75
P	.001	.70	<.001	.005
Current emblems on home pages				
Total, n	36[c]	77[d]	7	8
Adjusted OR[b]	0.38	1.08	2.75	1.92
95% CI	0.14-1.02	0.62-1.89	0.61-12.50	0.47-7.80
P	.06	.79	.19	.36

[a]OR: odds ratio.

[b]Adjusted for school's geographic region and longevity; health professional school was the reference variable. We found no significant interaction effects in the analysis of current and past emblems in Google Images.

[c]Significant interaction effects in the analysis of current emblems on home pages were newer health professional schools displaying traditional asklepian more than older health professional schools (OR 1.020, 95% CI 1.002-1.040, P=.03).

[d]Significant interaction effects in the analysis of current emblems on home pages were western medical schools displaying any asklepian less than western health professional schools (OR 0.22, 95% CI 0.06-0.80, P=.02).

Table 3. Display of asklepians and caducei among current emblems on Internet home pages of US and Canadian medical and other health professional schools in 2014.

Schools	Longevity[a], mean (SD, range)	Traditional asklepian, n (%)	Traditional or variant asklepian, n (%)	Traditional caduceus, n (%)	Traditional or variant caduceus, n (%)	Neither/ both, n (%)
All schools (n=482)	75.8 (58.5, 1-249)	36 (7.5)	77 (16.0)	7 (1.5)	8 (1.7)	397 (82.4)
Medical schools						
All (n=159)	98.5 (61.3, 1-249)	5 (3.1)	23 (14.5)	4 (2.5)	4 (2.5)	132 (83.0)
US[b](n=137), PR[c](n=4)	97.7 (62.0, 1-249)	5 (3.5)	22 (15.6)	4 (2.8)	4 (2.8)	115 (81.6)
Canada (n=18)	104.5 (58.1, 9-185)	0 (0)	1 (6)	0 (0)	0 (0)	17 (94)
Medical schools: region						
Northeast (n=44)	119.9 (72.8, 1-249)	2 (5)	8 (18)	0 (0)	0 (0)	36 (82)
Midwest (n=33)	97.9 (53.2, 1-178)	0 (0)	5 (15)	1 (3)	1 (3)	27 (82)
South (n=56)	87.9 (58.8, 2-207)	1 (2)	7 (13)	1 (2)	1 (2)	48 (86)
West (n=26)	86.0 (47.0, 6-195)	2 (8)	3 (12)	2 (8)	2 (8)	21 (81)
Other health professional schools						
All (n=323)	65.8 (53.5, 1-1931)	31 (9.6)	54 (16.7)	3 (0.9)	4 (1.2)	265 (82.0)
US (n=287), PR (n=3)	65.1 (53.8, 1-193)	30 (10.3)	52 (17.9)	2 (0.7)	3 (1.0)	235 (81.0)
Canada (n=33)	71.8 (44.0, 5-154)	1 (3)	2 (6)	1 (3)	1 (3)	30 (91)
Other health professional schools: region						
Northeast (n=78)	74.3 (55.3, 1-193)	2 (3)	5 (6)	1 (1)	1 (1)	72 (92)
Midwest (n=75)	86.9 (49.3, 1-164)	5 (7)	9 (12)	0 (0)	0 (0)	66 (88)
South (n=106)	51.7 (46.7, 1-173)	9 (8.5)	16 (15.1)	0 (0)	0 (0)	90 (84.9)
West (n=64)	53.9 (46.1, 1-144)	15 (23)	24 (38)	2 (3)	3 (5)	37 (58)
Other health professional schools: osteopathic medicine						
All (n=40)	32.3 (33.6, 1-122)	10 (25)	14 (35)	1 (3)	1 (3)	25 (63)
US (n=34)	33.1 (36.2, 1-122)	10 (29)	14 (41)	0 (0)	0 (0)	20 (59)
Canada (n=6)	27.5 (11.7, 11-33)	0 (0)	0 (0)	1 (17)	1 (17)	5 (83)
Other health professional schools: veterinary medicine						
All (n=35)	82.5 (45.5, 16-162)	6 (17)	10 (29)	0 (0)	0 (0)	25 (71)
US (n=30)	82.8 (45.0, 16-162)	6 (20)	9 (30)	0 (0)	0 (0)	21 (70)
Canada (n=5)	81.0 (58.3, 28-152)	0 (0)	1 (20)	0 (0)	0 (0)	4 (80)
Other health professional schools: podiatric medicine						
All (n=10)	60.9 (47.2, 5-119)	1 (1)	4 (40)	0 (0)	0 (0)	6 (60)
USA (n=9)	66.6 (47.1, 5-119)	1 (1)	4 (44)	0 (0)	0 (0)	5 (56)
Canada (n=1)	10.0 (N/A[d])	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)
Other health professional schools: dentistry						
All (n=74)	80.7 (47.9, 1-174)	5 (7)	7 (9)	1 (1)	1 (1)	66 (89)
US (n=64), PR (n=1)	80.2 (49.7, 1-174)	5 (8)	7 (11)	1 (2)	1 (2)	57 (88)
Canada (n=9)	83.8 (40.5, 43-139)	0 (0)	0 (0)	0 (0)	0 (0)	9 (100)
Other health professional schools: pharmacy						

Schools	Longevity[a], mean (SD, range)	Traditional asklepian, n (%)	Traditional or variant asklepian, n (%)	Traditional caduceus, n (%)	Traditional or variant caduceus, n (%)	Neither/ both, n (%)
All (n=141)	64.0 (55.5, 1-193)	8 (5.7)	16 (11.3)	1 (0.7)	1 (0.7)	124 (87.9)
US (n=130), PR (n=1)	62.2 (55.8, 1-193)	7 (5.3)	15 (11.5)	1 (0.8)	1 (0.8)	115 (87.8)
Canada (n=10)	88.6 (49.0, 5-154)	1 (10)	1 (10)	0 (0)	0 (0)	9 (90)
Other health professional schools: optometry						
All (n=23)	65.4 (46.5, 1-168)	1 (4)	3 (13)	0 (0)	1 (4)	19 (83)
US (n=20), PR (n=1)	64.5 (47.7, 1-168)	1 (5)	3 (14)	0 (0)	1 (5)	17 (81)
Canada (n=2)	75.5 (51.1, 47-104)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)

[a]Number of years since founding: *t* =-6.21; *P*<.001.
[b]US: the United States.
[c]PR: Puerto Rico.
[d]N/A: not applicable.

Discussion

To our knowledge, this is the first systematic analysis of asklepian and caduceus prevalence among Internet images of medical and kindred health professional school emblems. We found that all schools' emblems displayed the asklepian substantially more than the caduceus. This result supports the historically grounded preference for the asklepian as the symbol for healing and medicine, at least among all medical and other health professional schools, although inconsistency persists even within the constituency most expected to exemplify accurate understanding.

Human allopathic medicine in the Greco-Roman tradition appears to be the most direct descendant of Asklepios [44], yet medical schools are no more likely than health professional schools to display the traditional or any asklepian and are more likely to display the caduceus. The opportunity to improve education for correct symbol use clearly exists, as supported by the recent survey finding that only 6% of doctors knew that the asklepian is the correct symbol of medicine [14]. Medical schools and the profession can relearn and teach themselves, then promote to the public, that the asklepian represents their link to the long tradition of the healing arts and sciences.

Loss of the staff in emblems with variant asklepians may reflect not only creativity in branding, but also misunderstanding of the symbol. The staff and the serpent are a unified representation of healing through regeneration—relevant in the current era of organ, tissue, and cell transplantation. Creative use of variants can also perpetuate or increase confusion, as in the examples of the single serpent around a winged staff (Figure 2, c [30] and of the double helix conflated with the serpent symbol (Figure 2, h [35].

Fewer than 20% of current medical school and health professional school emblems in this study displayed either symbol, a finding that suggests diminished relevance of ancient symbols to the current identities of all health professional schools. Most of the schools in this study displaying neither symbol carry the crest or logo of their sponsoring universities. Health professional schools can brand their unique mission by displaying an asklepian alongside their university acronyms or insignia.

This cross-sectional study identified current symbol display, but it could not distinguish current from past symbol display. It could not identify symbol selection or change over time. For example, the Association of American Medical Colleges' emblem has changed at least twice since 1970, culminating in the current variant asklepian (Figure 2, j [37] and k [38]). Also, we could not test Friedlander's finding that, in contrast to medical professional organizations' preference for the asklepian, "…76% of commercial organizations were more likely to use the caduceus" [6], an observation that supports anecdotal observation of current popular and media usage. This study does propose a novel symbol classification, and its results provide increased precision in measuring asklepian versus caduceus use over time.

Evaluating global symbol use by medical and health professional schools and other health-related organizations awaits further research. Many practitioners, private and governmental [45] health care enterprises and programs, news companies, Internet knowledge providers, and others erroneously brand medicine and health care with the caduceus. Health care organizations aligning for clinically and financially accountable care in the United States and elsewhere, especially those planning to rebrand, have the opportunity to unite with all health professional schools by incorporating the asklepian, traditional or variant, into their emblems as the single symbol of a shared, interdisciplinary mission of healing.

Acknowledgments

The primary author gratefully acknowledges the late Donald Bates, MD, Professor of History of Medicine at the McGill University Faculty of Medicine; the late Adalbert Erler, PhD, Professor of History of Law, the primary author's grandfather, for awakening interest in the symbols of medicine and healing; and Dianne Gustafson for review of the manuscript.

This paper represents original, unfunded work not under consideration for publication elsewhere. Both authors meet criteria for authorship; no one else has contributed to this work. The work performed for this article by the second author is not endorsed by, nor does it represent her work at, either of her affiliations.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Criteria for symbol definition and examples of traditional and variant asklepians and caducei.

[PDF File (Adobe PDF File), 465KB - mededu_v2i1e6_app1.pdf]

Multimedia Appendix 2

Current and past asklepian and caduceus symbols in emblems of medical schools.

[PDF File (Adobe PDF File), 957KB - mededu_v2i1e6_app2.pdf]

Multimedia Appendix 3

Current and past asklepian and caduceus symbols in emblems of other health professional schools.

[PDF File (Adobe PDF File), 214KB - mededu_v2i1e6_app3.pdf]

References

1. Wilcox RA, Whitham EM. The symbol of modern medicine: Why one snake is more than two. Ann Intern Med 2003 Apr 15;138(8):673-677. [Medline: 12693891]
2. Claridge A. Rome: An Oxford Archaeological Guide. Oxford, UK: Oxford University Press; 1998.
3. Nayernouri T. Asclepius, Caduceus, and Simurgh as medical symbols, part I. Arch Iran Med 2010 Jan;13(1):61-68 [FREE Full text] [Medline: 20039773]
4. Garrison F. The use of the caduceus in the insignia of the army medical officer. Bull Med Libr Assoc 1919 Oct;9(2):13-16 [FREE Full text] [Medline: 16015887]
5. McCulloch C. The coat of arms of the Medical Corps. Mil Surg 1917;41:137-148.
6. Friedlander WJ. The Golden Wand of Medicine: A History of the Caduceus Symbol in Medicine. New York, NY: Greenwood Press; 1992.
7. The Chapman Society, College of Medicine. Gainesville, FL: University of Florida What's in a symbol? URL: http://humanism.med.ufl.edu/chapman-projects/art-of-medicine-project-2005-2006/whats-in-a-symbol/ [accessed 2016-01-10] [WebCite Cache ID 6eQrxwYO8]
8. Sacks AC, Michels R. Images and Asclepius. Caduceus and Asclepius: History of an error. Am J Psychiatry 2012 May;169(5):464. [doi: 10.1176/appi.ajp.2012.11121800] [Medline: 22549207]
9. Pearn J. Agathos Daimon and the Asklepian serpent. Vesalius 2011 Jun;17(1):4-9. [Medline: 22043596]
10. Wikipedia. Hippocrates URL: https://en.wikipedia.org/wiki/Hippocrates [accessed 2016-01-10] [WebCite Cache ID 6eQsMavAO]
11. Edelstein L. The Hippocratic Oath: Text, Translation, and Interpretation. Baltimore, MD: Johns Hopkins University Press; 1943.
12. Schouten J. The Rod and the Serpent of Asklepios. Amsterdam, the Netherlands: Elsevier; 1967.
13. Grainger B. A survey of symbols of medicine and veterinary medicine. In: Proceeds of the 8th International Congress on Medical Librarianship. 2000 Jul 05 Presented at: 8th International Congress on Medical Librarianship; July 2-5, 2000; London, UK URL: https://research.libraries.wsu.edu/xmlui/bitstream/handle/2376/1991/Grainger%20Survey%20of%20Symbols.pdf?sequence=1 [WebCite Cache ID 6eQuNWhkw]
14. Shetty A, Shetty S, Dsouza O. Medical symbols in practice: Myths vs reality. J Clin Diagn Res 2014 Aug;8(8):PC12-PC14 [FREE Full text] [doi: 10.7860/JCDR/2014/10029.4730] [Medline: 25302242]
15. Association of American Medical Colleges. Member directory search result - Medical school URL: https://members.aamc.org/eweb/DynamicPage.aspx?site=AAMC&webcode=AAMCOrgSearchResult&orgtype=Medical%20School [WebCite Cache ID 6eQuNWhkw]

16. American Association of Colleges of Osteopathic Medicine. US colleges of osteopathic medicine URL: http://www.aacom.org/become-a-doctor/us-coms [accessed 2016-01-10] [WebCite Cache ID 6eQuU5SzL]
17. Ontario Association of Osteopathic Practitioners. Accredited schools URL: http://www.osteopathicboard.org/accredited-schools/ [accessed 2016-01-10] [WebCite Cache ID 6eQua3h4f]
18. Council on Podiatric Medical Education. List of podiatric medical colleges URL: http://www.cpme.org/colleges/content.cfm?ItemNumber=2425 [accessed 2016-01-10] [WebCite Cache ID 6eQufUl5l]
19. Université du Québec à Trois-Rivières. Répertoire des programmes d'études URL: https://oraprdnt.uqtr.uquebec.ca/pls/public/pgmw001?owa_cd_pgm=7017 [accessed 2016-01-10] [WebCite Cache ID 6eQw5Mone]
20. Association of American Veterinary Medical Colleges. AAVMC members URL: http://www.aavmc.org/aavmc-members/full-member-listing.aspx [accessed 2016-01-10] [WebCite Cache ID 6eQwALAK4]
21. American Dental Association. Council on Dental Accreditation: Search for dental programs URL: http://www.ada.org/en/coda/find-a-program/search-dental-programs/dds-dmd-programs [accessed 2016-01-10] [WebCite Cache ID 6eQwIpjWA]
22. American Optometric Association. 2015 Mar 23. Accreditation Council on Optometric Education: Accredited professional optometric degree programs URL: http://www.aoa.org/Documents/students/OD_program_directory_3_23_2015.pdf [accessed 2016-01-10] [WebCite Cache ID 6eQwNyYl8]
23. Canadian Association of Optometrists. Becoming a doctor of optometry URL: https://opto.ca/becoming-a-doctor-of-optometry [accessed 2016-01-10] [WebCite Cache ID 6eRT26AkL]
24. Accreditation Council for Pharmacy Education. Preaccredited and accredited professional programs of colleges and schools of pharmacy URL: https://www.acpe-accredit.org/shared_info/programsSecure.asp [accessed 2016-01-10] [WebCite Cache ID 6eQyLMsAI]
25. Canadian Pharmacists Association. Canadian faculties and schools of pharmacy URL: http://www.pharmacists.ca/index.cfm/pharmacy-in-canada/directory-of-pharmacy-organizations/canadian-faculties-and-schools-of-pharmacy/ [WebCite Cache ID 6eQyRItzm]
26. Jing Y, Baluja S. Pagerank for product image search. In: Proceedings of the 17th International World Wide Web Conference (WWW2008). 2008 Apr Presented at: 17th International World Wide Web Conference (WWW2008); April 21-25, 2008; Beijing, China URL: http://cseweb.ucsd.edu/~elkan/291spring2008/dafna2.pdf [WebCite Cache ID 6hJ2Z0G95]
27. Chitu A. Google Operating System. 2013 Jun 13. How Google's image recognition works URL: http://googlesystem.blogspot.com/2013/06/how-googles-image-recognition-works.html [accessed 2016-01-10] [WebCite Cache ID 6eQyl4Tjq]
28. The Student National Medical Association. Region V SNMA chapters URL: http://www.snma.org/index.php?pID=89 [accessed 2016-01-10] [WebCite Cache ID 6eQzxG2AC]
29. YouTube. University of Wisconsin Medical Student Association (UW MSA) URL: https://www.youtube.com/user/uwiscmsa [WebCite Cache ID 6eRU9f6S8]
30. New York Medical College. URL: https://www.nymc.edu/ [accessed 2016-01-10] [WebCite Cache ID 6eR0Teo91]
31. Marquette University School of Dentistry Criminal Background Check Policy. Milwaukee, WI: Marquette University School of Dentistry URL: http://www.marquette.edu/dentistry/admissions/documents/CBC-policy.pdf [accessed 2016-04-12] [WebCite Cache ID 6giGRajl5]
32. Eventbrite. Chicago State University College of Pharmacy URL: http://www.eventbrite.com/o/chicago-state-university-college-of-pharmacy-1277511417 [accessed 2016-01-10] [WebCite Cache ID 6eRMqoTSO]
33. Wikipedia. East Tennessee State University James H. Quillen College of Medicine URL: https://en.wikipedia.org/wiki/East_Tennessee_State_University_James_H._Quillen_College_of_Medicine [accessed 2016-01-10] [WebCite Cache ID 6eRQUKcRM]
34. John A Burns School of Medicine. Honolulu, HI: John A Burns School of Medicine University of Hawai'i at Mānoa URL: http://jabsom.hawaii.edu/ [accessed 2016-01-10] [WebCite Cache ID 6eRQbAODl]
35. University of Illinois, College of Medicine. Chicago, IL: University of Illinois, College of Medicine Medical Scientist Training Program (MSTP) URL: http://chicago.medicine.uic.edu/education/masters_and_doctorate_programs/medical_scientist_training_program___m_s_t_p_ [accessed 2016-01-10] [WebCite Cache ID 6eRQkGKs2]
36. University of Ottawa, Faculty of Medicine. Ottawa, ON: University of Ottawa, Faculty of Medicine Our coat of arms URL: https://med.uottawa.ca/en/about/history/our-coat-arms [accessed 2016-01-10] [WebCite Cache ID 6eRUYO5Pq]
37. Trademarkia. AAMC American Association of Medical Colleges URL: http://www.trademarkia.com/aamc-association-of-american-medical-colleges-76505303.html [accessed 2016-01-10] [WebCite Cache ID 6eRRRezy2]
38. American Association of Medical Colleges. URL: https://www.aamc.org/ [accessed 2016-01-10] [WebCite Cache ID 6eRRfVxe7]
39. Current Policies: Adopted 1954–2013. Chicago, IL: American Dental Association; 2014. Dental insigne URL: http://www.ada.org/~/media/ADA/Member%20Center/FIles/2013%20Current%20Policies%20Final.ashx [accessed 2016-01-10] [WebCite Cache ID 6eQysmgYs]
40. Smith W. A Dictionary of Greek and Roman Biography and Mythology. Boston, MA: Little, Brown and Co; 1867.
41. Pharmaceutical Symbols. London, UK: Museum of the Royal Pharmaceutical Society URL: http://www.rpharms.com/museum-pdfs/13-pharmaceutical-symbols.pdf [accessed 2016-01-10] [WebCite Cache ID 6eQzSFwxj]

42. Cohen J. A coefficient of agreement for nominal scales. Educ Psychol Meas 1960 Apr 01;20(1):37-46. [doi: 10.1177/001316446002000104]
43. United States Census Bureau. Geographic terms and concepts - Census divisions and census regions URL: https://www.census.gov/geo/reference/gtc/gtc_census_divreg.html [accessed 2016-01-10] [WebCite Cache ID 6eQzXTdF1]
44. Dana CL. The cult of Aesculapius, his statues and his temples. In: The Proceedings of the Charaka Club. Volume I. New York, NY: William Wood and Company; 1902:59-71.
45. The White House. Health care in America URL: https://m.whitehouse.gov/health-care-in-america?utm_source=email&utm_medium=email&utm_content=email470-text1&utm_campaign=healthcare [WebCite Cache ID 6eQzhDOC6]

Abbreviations

AAMC: Association of American Medical Colleges
N/A: not applicable
OR: odds ratio
PR: Puerto Rico
US: the United States

Edited by G Eysenbach; submitted 11.01.16; peer-reviewed by E van Leeuwen, A Shetty; accepted 25.03.16; published 25.05.16.

Please cite as:
Hamann C, Martelon M
Branding Asklepios and the Traditional and Variant Serpent Symbol Display Among Health Professional Schools in the United States, Puerto Rico, and Canada: A Cross-Sectional Survey
JMIR Medical Education 2016;2(1):e6
URL: http://mededu.jmir.org/2016/1/e6/
doi:10.2196/mededu.5515
PMID:27731851

Original Paper

Health Sciences Students' Self-Assessment of Information and Communication Technology Skills and Attitude Toward e-Learning

Ali Jassem Buabbas[1], MSc, PhD; Hamza Mohammad Hassan Al-Shawaf[2], BSc, MSc; Abdullah Abdulaziz Almajran[1], BSc, MSc

[1]Faculty of Medicine, Department of Community Medicine and Behavioral Sciences, Kuwait University, Jabriya, Kuwait
[2]Faculty of Allied Health Sciences, Department of Health Information Administration, Kuwait University, Jabriya, Kuwait

Corresponding Author:
Ali Jassem Buabbas, MSc, PhD
Faculty of Medicine
Department of Community Medicine and Behavioral Sciences
Kuwait University
Jabriya
Kuwait
Phone: 965 25319504
Fax: 965 25330472
Email: ali.buabbas@hsc.edu.kw

Abstract

Background: In medical education, information and communication technology (ICT) knowledge and skills have become a necessity and an integral part of preparing tomorrow's doctors to be sufficiently competent to use informatics resources effectively and efficiently for the best practice of medicine.

Objective: This research aimed to study the literacy of the preprofessional students in ICT before and after taking the basic informatics course at the Health Sciences Center at Kuwait University, to understand their potential and their attitudes toward using ICT, including e-learning.

Methods: A validated questionnaire was used to collect data from 200 students in 2 stages: before and after the informatics course on the preprofessional program. In addition, the tutors' observational assessments of the students' achievements during the informatics course were obtained.

Results: The response rate of students before the course was 85.5% (171/200) and after was 77% (154/200). Of 200 students, 85% were female, and 15% were male. This disproportional representation of genders was due to the fact that 85% of registered students were female. Approximately 59% (101/171) of the students assessed themselves before the course as computer literate; afterward, this increased to 70.1% (108/154). Students who were still computer illiterate (29.2%; 45/154) mostly used the excuse of a lack of time (60%; 27/45). In generic ICT skills, the highest levels were for word processing, email, and Web browsing, whereas the lowest levels were for spreadsheets and database. In specific ICT skills, most respondents were reported low levels for statistical package use and Web page design. The results found that there was a significant improvement between students' general ICT skills before and after the course. The results showed that there were significant improvement between how frequently students were using Medline ($P<.001$), Google Scholar ($P<.001$), and Cochrane Library ($P<.001$) before and after the informatics course. Furthermore, most of the students who completed the course (72.8%; 110/151) chose the learning management system as the most useful e-learning tool. The results of the tutors' assessments confirmed the obvious improvement in most of the students' skills in using ICT.

Conclusions: The ICT knowledge and skills of the students before the course seemed insufficient, and the magnitude of the improvements that were acquired throughout the informatics course was obvious in most of the students' performance. However, the findings reveal that more practice was required. The attitudes of most of the students toward the potential of e-learning were considered positive, although the potential of Web-based learning in medical training was not well known among the students.

(JMIR Med Educ 2016;2(1):e9) doi:10.2196/mededu.5606

KEYWORDS

ICT literacy; health sciences student attitudes; health informatics; e-learning; medical education

Introduction

In medical education, information and communication technology (ICT) knowledge and skills have become a necessity and an integral part of preparing tomorrow's doctors to be sufficiently competent to use the varied informatics resources effectively and efficiently for the best practice of medicine. Introducing ICT at early stages in the medical education system will ensure that future health care providers are well equipped and able to use different informatics resources in an effective and efficient manner to improve their practices. For instance, ICT enhances competency in the use of medical databases and search strategies, the navigation of websites, the use of Microsoft Office, and the use of e-learning, as well as the use of electronic records [1,2].

Many higher education institutions around the world have adopted ICT to enhance the educational process. Incorporating ICT into education is widely adopted by developed countries, in which the Internet, Web-based databases, e-learning, and other resources can be used by the students and staff [3]. In the United States, the need to introduce ICT into medical education was demonstrated when academic staff found themselves responsible for a wide array of current topics that needed to be delivered to the students [4]. However, the standard educational method alone could not support such needs at that time. Furthermore, countries in the Middle East, such as Egypt, Jordan, and Saudi Arabia, have implemented different ICT tools, which have improved the students' leaning experience [5-8]. In Iran, the impact of digital technologies applications on education has been studied [9,10], with particular attention on ICT literacy of medical students [11,12]. In Kuwait, research studies at Kuwait University found into information literacy and Internet use among students [13] and effectiveness of e-learning on learning environment [14].

Kuwait University Health Sciences Center

Kuwait University has experience of adopting and using ICT to support the traditional teaching and learning processes, but few of the faculties have used these facilities. The matter is not about bringing technology to the educational field, it is about the competence of the user or student that is going to use the computer technology efficiently.

The Health Sciences Center (HSC) at Kuwait University uses only a conventional educational method, which focuses on the material itself rather than the learner, although the facilities are equipped with modern computer systems, computer laboratories, and a library supported by varied e-resources. Kuwait University is striving toward attaining the optimum environment for students to acquire the best education that keeps pace with developments worldwide by availing the latest technologies. As a result, an informatics course in a preprofessional program has been prepared for all students from medicine, dentistry, and pharmacy who have newly joined the HSC.

In many universities, obligatory courses in basic computer knowledge are offered to students, although there are still differences in computer skills among the students [2]. In Kuwaiti society, the use of ICT is widespread and has spread among people through mobile phones and notebooks. In addition, their experiences in using computers made us curious to know what ICT skills the students had before joining the university.

Overall, in the Middle East, little research has been done on ICT or informatics in medical education [5,8]. Consequently, assessing students for their literacy in using ICT at the HSC is considered new research at Kuwait University.

Research Questions

- Are preprofessional students literate in using ICT for faculty-related purposes at the HSC?
- What are the attitudes of the students toward using an e-learning system at the HSC?

This research aimed to study the literacy of the preprofessional students in ICT before and after taking the basic informatics course at the HSC at Kuwait University, to understand their potential and their attitudes toward using ICT, including e-learning.

Research Objectives

Before starting the course:

1. To explore the existing ICT knowledge and skills of the preprofessional students.

2. To explore the attitudes of the students toward using the e-learning system.

After completing the course:

1. To identify the ICT knowledge and skills acquired after completing the informatics course.

2. To assess the attitudes of the students toward using the e-learning system.

Methods

Study Design and Population

This cross-sectional study enrolled first-year students attending the HSC at Kuwait University who were registered on the "Informatics in Healthcare" course. This course is mandatory for all preprofessional students from medicine, dentistry, and pharmacy in the first semester at the HSC in Kuwait University. It covers the following topics: an overview of health informatics, the information hierarchy of the health information system, Web-based medical resources, and medical information retrieval, in addition to the use of Microsoft Office programs, which are offered over the Internet to the students via the electronic resources of Kuwait University. This course on informatics in health care is taught once a week and is supported by computer laboratory sessions, where students can practice accessing Web-based databases to locate specific research articles and to evaluate formal website design using specific criteria. Informed consent was obtained from each participant in the study. Ethical approval was elicited from the Research Committee at the HSC at Kuwait University.

Study Design

This study used an ICT literacy and resource utilization survey, which is a validated questionnaire [15]. This questionnaire was modified to suit our research objectives. This modification included excluding some ICT skills from the questionnaire, which encompassed: 2 generic ICT skills (programming and software installation) and 7 specific ICT skills, namely: print out a document, cut and paste information, draw and paint, organize, learn new applications, play games, and set up a mailbox. These excluded items were found to be irrelevant to the health informatics course, although some specific skills were asked in the questionnaire in a general form, such as print out a document, cut and paste information, and set up a mailbox. The questionnaire was pretested with 20 students, who were excluded from the main study.

The collection of data was performed in 2 stages. Stage 1: Before starting the course in September 2015, the students were asked in the introductory lecture to complete a Web-based questionnaire that was posted on "Moodle" (the Web-based learning environment). Stage 2: After completing the course in December 2015, the students were asked to complete the same Web-based questionnaire. The ICT literacy of the students was assessed using a questionnaire with 20 items comprising 4 criteria: (1) demographic data; (2) ICT training and skills, including (a) generic ICT skills and (b) specific ICT skills; (3) ICT resource availability and utilization; and (4) attitudes toward e-learning using computer skills.

In addition to the self-perceived questionnaire, an assessment was included in this study to maximize the validity of the individualized assessment. This was made through sending an email to 3 of the course tutors to obtain their opinions on students' achievements during the course. This assessment was based on the students' competencies, including course assessments in the following items: (1) skills in using computer software, such as Microsoft Office, including word processing, where the students were assessed in creating and editing a document, writing 100 words, inserting a table using given data, and inserting a page number, header, and footer. In regard to Excel sheets, the students were assessed in opening a sheet, inserting a table with given data, using a formula to calculate the average percentage, inserting a column with a title, and using ascending and descending orders. In regard to PowerPoint graphical presentations, the students were assessed in creating a slide with a title, inserting a table using given data, using a chart to present the data graphically, inserting and resizing the chart image, and changing the font size. Finally, all files had to be given new names and saved to the desktop. (2) Using different electronic resources to retrieve medical information and research articles, the students were asked a question that required access to the e-library at Kuwait University to retrieve medical information, such as a description of a disease or a clinical use of a medication. Moreover, a citation was provided to the students to search and find the full-text article using the PubMed, Scopus, or Ovid databases. Also, the tutors were asked to describe (3) the students' attitudes regarding using "Moodle" as a learning management system with multiple functions, such as Web-based discussions.

Statistical Analysis

For the questionnaire, the data obtained were processed and analyzed using the Statistical Package for the Social Sciences (SPSS version 23). Comparisons of frequencies before and after the course were performed using the chi-square test, considering the probability value P<.05 as statistically significant. For the data obtained from the tutors, analysis was made manually using the aforementioned 3 items of course assessment to assess the students' achievements appropriately.

Results

Questionnaires

Description of Study Population

Of 200 students, 171 responded to the questionnaire before starting the course, giving a response rate of 85.5%. By contrast, 154 students completed the questionnaire after completing the course, with a response rate of 77%.

Demographic Data

Table 1 summarizes the characteristics of the sample study. Most students were female, representing 84.9% (276/325) of the total respondents. This disproportional representation of genders was due to the fact that 85% of the registered students were female. Kuwaiti students represented 90.2% (293/325) of the total respondents, which constituted most of the sample.

Table 1. Demographics of the preprofessional students.

Characteristics		Total No. (%)	Before No. (%)	After No. (%)
Number		325	171	154
Age (Mean±SD, years)		17.8 ±0.60	17.7 ±0.62	17.9 ±0.57
	17	96 (29.7)	62 (36.5)	(22.2)
	18	193 (59.8)	92 (54.1)	101 (66)
	19	34 (10.5)	16 (9.4)	18 (11.8)
Gender				
	Female	276 (84.9)	145 (84.8)	131 (85.1)
	Male	49 (15.1)	26 (15.2)	23 (14.9)
Nationality				
	Kuwaiti	293 (90.2)	152 (88.9)	141 (91.6)
	Non-Kuwaiti	32 (9.8)	19 (11.1)	13 (8.4)

ICT Training and Skills

The students were asked 4 questions; 3 of them were about their background in using ICT, including queries about previous training courses, computer literacy, and reasons for illiteracy. The last question of this section assessed the students' ICT skills, which were divided into 2 levels: generic and specific items (see Table 2). Each item was rated on a scale of 1 to 4 regarding the proficiency of use ("I do not know," "some elementary skills," "can use it but need to learn more," and "acceptable skills," which means that the student feels at ease when using computer software).

Table 2. Generic and specific ICT skills.

Skill	Included items
Generic ICT skills	Use of word processing, Windows, file management, graphical presentations and PowerPoint, spreadsheets, email, Web-based databases, and Web browsing.
Specific ICT skills	Use of statistical packages, Web-based discussions, and Web page design.

The results of the questionnaires show that most of the students (63.9%; 108/169) had not received any previous ICT training before joining the university, whereas only 36.1% (61/169) of the students had received training on ICT, mostly in an informal way (72%; 44/61). The study shows that 60.1% (101/168) of the students assessed themselves as computer literate before taking the course, whereas 39.9% did not, mostly using the excuses of a lack of time (39%; 26/67) and not being interested in computers (37%; 25/67). After the students had completed the course, the results show that 70.6% (108/153) of the students assessed themselves as computer literate, whereas 29.4% (45/153) did not, citing lack of time (60%; 27/45) as the main reason.

Generic ICT Skills

In this section, the students were asked about their general ICT skills. Table 3 summarizes the self-assessment of students' ICT knowledge and skills before and after the informatics course. The highest levels of students' skills were for word processing, email, and Web browsing, whereas the lowest levels were for spreadsheets and database. The study results before the course reveal that the students skills were mostly between the average (can use it but want to learn more) and acceptable levels (feel at ease when using computer software) for word processing, Windows, PowerPoint and graphical presentations, email, and Web browsing. Regarding other skills, including using spreadsheets and databases, most of the students were between the categories "no elementary skills" and "some elementary skills."

After the health informatics course, most of the students' generic skills were improved. The study results show that there were significant positive improvements in the students' general ICT skills before and after the course in regard to the use of graphical presentations and PowerPoint (P=.001), spreadsheets (P=.006), Web-based databases (P<.001), file management (P=.002), and email (P=.046). By contrast, there were no significant improvements in the levels of students' skills in regard to word processing (P=.290), Windows (P=.211), and Web browsing (P=.821) before and after the informatics course.

Table 3. Data analysis of the preprofessional students' general ICT skills.

Skills	Before No. (%)	After No. (%)
Word processing		
Do not know how to use it	12 (7.2)	9 (5.8)
Some elementary skills	14 (8.4)	18 (11.7)
Can use it but want to learn more	61 (36.7)	36 (23.4)
My skills are acceptable	79 (47.6)	91 (59.1)
Windows		
Do not know how to use it	7 (4.2)	3 (1.9)
Some elementary skills	29 (17.3)	35 (22.7)
Can use it but want to learn more	80 (47.6)	49 (31.8)
My skills are acceptable	52 (31)	67 (43.5)
File management		
Do not know how to use it	26 (15.5)	10 (6.5)
Some elementary skills	48 (28.6)	34 (22.2)
Can use it but want to learn more	54 (32.1)	58 (37.9)
My skills are acceptable	40 (23.8)	51 (33.3)
Graphical presentations and PowerPoint		
Do not know how to use it	17 (10.1)	9 (5.9)
Some elementary skills	30 (17.9)	19 (12.5)
Can use it but want to learn more	73 (43.5)	50 (32.9)
My skills are acceptable	48 (28.6)	74 (48.7)
Spreadsheet		
Do not know how to use it	60 (36.6)	40 (26.7)
Some elementary skills	60 (36.6)	47 (31.3)
Can use it but want to learn more	28 (17.1)	39 (26)
My skills are acceptable	16 (9.8)	24 (16)
Database		
Do not know how to use it	66 (39.5)	36 (23.5)
Some elementary skills	54 (32.3)	36 (23.5)
Can use it but want to learn more	38 (22.8)	44 (28.8)
My skills are acceptable	9 (5.4)	37 (24.2)
Email		
Do not know how to use it	6 (3.6)	3 (2)
Some elementary skills	20 (12)	12 (7.9)
Can use it but want to learn more	44 (26.3)	33 (21.7)
My skills are acceptable	97 (58.1)	104 (68.4)
Web browsing		
Do not know how to use it	6 (3.6)	3 (1.9)
Some elementary skills	8 (4.8)	16 (10.4)
Can use it but want to learn more	37 (22)	27 (17.5)
My skills are acceptable	117 (69.6)	108 (70.1)

Specific ICT Skills

In this section, students were assessed regarding their specific ICT knowledge and skills before and after the informatics course. Before the course, the study results show that most of the students were between the average (can use it but want to learn more) and acceptable levels (feel at ease when using computer software) regarding Web-based discussions. Regarding other skills, such as Web page design and using statistical packages, most of the students were reported low levels, which fall the categories "no elementary skills" and "some elementary skills" (see Table 4).

From the study results, it is revealed that there were significant positive improvements between the students' skills before and after the informatics course for statistical package use (*P*<.001) and Web page design (*P*<.001). However, there was no significant association with Web-based discussions, where *P*=.480, showing no significant improvement in the students' skills.

Table 4. Data analysis of the preprofessional students' specific ICT skills.

Skills	Before No. (%)	After No. (%)
Use of a statistical package		
Do not know how to use it	55 (33.7)	31 (20.8)
Some elementary skills	62 (38)	34 (22.8)
Can use it but want to learn more	34 (20.9)	44 (29.5)
My skills are acceptable	12 (7.4)	40 (26.8)
Web-based discussions		
Do not know how to use it	26 (15.8)	26 (17)
Some elementary skills	40 (24.2)	29 (19)
Can use it but want to learn more	44 (26.7)	38 (24.8)
My skills are acceptable	55 (33.3)	60 (39.2)
Web page design		
Do not know how to use it	61 (36.7)	33 (21.9)
Some elementary skills	64 (38.6)	50 (33.1)
Can use it but want to learn more	32 (19.3)	30 (19.9)
My skills are acceptable	9 (5.4)	38 (25.2)

ICT Resource Availability and Utilization

Ten questions were asked to the students about their main access to a computer or the Internet and how they use ICT resources (Microsoft Word, spreadsheets, charts, Web-based discussions, and searching the Internet for medical information), e-information sources, and e-learning programs, based on a frequency scale ("never," "rarely," "quite often," and "very often").

The results show that most of the students before (82.1%; 138/168) and after the study (81.5%; 123/151) had personal computers, which the majority had been using for 1 to 3 years. Moreover, a high percentage of the students were using family Internet connections, including a telephone line or cable or another type of broadband. From the overall results, it is reported that the students were spending (mean ± standard deviation) 7.7 ± 12.8 hours per week regularly doing their work on computers.

In regard to ICT activities, the results show that there were no significant improvements between students using ICT for studying (*P*=.162) or for leisure (*P*=.062) purposes, before and after the informatics course, using frequency scales, where *P*>.05. There was only a significant positive association that proved an increase in the research activity at the end of the course, where *P*=.002.

With respect to the utilization of ICT resources among the students, it was found that there were no improvements between the frequency levels of students before and after the course in using Microsoft Word (*P*=.088), using spreadsheets (*P*=.086), using charts (*P*=.414), using Web-based discussion boards (*P*=.148), and searching the Internet for medical information (*P*=.685). There was only a positive significant association with email use (*P*<.001), wherein most of the students (before: 34.5%; 59/171, after: 63.6%; 98/154) showed an increase in using email very often (more than 2 times a week). From the results, it was noticed that many of the students had never used spreadsheets (47.4%; 81/171) and charts (38%; 65/154) before the course.

In regard to using e-information sources, the results show that there were significant positive associations between how frequently students used Medline (*P*<.001), Google Scholar (*P*=.001), and Cochrane Library (*P*<.001) before and after the informatics course, showing an increase in the use of e-information sources (see Table 5).

Table 5 shows that there was an obvious change in the number of students who had never used Medline (before: 117, after: 53) or Cochrane Library (before: 123, after: 75).

Table 5. Data analysis of the preprofessional students' use of e-information sources.

E-information sources	Before No. (%)	After No. (%)
Medline (PubMed or Ovid)		
0 (Never)	117 (68.4)	53 (34.4)
1 (Rarely: 1-7 times/semester)	37 (21.6)	64 (41.6)
2 (Quiet often: 2-7 times/month)	7 (4.1)	27 (17.5)
3 (very often ≥2 times/week)	1 (0.6)	6 (3.9)
Google Scholar		
0 (Never)	58 (33.9)	37 (24)
1 (Rarely: 1-7 times/semester)	35 (20.5)	61 (39.6)
2 (Quiet often: 2-7 times/month)	25 (14.6)	29 (18.8)
3 (very often ≥2 times/week)	44 (25.7)	22 (14.3)
Cochrane Library		
0 (Never)	123 (71.9)	75 (48.7)
1 (Rarely: 1-7 times/semester)	28 (16.4)	51 (33.1)
2 (Quiet often: 2-7 times/month)	9 (5.3)	18 (11.7)
3 (very often ≥2 times/week)	0 (0)	4 (2.6)

In the last question of this section, students were asked about their experience in using e-learning programs. The results showed that most of the students had experience with Web-based quizzes (before: 67.2%, after: 33.1%), image repositories (before: 16.3%, after: 9%), and learning management systems (before: 45%, after: 70.1%).

Attitudes Toward Using e-Learning

Two questions were asked to the students under this topic: question 1, with multiple choices about the most useful tools of e-learning from the students' points of view; and question 2, which provided 3 options (agreement, neutral, and disagreement) and asked about specific statements regarding e-learning in medical education.

From the results, the students said that the learning management system is the most useful tool of e-learning, as it is a portal for Web-based courses, scoring 49.1% (83/169) before the course and 72.8% (110/151) after the course. In regard to using e-learning in medical education, specifically regarding disagreement with the notion that e-learning can replace lectures, significant results were reported before (102; 60.7%) and after the course (51; 33.1%), giving $P<.001$. Furthermore, the results show that most of the students disagreed (86 (50.5%), 95(61.6%)) that there was no need for e-learning programs for medical training ($P=.07$). Most of the students (124 (72.5%), 115 (74.6%)) said that e-learning systems (including Web-based training) should supplement lectures and exercises ($P=.32$). Moreover, the results show that most of the students (134; 78.3%) believed before the course that e-learning was nothing more than the distribution of notes over the Internet. This belief was abated after completing the course (71; 46.4%), giving $P<.001$.

Tutors' Assessment of Students' ICT Skills

The results reveal that all 3 tutors confirmed that initially, most of the students had shown poor computer skills, such as using Microsoft Office. However, the students did well in the assessment after the course. As one of the tutors said, "*most of the students were struggling at first in using computer skills; thereafter, they showed their enthusiasm and did well in the assessment.*" Furthermore, the tutors stated that the students showed an obvious improvement in using numerous databases (PubMed, Google Scholar, Cochrane, Scopus, Ovid, and so forth) and became familiar with extracting medical information and using citations to retrieve full-text articles efficiently. Another tutor demonstrated that most of the students had become competent in using ICT for educational purposes through showing the total average grades of the students, which were 85% (very good) for using computer software programs and 92% (excellent) for using e-information resources and retrieving information or articles. In regard to the students' attitudes toward e-learning systems, the tutors observed that most of the students found it easy to follow the e-learning site and made use of this facility effectively through using e-books, e-lecture notes, and materials, in addition to the Web-based discussion.

Discussion

In this study, the literacy of the students, who came from different backgrounds, in ICT use was assessed, in addition to their attitudes toward using e-learning systems, which was of no lesser importance.

In general, the findings reveal that the informatics course made obvious improvements to the students' knowledge and skills, as most of students' responses showed a willingness to learn and practice to get to an acceptable level in which they feel at ease using computer programs. Furthermore, most of the students agreed with using e-learning systems as a supplement to conventional learning, although the findings reveal a lack of knowledge on the potential of Web-based technologies in education.

The findings show that the number of male students was lower compared with the number of female students at the HSC, at a ratio of 1:3. This disproportional representation of genders was due to the fact that 85% (276/325) of registered students were female.

The ICT Experience of Preprofessional Students at the HSC

The findings show that, before the course, more than half of the students assessed themselves as computer literate (60.1%; 101/168). After the informatics course had been completed in the preprofessional year, students' ICT literacy improved to 70.6% (108/153), whereas fewer students reported computer illiteracy. This could be explained that some of the students were occupied with their personal perceptions and expectations on the concept of literacy.

The findings of the study indicate that the students who were not interested (37%; 25/67) in computers, together with those who said they lacked time (60%; 27/45), lacked awareness about the potential impact of computers in education, particularly in medicine. Alternatively, it could be that using computers in education was not one of the top priorities of some of the students, as most of the students had received their ICT training informally (72%; 44/61) through private home sessions or from family or friends.

The findings reveal that the general ICT skills of the students improved after completing the course on informatics, especially regarding rating their use of Web-based literature databases as "acceptable" (before: 5.4%; 9/167, after: 24.2%; 38/154). Web-browsing skills had the highest percentage of students rating their skills as "acceptable": 70% before and after the course. This could indicate that Web browsing is a common skill among people who use computer technology. This result is consistent with those of previous studies that found Web browsing is on top priority when searching for information [11,12]. The results of the tutors' assessments of the students further complemented these findings and confirmed the competency of most of the students (average grade=85%) in using computer programs (Microsoft Word, Excel, and PowerPoint). Generally, this noticeable improvement in ICT skills pertained to the informatics course and its objectives, as it was intended to enable the students to use the e-resources offered by the HSC library and the e-learning center at Kuwait University.

On the basis of the findings of this study, the percentage of students who said they needed more knowledge in general ICT skills before the course on informatics was lower than the percentage who said they required it after the course. The impact of the informatics course on the students' pattern of general ICT use was apparent. Nevertheless, the findings indicate that additional general ICT knowledge was still required, particularly on spreadsheets or Excel.

In regard to specific ICT skills, the findings demonstrate that approximately half of the students who had some basic skills in Web page design, Web-based discussions, and statistical packages still asked for more learning, particularly for statistical packages. These findings are comparable to results of previous studies [7,12] that found software, such as Excel and statistical packages were less familiar among students, in which a training program is recommended.

The Preprofessional Students and ICT Resource Availability and Utilization

From the findings, it was revealed that most of the students (82% (before 138/168; after 123/151)) had personal computers with Internet connections. This indicates that computer and Internet connection availability was not an obstacle, particularly as these were offered by Kuwait University as well. These findings are consistent with those of a recent study in Saudi Arabia and another previous study in Jordan [8,5]. By contrast, in Egypt, some students (24.9%) found that having a computer with an Internet connection was a financial burden [7]. Furthermore, the frequency of email use among the students improved: before the course, 34.5% (59/171) of the students used email very often—this increased to 63.6% (98/154) after the course. A study in Kuwait University showed better results in regard to email use among social sciences students (70%) [13], in addition to other previous studies in the Gulf region, such as in Iran (86.8%) [6] and Saudi Arabia (98.6%) [8]. It seems that not all the preprofessional students were using email as the formal communication medium at the university, so they might have still been looking for person-to-person meetings, as they experienced when they were in high school.

After completing the course, improvement in the students' activities using ICT was reported mostly for research purposes. This is consistent with another finding in this study, which indicates an obvious increase in the use of the Medline (PubMed or Ovid) and Cochrane databases rather than Google Scholar after the course on informatics. This indicates that the students improved their knowledge during the course regarding the retrieval of medical information or searching for full-text articles and became familiar with several medical databases, such as Medline. This finding is similar to that of another study [5,16], in which PubMed was the most Internet sites the medical students used to access for academic purpose. However, some other studies [8,17] showed that Yahoo and Google were on the top of the Internet sites for searching the Internet among medical students.

Attitudes of Students Toward Using e-Learning in Medical Education

The findings show that the learning management system was chosen as the most useful tool of e-learning (before: 49.1%; 83/169, after: 72.8%; 110/151). This could demonstrate that the experience of the students in using "Moodle" throughout the course had an influence on their responses. In addition, some of the students preferred the easy way of getting material over the Internet at any time, as e-learning is considered a medium for sharing knowledge and experiences among students and staff, as shown by previous studies [18,19]. Moreover, the tutors of the course had observed most of the students enjoying e-learning and using the easy sharing of e-materials and knowledge through Web-based discussions.

Furthermore, the findings show that the students mostly disagreed (60.7%; 102/168) with the statement "Web-based learning programs are able to replace lectures" before the course started. The percentage of students who disagreed reduced to 33.1% (51/154) after the course, with an increase in agreement to 51.2% (79/154). This positive improvement could have resulted from the positive experience of students in using the Web-based learning management system during the course. However, the students preferred the blended learning system, reinforcing the findings of other studies [20-22]. Moreover, the findings show that the use of "Moodle" resulted in more positive responses from the students, which offered the students more individualization in the way of studying, as it supplemented the conventional learning approach. Hence, most of the students before (124; 72.5%) and after the study (115; 74.6%) preferred computer- and Web-based programs to support the traditional learning environment.

Finally, in regard to medical training and Web-based programs, 61.6% (95/154) of the students' responses were negative, stating that they did not need these programs during medical training. This could indicate that most of the students were not knowledgeable about the potential of computer- and Web-based programs, such as the use of e-learning systems, to track training performance and to supply the trainers with up-to-date information. This reflects the need for an improvement in the knowledge of the potential and power of Web-based learning programs in medical training and education.

Limitations

This study has some limitations: (1) the study excluded upper-class students in the faculties of medicine, dentistry, and pharmacy; (2) the study excluded other faculties of the HSC, such as allied health and public health; and (3) the students' attitudes regarding e-learning were assessed using a limited number of variables. Hence, future research should be entirely focused on this topic, considering more variables [18]. Furthermore, due to the high prevalence of mobile technology (e.g, mobile phones) among students in Kuwait, future research would be recommended to study the use of mobile phone technology in medical education among students and academic staff, as these digital technologies require skills to use [23].

Conclusion

Addressing today's health care issues requires well-educated and competent new generations of medical professionals to be good researchers, lifelong learners, and excellent clinicians. This will not be achieved unless they become competent in using ICT. Therefore, preprofessional students in medical education need to be equipped with ICT knowledge and skills to enable them to use the varied informatics resources offered to them in an efficient way. Accordingly, this research study has made 3 important conclusions: (1) the ICT skills of the students before the course seemed insufficient; (2) the magnitude of the improvements to the students' ICT knowledge and skills through the informatics course was obvious in most of the students' performance, but the findings reveal that more practice was required; and (3) the attitudes of the students toward using e-learning using their computer skills was considered positive, although the potential of Web-based learning in medical training was not apparent to all the students. On the basis of these conclusions, several recommendations are proposed: First, the use of HSC email should be promoted among preprofessional students as a standard communication medium in the university, so emails need to be checked and responded to regularly. Second, a supplementary section should be added to the course on informatics in medicine. This should talk about the different computer systems (including digital mobile technology) and Web-based programs used in medical education and training, such as computer-assisted learning, expert systems, and surgical simulation programs. Furthermore, include statistical packages in the curriculum of the course to enable the acquisition of the required skills in data analysis and spreadsheet use, including how to use charts for the presentation of results. Third, more time should be provided for practicing different ICT skills. This requires an increase in the time spent on teaching and practicing ICT for educational purposes. This could be possible if the module of the informatics course were given more flexibility in terms of time throughout the medical education curriculum. This has also been recommended by other studies [19,24]. Finally, the medical faculty's policy should be geared toward making the learning environment of the students electronic based to encourage the staff and students to use it, as suggested by other studies [24,25].

Acknowledgments

The authors thank the preprofessional students of the HSC for their participation in the study.

Conflicts of Interest

None declared.

References

1. Richardson JE, Bouquin DR, Tmanova LL, Wright D. Information and informatics literacies of first-year medical students. J Med Libr Assoc 2015 Oct;103(4):198-202 [FREE Full text] [doi: 10.3163/1536-5050.103.4.008] [Medline: 26512221]

2. Hamissi J, Gholami S, Hamissi H. Evaluation of information and communication technology knowledge among undergraduate dental students in Iran. Asian Journal of Computer Science and Information Technology. 2012. (8) p. 247-250 URL: http://innovativejournal.in/index.php/ajcsit/article/viewFile/322/309 [WebCite Cache ID 6iJJKvMM7]
3. Bauk S. Assessing Students' Perception of E-Learning in Blended Environment: An Experimental Study. Procedia - Social and Behavioral Sciences 2015 Jun;191:323-329. [doi: 10.1016/j.sbspro.2015.04.393]
4. Ruiz JG, Mintzer MJ, Leipzig RM. The impact of E-learning in medical education. Acad Med 2006 Mar;81(3):207-212. [Medline: 16501260]
5. Rajab LD, Baqain ZH. Use of information and communication technology among dental students at the University of Jordan. J Dent Educ 2005 Mar;69(3):387-398 [FREE Full text] [Medline: 15749951]
6. Hamissi J, Gholami S, Hamissi H. The Emerging Role of Computer Literacy in Improving the Performance of Dental Students. International Journal of Collaborative Research on Internal Medicine & Public Health. 2013. (7) p. 517-525 URL: http://www.iomcworld.com/ijcrimph/files/v05-n07-03.pdf [WebCite Cache ID 6iJJOUc0m]
7. Taher E, Ahmed D. The Extent of Computer Literacy among Medical Students at Cairo University and their Attitudes towards its Use in Medical Education. International Public Health Forum. 2014 Mar. (1) p. 30-36 URL: http://researchpub.org/journal/iphf/number/vol1-no1/vol1-no1-6.pdf [WebCite Cache ID 6iJJQnpiX]
8. Rahman G. Use of computers among students of dental college in Saudi Arabia. Journal of Education and Ethics in Dentistry 2011;1(1):12-17.
9. Farahani PZ, Bahamiriyan M, Sadeghi M. Information and Communication Technology in Education of Iran. International Journal of Economy, Management and Social Sciences. 2015 Jan. (1) p. 100-104 URL: http://www.tijournals.com/index.php?action=journal&page=showpaper&jid=6&iid=137&pid=822 [WebCite Cache ID 6iJJUxH38]
10. Kamali N, Shariatmadari A, Naderi E. Investigating the Role of ICT in the Educational System of Iran from the Perspective of Teachers and Students: A Case Study (Islamic Azad University (District 2)). IJAREMS 2014 Jul 19;3(4):1-10. [doi: 10.6007/IJAREMS/v3-i4/1039]
11. Mohagheghzadeh MS, Mortazavi SMJ, Ghasempour M, Jarideh S. The Impact of Computer and Information Communication Technology Literacy on the Academic Achievement of Medical and Dental Students at Shiraz University of Medical Sciences. Eur. Sci. J 2014;10(9):273-280.
12. Robabi H, Arbabisarjou A. Computer literacy among students of Zahedan University of Medical Sciences. Glob J Health Sci 2015 Jan;7(4):136-142 [FREE Full text] [doi: 10.5539/gjhs.v7n4p136] [Medline: 25946919]
13. Alqudsi-ghabra T, Al-Dousari E. Internet Use Among Incoming Undergraduate Students of Kuwait University. J. Info. Know. Mgmt 2014 Jun;13(02):11. [doi: 10.1142/S0219649214500178]
14. Safar AH, AlKhezzi FA. Beyond Computer Literacy: Technology Integration and Curriculum Transformation. College Student Journal 2013 Dec;47(4):614-626.
15. Eze BI, Mba AU, Ozemena OFN. Information and communication technology skills and resource utilization: preclinical versus clinical medical students in a resource-limited African setting. OAB 2011 Apr;3:75-84. [doi: 10.2147/OAB.S16473]
16. Ayatollahi A, Ayatollahi J, Ayatollahi F, Ayatollahi R, Shahcheraghi SH. Computer and Internet use among Undergraduate Medical Students in Iran. Pak J Med Sci 2014 Sep;30(5):1054-1058 [FREE Full text] [doi: 10.12669/pjms.305.5355] [Medline: 25225525]
17. Ashwin CS, Al Ghamdi NM, Al Amer WI. Utilization of electronic scientific information resources among undergraduate dental students in Kingdom of Saudi Arabia. J. Dent. Oral Hyg 2015 Jun 30;7(6):97-101. [doi: 10.5897/JDOH2015.0155]
18. Rowe M, Frantz J, Bozalek V. The role of blended learning in the clinical education of healthcare students: a systematic review. Med Teach 2012;34(4):e216-e221. [doi: 10.3109/0142159X.2012.642831] [Medline: 22455712]
19. Frehywot S, Vovides Y, Talib Z, Mikhail N, Ross H, Wohltjen H, et al. E-learning in medical education in resource constrained low- and middle-income countries. Hum Resour Health 2013;11:4 [FREE Full text] [doi: 10.1186/1478-4491-11-4] [Medline: 23379467]
20. Masic I. Quality assessment of medical education at faculty of medicine of sarajevo university - comparison of assessment between students in bologna process and old system of studying. Acta Inform Med 2013;21(2):76-82 [FREE Full text] [doi: 10.5455/aim.2013.21.76-82] [Medline: 24039331]
21. Hamissi J, Gholami S, Hamissi H. Evaluation of information and communication technology knowledge among undergraduate dental students in Iran. Asian Journal of Computer Science & Information Technology 2012;2(8):247-250.
22. Sezer B. Faculty of medicine students' attitudes towards electronic learning and their opinion for an example of distance learning application. Computers in Human Behavior 2016 Feb;55:932-939. [doi: 10.1016/j.chb.2015.10.018]
23. Mesko B, Győrffy Z, Kollár J. Digital Literacy in the Medical Curriculum: A Course With Social Media Tools and Gamification. JMIR Medical Education 2015 Oct 01;1(2):e6. [doi: 10.2196/mededu.4411]
24. George PP, Papachristou N, Belisario JM, Wang W, Wark PA, Cotic Z, et al. Online eLearning for undergraduates in health professions: A systematic review of the impact on knowledge, skills, attitudes and satisfaction. J Glob Health 2014 Jun;4(1):010406 [FREE Full text] [doi: 10.7189/jogh.04.010406] [Medline: 24976965]
25. Muñoz DC, Ortiz A, González C, López DM, Blobel B. Effective e-learning for health professional and medical students: the experience with SIAS-Intelligent Tutoring System. Stud Health Technol Inform 2010;156:89-102. [Medline: 20543344]

Abbreviations

HSC: Health Sciences Center
ICT: information and communication technology
SPSS: Statistical Package for the Social Sciences

Edited by G Eysenbach; submitted 05.02.16; peer-reviewed by M Clarke, N Lafferty, C Pimmer; comments to author 02.03.16; revised version received 22.03.16; accepted 05.05.16; published 20.06.16.

Please cite as:
Buabbas AJ, Al-Shawaf HMH, Almajran AA
Health Sciences Students' Self-Assessment of Information and Communication Technology Skills and Attitude Toward e-Learning
JMIR Med Educ 2016;2(1):e9
URL: http://mededu.jmir.org/2016/1/e9/
doi:10.2196/mededu.5606
PMID:27731863

Original Paper

Student Response to Remote-Online Case-Based Learning: A Qualitative Study

Peter Nicklen[1*], B Physio; Jennifer L Keating[1*], B AppSc, PG Dip Musculoskeletal, PhD; Stephen Maloney[1*], B Physio, MPH, PhD

Monash University, Department of Physiotherapy, Melbourne, Australia

[*]all authors contributed equally

Corresponding Author:
Peter Nicklen, B Physio
Monash University
Department of Physiotherapy
McMahons Road, Frankston VIC 3199
Melbourne,
Australia
Phone: 61 3 990 44240
Fax: 61 3 990 44812
Email: pdnic1@student.monash.edu

Abstract

Background: Case-based learning (CBL) typically involves face-to-face interaction in small collaborative groups with a focus on self-directed study. To our knowledge, no published studies report an evaluation of Web conferencing in CBL.

Objective: The primary aim of this study was to explore student perceptions and attitudes in response to a remote-online case-based learning (RO-CBL) experience.

Methods: This study took place over a 2-week period in 2013 at Monash University, Victoria, Australia. A third year cohort (n=73) of physiotherapy students was invited to participate. Students were required to participate in 2 training sessions, followed by RO-CBL across 2 sessions. The primary outcome of interest was the student feedback on the quality of the learning experience during RO-CBL participation. This was explored with a focus group and a survey.

Results: Most students (68/73) completed the postintervention survey (nonparticipation rate 8%). RO-CBL was generally well received by participants, with 59% (40/68) of participates stating that they'd like RO-CBL to be used in the future and 78% (53/68) of participants believing they could meet the CBL's learning objectives via RO-CBL. The 4 key themes relevant to student response to RO-CBL that emerged from the focus groups and open-ended questions on the postintervention survey were how RO-CBL compared to expectations, key benefits of RO-CBL including flexibility and time and cost savings, communication challenges in the online environment compared to face-to-face, and implications of moving to an online platform.

Conclusions: Web conferencing may be a suitable medium for students to participate in CBL. Participants were satisfied with the learning activity and felt they could meet the CBL's learning objectives. Further study should evaluate Web conferencing CBL across an entire semester in regard to student satisfaction, perceived depth of learning, and learning outcomes.

(JMIR Medical Education 2016;2(1):e3) doi:10.2196/mededu.5025

KEYWORDS

case-based learning; Web conferencing; remote-online case-based learning; student satisfaction; perceived depth of learning

Introduction

Case-based learning (CBL) is an educational approach where students work in collaborative groups to solve a series of problems presented in a context that students are likely to encounter in practice [1]. CBL typically involves face-to-face interaction in small groups with a focus on self-directed study [2]. In CBL, students are responsible for identifying knowledge deficits relating to the case; this encourages learners to develop and manage their own learning goals and strategies needed for lifelong learning [3]. Problem-based learning (PBL) is a different instructional method in which students in collaborative groups learn through facilitated problem solving, working through a complex problem that does not have a single correct answer [3]. Like CBL, PBL has a focus on self-directed learning;

however, a key difference suggested by Savery [4] is that CBL may influence the learner's role in setting the goals and outcomes for a problem given its structured nature around a case presentation. Given the similarities of the two methods, we feel the findings of our study would apply equally to PBL.

Computer-assisted learning (CAL) is the implementation of computer technology to create a rich environment for active learning [5]. CAL has the potential to facilitate active, self-directed learning and enhance student knowledge and understanding [6] and may complement the current CBL process [1]. Lewis et al [6] reviewed 25 papers evaluating the use of CAL in nursing education and highlighted the overall poor quality of the studies and need for further investigation. In a review of 6 papers, Cook [1] concluded that Web-based PBL in nursing education encourages student autonomy and provides flexibility and opportunities for discussion. However, a paucity of relevant research was also noted [1]. Other benefits of Web-based learning (WBL) include the reduction in barriers of distance and time and the option to individualize learning opportunities for students [7]. Major challenges reported include technical difficulties and slow download speeds, costs associated with setting up and participating in WBL activities, and the potential for students to experience social isolation [1,7]. Cook [7] defined WBL in medical education as any educational interventions that make use of the Internet (or a local intranet) and broadly categorized these into tutorials, online discussion groups, and virtual patients. In this study, Web conferencing was used to integrate CBL and WBL, which we labeled remote-online CBL (RO-CBL). To our knowledge, no published studies report an evaluation of Web conferencing in CBL.

Following a systematic review, Crawford [1] concluded that CAL could be beneficial within the context of CBL. Crawford [1] recommended that carefully planned training sessions are required to reduce some of the challenges of implementing a Web-based activity and further research is required to determine the effectiveness, efficiency, and sustainability of Web-based CBL. Student satisfaction was not an outcome of interest in that review. The authors of 4 randomized controlled studies [8-11] concluded that Web-based CBL is comparable to face-to-face CBL in student learning outcomes. However, training in preparation for Web-based activities was either not reported [9,10] or not reported with the detail required for replication [8,11]. None of the 4 trialed interventions incorporated online discussions in the form of Web conferencing.

Valaitis et al [12] also noted a lack of research into Web conferencing in health science education. Yeung [13] compared Web-conferenced learning to face-to-face learning and concluded that both approaches produce comparable learning outcomes. Anecdotally, participants generally have a high level of satisfaction with Web-conferenced learning [12,14-16]. However, it should be emphasized that Web-conferenced learning is a generic term incorporating a wide range of online systems with varying levels of functionality ranging from simple synchronous communication tools to high-technology replication of clinical environments such as virtual patients [17]. A pilot study by our research team provided data showing that RO-CBL results in comparable learning outcomes when compared to face-to-face CBL. Students faced connection issues during the pilot study, which resulted in CBL taking longer to complete; this made communication difficult and resulted in low student satisfaction. Raupach [10] also reported low student satisfaction with an online collaborative teaching module that incorporated live chats, asynchronous group discussions, and document exchange. Although both our study and the study by Raupach [10] indicated that learning outcomes for Web-based and face-to-face learning activities were comparable, low student satisfaction was a common theme with the Web-based medium. Student satisfaction is as important as learning outcomes when evaluating the effectiveness of new approaches to teaching and learning.

In an attempt to combat low student satisfaction, we explored student needs and preconceptions of RO-CBL prior to a trial of the learning activity. One-third of the participants (23/71, 32%) were hesitant to move to an online format. Prior to training, students reported that they understood how RO-CBL worked; however, they were unsure how it would work in practice. This could account for the hesitation to move to the online format. Training sessions were then designed to target improved understanding of RO-CBL and the way it works in practice. Following the training sessions, there was a significant shift with participants reporting increased knowledge about RO-CBL: how it would work in practice, how they could meet the learning objectives using this new mode of learning, and how it might be used effectively in the future. Participants were also confident using the Web conferencing software. It was hypothesized that targeted training when introducing Web-based learning might reduce resistance to change, enhance the potential for student satisfaction, and improve the learning experience.

This study was designed to investigate student feedback following an RO-CBL trial. The study aimed to explore how RO-CBL compared to preconceptions, evaluate overall student satisfaction and perceived depth of learning, and identify possible barriers to the uptake of Web-based CBL by understanding the student experience.

Methods

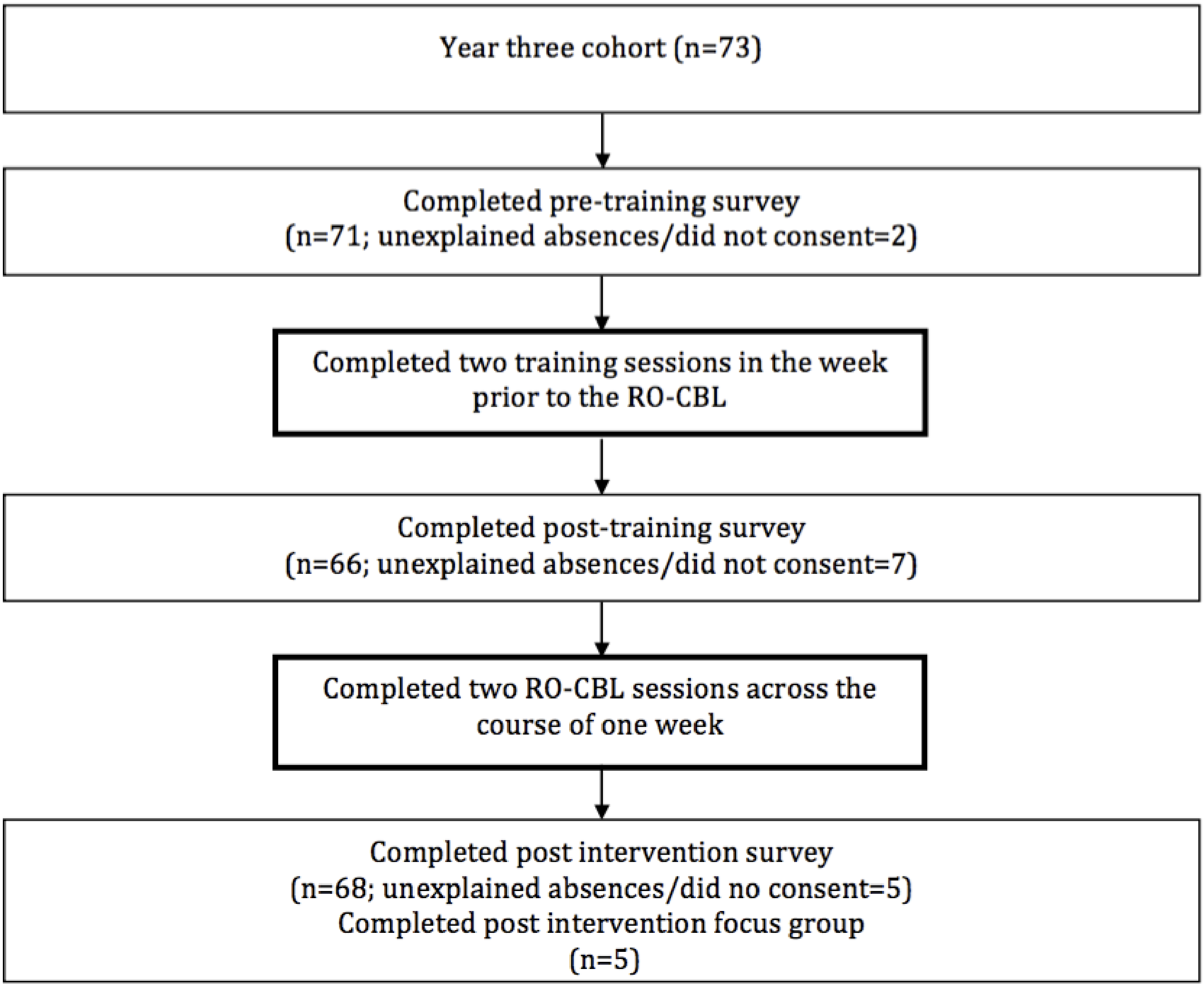
Design

This study used a mixed methods framework (focus groups and surveys) to assess the perceived value of RO-CBL after exposure to activities designed to build skills for participating in Internet-based CBL. Ethics approval was obtained through the Monash University Human Research Ethics Committee (Ethics CF 13/456-2013000200).

Participants

This study took place over a 2-week period in 2013 at Monash University, Victoria, Australia. All students are required to complete the RO-CBL as part of the third year curriculum, and the entire cohort (n=73) was invited to participate in the study. An independent research assistant recruited participants through face-to-face delivery and distribution of an information package with an explanatory statement. Students who did not consent to the study were not required to complete the outcome measures questionnaires that were administered. Figure 1 summarizes participant flow and data collection process.

Figure 1. Participant flowchart and data collection points.



Intervention

In the Monash physiotherapy program, the two-part CBL is completed in small groups of 4 to 6 students on campus over the course of one academic week. Students are required to assign members of their CBL team the roles of leader, scribe, and recorder. The leader's role is to keep the discussion on topic and make sure the CBL is completed within the designated time frame. In the traditional CBL format, the scribe makes notes of discussions on a whiteboard, and the recorder transcribes the whiteboard notes to a format that can be distributed to other students. In earlier years of the program, students learn to conduct effective CBL with dedicated facilitators. By the third year, students are reasonably proficient, and only one academic facilitator is required to monitor and provide guidance to all CBL groups, encouraging student-led discovery and achievement of learning objectives.

Part 1 of the case begins with a trigger (brief scene setting), followed by the case details: history, physical examination outcomes, further information, actions arising (eg, treatments, tests), reassessment, and closure, all of which are scripted to simulate a typical client interaction. Students are required to answer questions presented throughout the case and produce a problem list, which helps guide discussion. Students identify additional learning they are required to seek out in order to understand the case (learning issues); these questions and topics are then researched by individuals or groups of students during the week and presented to the group in Part 2.

During the first semester of 2013, third year students participated in an RO-CBL. Students were required to attend two training sessions the week prior to the RO-CBL, which then took place over the course of one week and required students to complete Part 1 and Part 2 online in groups of 4 to 6. Students were not required to be on campus, allowing them to participate from a location of their choice. Students supplied their own computers, microphones, and video cameras. One academic facilitator was responsible for monitoring all groups.

Web Conferencing Software

The Web conferencing software (Google Hangouts) allowed students to interact via webcam and microphone as well as access and work collaboratively on the same document. This shared document saved automatically and could be viewed by students at any time during or after the CBL. Students were also able to upload documents and present findings to others in the group using the screen sharing function. All students used the same Web conferencing software.

Training Procedure

Two training sessions occurred prior to the RO-CBL. The first was a 60-minute information session run by the RO-CBL facilitator. During this session, students were shown how to set up an RO-CBL and use the key functions with a step-by-step demonstration of the Web conferencing software. The second session was a 30-minute self-directed session. Students were required to set up an RO-CBL and complete a checklist demonstrating that they had mastered the key features of the Web conferencing software. Two assistants were available to answer questions and help with issues that arose. Students also had access to the sessions in the weeks prior to the RO-CBL and were encouraged to explore them during this time.

Outcomes

The primary outcomes of interest were the student perceptions and attitudes in response to an RO-CBL learning experience, collected via focus group and survey following participation in the RO-CBL. Postparticipation assessment to understand the student experience explored student satisfaction, perceived depth of learning, and how RO-CBL compared to preconceptions to identify possible barriers to the uptake of Web-based CBL.

The survey was distributed on the day following Part 2 of the RO-CBL. It explored opinions about the experience of participation and the willingness to incorporate RO-CBL into the curriculum. Responses were provided using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." There were 3 open-ended questions: What did you like about the RO-CBL experience? How could your RO-CBL and/or training be improved? How did the RO-CBL experience compare to your preconceived thoughts? Data contributing to an economic analysis of RO-CBL compared to traditional face-to-face CBL were also collected [18]. The survey was distributed and collected by a research assistant who was not involved in teaching or assessing participants. Students who completed both RO-CBL sessions were invited to participate in optional focus groups by a second independent research assistant who also ran the session. Participant selection was based on order of response to the invitation.

Two focus groups were conducted approximately 2 weeks after the intervention period and ran for approximately 30 minutes each. Inquiry was aligned with the survey and allowed for greater depth of discussion. Survey responses and focus group data were collected prior to analysis. Textbox 1 presents the focus group questions that served as prompts for discussion. An external transcription service was used to deidentify and transcribe recordings.

Textbox 1. Focus group questions.

Questions guiding focus group discussion:

- What did you like about the online CBL experience?
- How does this experience compare to your preconceptions of online CBL?
- What could have improved the online CBL experience?
- How do you see online CBL being used in the future?

Data Analysis

Thematic analysis was used to interpret the focus group transcripts and responses to the open-ended questions. Two independent researchers classified and grouped segments of text to create and define themes that emerged from the data [19]. Responses to both the focus group and open-ended questions were pooled prior to coding and development of themes. Once patterns were identified after coding, the researchers worked together to reach a consensus on the final themes. Responses to Likert scales were summarized using percentage and number of participants selecting each response option.

Results

Participants

All students enrolled in the third year of a Bachelor of Physiotherapy program at Monash University, Victoria, Australia, in 2013 were invited to participate. All 73 students were required to attend the two training sessions and complete the two parts of the RO-CBL in the designated times. Of these, 68 students completed the postintervention survey (nonparticipation rate 8%) and 5 participated in the focus groups.

Survey Responses

Almost all participants responded to the questions "What did you like about the RO-CBL experience?" (67/68, 99%) and "How did the RO-CBL experience compare to your preconceived thoughts?" (66/68, 97%). Fewer participants (55/68, 81%) responded to the question "How could your RO-CBL and/or training be improved?" See Table 1 for responses to the postintervention surveys.

Table 1. Postlearning activity survey responses.

	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)
I met the CBL's learning objectives via RO-CBL.	0 (0)	1 (1)	14 (21)	30 (44)	23 (34)
I could envisage RO-CBL being used in the future.	1 (1)	2 (3)	15 (22)	24 (35)	26 (38)
I would not like RO-CBL to be used in the future.	17 (25)	23 (34)	18 (26)	6 (9)	4 (6)
I did not enjoy trialing RO-CBL.	28 (41)	22 (32)	10 (15)	7 (10)	1 (1)
With some more practice, I believe I would prefer RO-CBL to face-to-face CBL.	3 (4)	13 (19)	25 (37)	12 (18)	15 (22)
Google Hangouts was difficult to use.	23 (34)	29 (43)	12 (18)	3 (4)	1 (1)

The 4 key themes relevant to student response to RO-CBL that emerged from the focus groups and open-ended questions on the postintervention survey were expectations, benefits of RO-CBL, communication, and implications of moving to an online platform.

Theme 1: Expectations

RO-CBL surpassed many students' initial expectations. Almost half (32/68, 47%) of the participants reported that RO-CBL was better than anticipated, stating that it was much smoother, easier to use, more enjoyable, and more practical than expected. Two participants stated they would be happy to use RO-CBL again, and 59% (40/68) disagreed with the statement "I would not like RO-CBL to be used in the future."

> *I was a little hesitant to begin with however I enjoyed the experience and would use it again.*
>
> *Thought it was going to be really bad, turns out was quite practical and have since used it for group assignments.*

A total of 9 (13%) participants stated that RO-CBL met their expectations. One participant suggested this was due to adequate training prior to the learning activity; another had prior experience with video calls.

> *I thought it was pretty much what I expected from the lectures . . . I guess I've done . . . Skype calls and things like that before, so I knew how it was going to work and it . . . worked that way.*

In contrast to this, 9% (6/68) of participants reported that RO-CBL did not meet expectations, stating that it did not run as smoothly as anticipated. One student suggested this might be due to poor Internet connectivity.

> *I just expected us to just do . . . a normal CBL case, read it out and have a bit more interaction. But it just turned out that we couldn't do that, because . . . maybe it was just our Internet connections and everything like that, but it just didn't flow.*

Theme 2: Benefits of RO-CBL

One significant benefit of RO-CBL is a flexibility that allowed participants to complete the CBL without having to be on campus. This had a significant impact on both time and costs associated with travel, including gas and road tolls.

> *I saved East Link [toll road], which up and back, that's $10 a day for me; and I saved petrol, which is probably $7, $7.50 a day for up and back as well. So that's $20, almost. I wouldn't mind that in my pocket.*

This reduction in travel time gave participants an opportunity to complete other activities, including study, work and job seeking, exercise, and additional sleep.

> *Obviously [RO-CBL] is going to affect how much I spent on petrol and things like that as well; that I got to sleep in more, which was really good, and I got to spend that time that I didn't spend travelling doing things like study and stuff like that, which was really good.*

Three participants in the focus group and 4 in the open-ended questions noted that RO-CBL was more efficient compared to traditional face-to-face CBL. Participants proposed this might be due to decreased set-up time, a reduction in additional conversation, or not having to wait for someone to write notes on a whiteboard. These participants did not believe that the increased efficiency led to a decreased attention to detail during discussions.

> *The CBL could be done in a shorter time frame as you needed to get straight to the point and it was too difficult to have big chats or go off topic.*
>
> *I think we were able to look at everything in detail. But just because no one was writing up, it just made it a bit faster.*

Theme 3: Communication

Communication issues were noted during the RO-CBL by 9% (8/68) of participants in the open-ended questions. This was primarily due to Internet and microphone dropouts as well as microphone feedback between students. One participant suggested that this affected the quality of the CBL, and another suggested it affected the CBL's efficiency.

> *Often . . . students . . . dropped out and then had to go back in, and we couldn't hear them, and the microphone wouldn't turn on properly. That really affected the quality, sometimes, of the CBL . . .*

Some participants had difficulty with communication etiquette in the online environment. Participants recognized that video chat did not allow them to interpret body language, which meant that some hesitated when contributing to the discussion. It also meant that participants found themselves talking over one another because they could not predict when another group member was about to talk.

> *You don't want to start speaking at the same time, and then you're cutting other people off, and it's harder to hear both. So I just thought that . . . etiquette thing was something, if it was worked on a bit more, then it'd flow better.*

The same number of participants stated that communication was easier than anticipated with RO-CBL.

> *I did not think initially that discussion would be possible with Internet dropouts however this was not the case.*

> *There wasn't an issue participating and taking turns. With further use it could improve as the novelty wears off and concentration increases.*

Theme 4: Implications of Moving to an Online Platform

One implication of moving to an online platform is the possibility of difficulties associated with technology. Participants reported Internet disconnections that would result in their removal from the online workspace. Poor Internet connection also contributed to video and audio lag. Three participants recognized the need for more technical support. Other participants had no issues with Internet connectivity or other technical issues.

> *Whilst I liked doing CBL at home . . . people would log in and out due to technical difficulties, which made it hard.*

> *The RO-CBL worked a lot better than I thought it would as a group we didn't encounter any tech difficulties, which I thought we might.*

Other issues associated with online learning identified by the participants included motivation and accountability. Three participants stated that they believed they learn better with face-to-face interactions compared to online due to increased motivation and decreased distractions. Two other participants suggested that online learning had less accountability resulting in fewer students contributing to discussions.

> *I think I'd learn better with a person, though. But everyone's different. Like if . . . yes, I don't think I'd learn as effectively just being on the computer the whole time.*

> *There's also less accountability. It feels like you can tune out a bit more easily . . . because when you're all there in person sitting around a table you're quite accountable.*

Additional cost is another complication of moving to an online platform. In order to participate in RO-CBL, students required Internet access and the necessary hardware, including a computer, microphone, and webcam.

> *I guess if everyone had a sort of a stable Internet connection, that . . . and like, really good webcam and really good microphones, that might be helpful.*

> *But I don't know how you'd do that without having a cost to the students . . .*

Training is also necessary to operate in an online environment. Some participants felt that greater practice would resolve technical issues encountered during the RO-CBL. Others who had no technical issues stated that they were adequately prepared for the RO-CBL.

> *I thought Monash prepared us well for the ROCBL experience.*

Discussion

Principal Findings

RO-CBL was generally well received by participants, with 59% (40/68) disagreeing with the statement "I would not like RO-CBL to be used in the future," and 78% (53/68) of participants believing they could meet the CBL's learning objectives via RO-CBL. This level of satisfaction contrasts with results from a pilot study by our research team, which found that 84% (16/19) of participants did not enjoy the Web-based activity and 73% (13/18) would not like to use the Web-based CBL in the future. However, results from this pilot study supported the notion that Web-conferencing CBL may provide students with a learning experience comparable to face-to-face CBL. This increase in student satisfaction could be due to the refined and improved implementation process of RO-CBL. Many participants found that RO-CBL exceeded expectations, suggesting that this might be due to the adequate training provided, while others reported that the learning activity only met expectations.

Those participants who found that RO-CBL did not meet expectations felt this was due to technical issues faced during the learning activity. Given that students completed the RO-CBL off campus, it is not surprising to find that some students experienced connection issues. This finding is consistent with other reports [8,9,12]. Participants noted that connection issues including microphone lag time and dropouts may have been detrimental to the flow of RO-CBL. Technical issues and difficulties associated with communication are common in Web-based learning [2,9,12]. Valaitis et al [12] recognized that the lag time and loss of conversational practices such as turn-taking and reference to previous statements creates challenges in online discussion. These issues were reported by a subset of students.

Participants recognized the flexiblity provided by RO-CBL. This is a common finding with Web-based learning [2,5,7,12]. Also important are the potential savings in financial costs and time for the student, which have not been previously quantified. These savings in time could also account for the perceived increase in efficiency students found with RO-CBL. Our preliminary data [18] indicate that user costs associated with RO-CBL are lower than costs for campus-based face-to-face CBLs ($6541 per student per semester compared to $7907). Cost from an institutional perspective has not been formally evaluated; however, given the reduction in space requirements, we anticipate RO-CBL will be found to be cost-effective. Cost is an important consideration when moving to an online platform, and further research is warranted.

Participants report benefits and obstacles with regard to RO-CBL. Although few participants reported technical issues relating to connectivity and appropriate hardware, this remains an ongoing issue. The most likely future is one where Internet access and connectivity improve and issues are resolved. Enabling learners through access to remote technical support may reduce connectivity issues, but these may also be resolved with anticipated advances in communication software.

Training appears to help learners operate in interactive, online environments and should be designed with consideration of learner needs [20]. Greenhalgh [5] highlighted that the amount of initial training for students to be comfortable using Web-based tools is often underestimated; our work supports the perceived benefits associated with opportunities to familiarize and troubleshoot with interactive environments. Participants felt that practice would resolve any technical issues. Learner needs might be assessed so training can target those who appear to be intimidated by the notion of Web-based learning [21]. Students need to adapt to communicating in these online environments; Valaitis et al [12] suggest there is a period of adaptation before students engaged in meaningful online PBL discussions. This might be facilitated by well-designed training.

Limitations

Students had two years of previous face-to-face CBL experience, so training was targeted at transferring those skills to an online environment. Care was taken within this study to minimize the impact of specific Web conferencing software on the results. To achieve this, only the features common across all Web conferencing platforms were used. Despite these efforts, it remains possible that the results may be different with an alternative program. Learning outcomes were not assessed directly in this study.

Conclusion

Web conferencing may be a suitable medium for student participation in CBL. Participants were satisfied with the learning activity and felt they could meet the CBL's learning objectives, which may be due to the training provided. While there are benefits to RO-CBL, obstacles remain. Ensuring students have remote technical support and adequate Internet connection are challenges that need to be addressed to successfully implement any remote learning activity. Targeted training is necessary to ensure students are comfortable operating and communicating in the online environment. It is hypothesized that these issues will be overcome once the students adapt to the online environment, but this needs further investigation. Further study should also evaluate Web conferencing CBL across an entire semester in regard to student satisfaction, perceived depth of learning, and learning outcomes.

Conflicts of Interest

None declared.

References

1. Crawford TR. Using problem-based learning in web-based components of nurse education. Nurse Educ Pract 2011 Mar;11(2):124-130. [doi: 10.1016/j.nepr.2010.10.010] [Medline: 21111680]
2. Strømsø HI, Grøttum P, Lycke KH. Content and processes in problem-based learning: a comparison of computer-mediated and face-to-face communication. J Comput Assist Learn 2007;23:271-282 [FREE Full text] [doi: 10.1111/j.1365-2729.2007.00221.x]
3. Hmelo-Silver CE. Problem-based learning: what and how do students learn? Educ Psychol Rev 2004 Sep;16(3):235-266. [doi: 10.1023/B:EDPR.0000034022.16470.f3]
4. Savery JR. Overview of problem-based learning: definitions and distinctions. In: Walker A, Leary H, Hmelo-Silver CE, Ertmer PA, editors. Essential Readings in Problem-Based Learning. West Lafayette, IN: Purdue University Press; 2015.
5. Greenhalgh T. Computer assisted learning in undergraduate medical education. Brit Med J 2001 Jan 6;322(7277):40-44 [FREE Full text] [Medline: 11141156]
6. Lewis MJ, Davies R, Jenkins D, Tait MI. A review of evaluative studies of computer-based learning in nursing education. Nurse Educ Today 2001 Jan;21(1):26-37. [doi: 10.1054/nedt.2000.0494] [Medline: 11162255]
7. Cook DA. Web-based learning: pros, cons and controversies. Clin Med (Lond) 2007;7(1):37-42. [Medline: 17348573]
8. Dennis JK. Problem-based learning in online vs. face-to-face environments. Educ Health (Abingdon) 2003 Jul;16(2):198-209. [doi: 10.1080/1357628031000116907] [Medline: 14741905]
9. Moeller S, Spitzer K, Spreckelsen C. How to configure blended problem based learning: results of a randomized trial. Med Teach 2010;32(8):e328-e346. [doi: 10.3109/0142159X.2010.490860] [Medline: 20662568]
10. Raupach T, Muenscher C, Anders S, Steinbach R, Pukrop T, Hege I, et al. Web-based collaborative training of clinical reasoning: a randomized trial. Med Teach 2009 Sep;31(9):e431-e437. [Medline: 19811180]
11. Taradi SK, Taradi M, Radic K, Pokrajac N. Blending problem-based learning with Web technology positively impacts student learning outcomes in acid-base physiology. Adv Physiol Educ 2005 Mar;29(1):35-39 [FREE Full text] [doi: 10.1152/advan.00026.2004] [Medline: 15718381]
12. Valaitis RK, Sword WA, Jones B, Hodges A. Problem-based learning online: perceptions of health science students. Adv Health Sci Educ Theory Pract 2005 Aug;10(3):231-252. [doi: 10.1007/s10459-005-6705-3] [Medline: 16193403]

13. Yeung SK. Synchronous Web conferencing: toward a pedagogical model for effective learning. J Scholarship Teach Learn 2014;1(1).
14. Ellingson DA, Notbohm M. Synchronous distance education: using Web-conferencing in an MBA accounting course. Am J Bus Educ 2012;5(5).
15. Huang HW, McConnell WR. The relationship between synchronous Web conferencing and course satisfaction in a blended online class. In: Gibson B, Dodge B, editors. Proceeding of Society for Information Technology & Teacher Education International Conference. Chesapeake, VA: Association for the Advancement of Computing in Education (AACE); 2010:546-551.
16. Skylar AA. A comparison of asynchronous online text-based lectures and synchronous interactive Web conferencing lectures. Issues Teacher Educ 2009;18(2) [FREE Full text]
17. Kononowicz AA, Berman AH, Stathakarou N, McGrath C, Bartynski T, Nowakowski P, et al. Virtual patients in a behavioral medicine massive open online course (MOOC): A case-based analysis of technical capacity and user navigation pathways. JMIR Med Educa 2015 Sep 10;1(2):e8. [doi: 10.2196/mededu.4394]
18. Nicklen P, Keating JL, Rivers G, Maloney S. Savings through Web-conference learning within health professional education. 2014 Presented at: Medicine 2.0; 2014; Malaga, Spain.
19. Fossey E, Harvey C, McDermott F, Davidson L. Understanding and evaluating qualitative research. Aust N Z J Psychiatry 2002 Dec;36(6):717-732. [Medline: 12406114]
20. Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students--barriers and their solutions. A systematic review of the literature: findings from the HeXL project. Health Info Libr J 2005 Dec;22 Suppl 2:20-32. [doi: 10.1111/j.1470-3327.2005.00614.x] [Medline: 16279973]
21. McLean M, Murrell K. WebCT: integrating computer-mediated communication and resource delivery into a new problem-based curriculum. J Audiov Media Med 2002 Mar;25(1):8-15. [doi: 10.1080/01405110220118365] [Medline: 12025491]

Abbreviations

CAL: computer-assisted learning
CBL: case-based learning
PBL: problem-based learning
RO-CBL: remote-online CBL
WBL: Web-based learning

Edited by P Bamidis; submitted 12.08.15; peer-reviewed by E Dafli, D Schwarz; comments to author 22.09.15; revised version received 13.11.15; accepted 04.01.16; published 22.03.16.

Please cite as:
Nicklen P, Keating JL, Maloney S
Student Response to Remote-Online Case-Based Learning: A Qualitative Study
JMIR Medical Education 2016;2(1):e3
URL: http://mededu.jmir.org/2016/1/e3/
doi:10.2196/mededu.5025
PMID:27731852

Original Paper

Exploring Student Preconceptions of Readiness for Remote-Online Case-Based Learning: A Case Study

Peter Nicklen[1*], B Physio; Jennifer L Keating[1*], B AppSc, PG Dip Musculoskeletal, PhD; Stephen Maloney[1*], B Physio, M PublicHealth, PhD

Monash University – Peninsula Campus, Department of Physiotherapy, Melbourne, Australia

[*]all authors contributed equally

Corresponding Author:
Peter Nicklen, B Physio
Monash University – Peninsula Campus
Department of Physiotherapy
McMahons Road, Frankston, Victoria, 3199
Melbourne, PO Box 527
Australia
Phone: 61 3 990 44240
Fax: 61 3 990 44812
Email: pdnic1@student.monash.edu

Abstract

Background: Case-based learning (CBL) is an educational approach where students work in small, collaborative groups to solve problems. Web-conferencing software provides a platform to present information and share concepts that are vital to CBL. Previous studies have found that participants were resistant to change associated with implementing e-learning; however, strategies to reduce this resistance have not been explored.

Objective: This study was designed to explore student preconceptions and understanding of remote-online case-based learning (RO-CBL).

Methods: The study took place during the Bachelor of Physiotherapy program at Monash University, Victoria, Australia, in 2013. The entire third-year cohort (n=73) was invited to participate. The primary outcome of interest was students' preconceptions of RO-CBL, collected via pre- and posttraining surveys.

Results: Of the 73 students, 66 completed both surveys (attrition rate 9.6%). Three key themes relevant to student preconceptions of RO-CBL emerged: flexibility in time and location of CBL, readiness or hesitation to change to a Web-based format, and the value of training in RO-CBL that included a demonstration and trial run. Thirty-four percent of the participants were hesitant to move to an online format.

Conclusions: This study explored students' preconceptions of Web-based learning and evaluated the change in students' attitudes after training. The results suggest that educational designers should not assume that students are confident and competent in applying these technologies to professional educational activities. By identifying students' needs before implementation, training sessions can be designed to target these needs, and improve the understanding of RO-CBL and how it works in practice. This may reduce resistance to change, enhance students' satisfaction, and ultimately improve the learning experience.

(JMIR Medical Education 2016;2(1):e5) doi:10.2196/mededu.5348

KEYWORDS

problem-based learning; professional education; teaching; distance education

Introduction

Case-based learning (CBL) is an educational approach where students work in small, collaborative groups to solve a series of problems that are presented in contexts similar to those in which they are likely to encounter them in practice [1]. In CBL, the learner is responsible for identifying knowledge deficits relating to the case. This encourages students to develop and manage learning goals and other strategies needed for lifelong learning [2]. Case-based learning typically involves face-to-face interaction with a focus on self-directed study [3].

Computer-assisted learning (CAL) is the implementation of computer technology to create a rich environment for active learning [4]. Key benefits of CAL are flexibility and accessibility, which promote student autonomy [1]. These characteristics have the potential to facilitate active self-directed learning, enhancing student knowledge and understanding [5]. Crawford [1] reviewed six qualitative investigations and concluded that the proposed benefits of CAL may complement the current CBL learning experience [1].

Four randomized controlled studies [6-9] concluded that Web-based CBL is comparable to face-to-face CBL with regard to student learning outcomes; however, none of these studies incorporated Web conferencing where students engage in a live activity with other students in real time. The synchronous communication, whiteboard, and screen-sharing functions of typical Web-conferencing software provide a platform to present information and share concepts [10]. These elements are at the core of the social constructivist pedagogy behind CBL and it is hypothesized that they could support the current CBL model. To the authors' knowledge, no randomized controlled studies have been published evaluating Web-conferencing learning within CBL.

Preliminary results from our research team (personal communication by Stephen Maloney, via email, April 2, 2014) support the notion that Web-conferencing CBL also provides students with a learning experience that is comparable to face-to-face CBL. An important finding of this study was that participants reported low satisfaction with the Web-based activity and were challenged by the transition to the Web-based environment. Low student satisfaction has been reported by others regarding Web-based programs [8] and may occur because the learner is not adequately aware of how to operate effectively in an online platform [11]. Feelings of social isolation are also an important consideration when implementing Web-based activities. McInnerney and Roberts [12] suggest that minimizing social isolation may make the difference between a successful and an unsuccessful online learning environment for many students. Rheingold [13] stated that fear is an important element in novice computer users. Keller et al [14] reported that only a small minority of public health faculty are engaged in social media. Grajales III et al [15] suggested that fear of the unknown appears to be a major barrier to the adoption of social media and suggests this may be due to a lack of understanding. A review [16] evaluated barriers to effective e-learning and found that participants were resistant to change associated with implementing e-learning and had negative views of the value of e-learning.

Huang and McConnell [17] reported that perceived learning and course satisfaction are correlated. Leh [18] suggested that students' preconceptions affect the way the students react to a situation, defining preconceptions as "conceptions that result from informal experiences in everyday life." It is also suggested that these preconceptions can be very difficult to change [18]. Therefore, it is possible that negative preconceptions toward Web-based learning may account for poor student satisfaction. This highlights the importance of student satisfaction within their education and their preconceptions. Stromso et al [19] suggested that students' level of computer skills and confidence may also influence their attitudes toward e-learning. Induction programs may need to be designed in response to assessed needs of a group of learners [11,16]. Hands-on training may help to facilitate learning particularly with students who are initially intimidated by Web-based learning [20]. However, this has not been formally evaluated.

This study was designed to explore student preconceptions and understanding of remote-online case-based learning (RO-CBL) as well as to identify training needs. The data were used to design training sessions that targeted these needs. It was hypothesized that implementing training designed to meet the learners' needs may reduce negative preconceptions of Web-based CBL, improve the implementation process, and, subsequently, increase student satisfaction with the learning experience.

Aims

Primary Aim

The primary aim of this study was to explore students' preconceptions and understanding of RO-CBL.

Secondary Aims

The secondary aims were to explore student-reported training needs before the implementation of RO-CBL, as well as the reported effects of training on students' preparedness.

Methods

Design

This study used a mixed method framework (qualitative and quantitative) whereby students were assessed, participated in training, and were then reassessed. In this single-cohort study, all participants were assessed on the same outcomes and exposed to the same intervention. Ethics approval for the study was obtained through the Monash University Human Research Ethics Committee (Ethics CF13/456 – 2013000200).

Participants

This study took place during the first semester of the third year of the Bachelor of Physiotherapy program at Monash University, Victoria, Australia, in 2013. The entire third-year cohort (n=73) was invited to participate. This cohort had previously completed 4 semesters of face-to-face CBL and therefore understood the process of CBL. Case-based learning attendance is a compulsory component of the undergraduate program, and, therefore, all students had to participate in the RO-CBL and the training sessions to meet course requirements. An independent research assistant recruited participants through face-to-face delivery and distribution of an information package, which included the explanatory statement. Students who chose not to consent to participate in the study were not required to complete pre and post assessment measures related to the study.

Context

In the Monash University Bachelor of Physiotherapy program, CBL is currently completed on campus in small groups of 4-6 students. Case-based learning is made up of Part 1 and Part 2, which are completed at the start and the end of the academic week, respectively. During Part 1, students are introduced to the case and are required to work through the subjective and objective examination. Learning issues are developed at the conclusion of Part 1, which students work on individually and present to their group in Part 2. During Part 2, several days later, students are required to discuss management and closure of the case. As part of this undergraduate degree, students are also required to travel between two campuses.

During semester 1 of the third year, students participated in RO-CBL. The learning activity took place over 1 week and required students to complete both Part 1 and Part 2 online. Unlike traditional face-to-face CBL, the RO-CBL allowed students to complete the learning activity at home, via Web-conferencing software, in groups of 4-6. One academic facilitator was responsible for logging in to all groups' online chat rooms. "Google Hangouts" was the computer program used for the RO-CBL, because of the ease of access and convenience of the university's licensing agreement. This was accessed in 2013. This allowed students to interact via webcam and microphone, as well as access and work on shared documents in "Google Docs." The features used in the study were basic and common to most Web-conferencing software.

Training was provided to introduce students to the Web-conferencing software, allowing them to operate in the online environment and learn the steps required to successfully participate in RO-CBL. The training sessions made up the intervention part of this case study.

Training (Intervention)

Two training sessions occurred 3 weeks before the RO-CBL. Students were required to attend a 60-minute information session that was run by the third-year co-coordinator. The coordinator was also the RO-CBL facilitator. During this session students were introduced to the RO-CBL and shown how to set up RO-CBL and use the key functions with a step-by-step demonstration of the Web-conferencing software. Students had access to the program in the weeks before the RO-CBL and were encouraged to explore it during this time. One week before the RO-CBL, students attended a 30-minute self-directed training session. Participants completed a checklist that involved setting up a RO-CBL environment and utilizing its key features. Two assistants were available to provide support as required.

Outcomes

The primary outcome of interest was student preconceptions of RO-CBL and their reflection on these preconceptions after the training sessions. Secondary outcomes included students' preconceptions of training requirements and response to training assessed. Data were collected via 2 paper-based surveys.

The first survey was completed before the first training session when students had not been introduced to RO-CBL. This survey explored students' preconceptions of RO-CBL using questions 1-6 (Textbox 1) as well as an open-ended question (question 11). The response options for the Likert scales ranged from "strongly disagree" (1) to "strongly agree" (5). Students were also required to consider self-reported confidence using the Web-conferencing software and their training requirements, before being exposed to RO-CBL, on the same 5-point Likert scale (questions 7 and 8). Students were asked if they had previously participated in a video call or Web conference involving several people (questions 9-10). Finally, training requirements were also explored via an open-ended question (question 12).

Textbox 1. Pre- and posttraining survey questions.

- Five-point Likert scale items with response options (Q1-8) 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree:

1. I understand what a RO-CBL is, conducted via Web conference with file sharing
2. I understand how RO-CBL will work in practice
3. I could meet the CBL's learning objectives via RO-CBL
4. I could envisage RO-CBL being used in the future
5. I would like RO-CBL to be used in the future
6. I am looking forward to trialing RO-CBL
7. I am confident using Google documents
8. I am confident using Google hangouts

- Yes or no questions:

1. I have participated in a video-call, that is, webcam call before: yes/no.
2. I have participated in a Web conference before (ie, using a webcam for a conversation with more than one person): yes/no.

- Open-ended questions:

1. What are your thoughts on moving to RO-CBL?
2. What training do you think you would require to effectively participate in RO-CBL?

The second survey was distributed after the second training session once students had been exposed to RO-CBL. Students were required to complete the same questions scored on the same 5-point Likert scale as in the first survey (questions 1-8), allowing the comparison with their pretraining beliefs about RO-CBL and self-assessed confidence with the Web-conferencing software. This provided an indication of the efficacy of the training sessions. All outcomes were distributed and collected by an independent research assistant.

Data Analysis

Responses to Likert scale items were presented in summary format, and pre- and posttraining session responses were compared and tested for statistical difference. A Kruskal-Wallis rank test was chosen as it can compare nonparametric data for 2 or more independent samples. Differences between pre- and posttest scores were considered statistically significant if the probability of differences occurring by chance alone was less than .05; Bonferroni adjustments were made to adjust significance levels for multiple questions. All quantitative statistical tests were performed using STATA 11 [21].

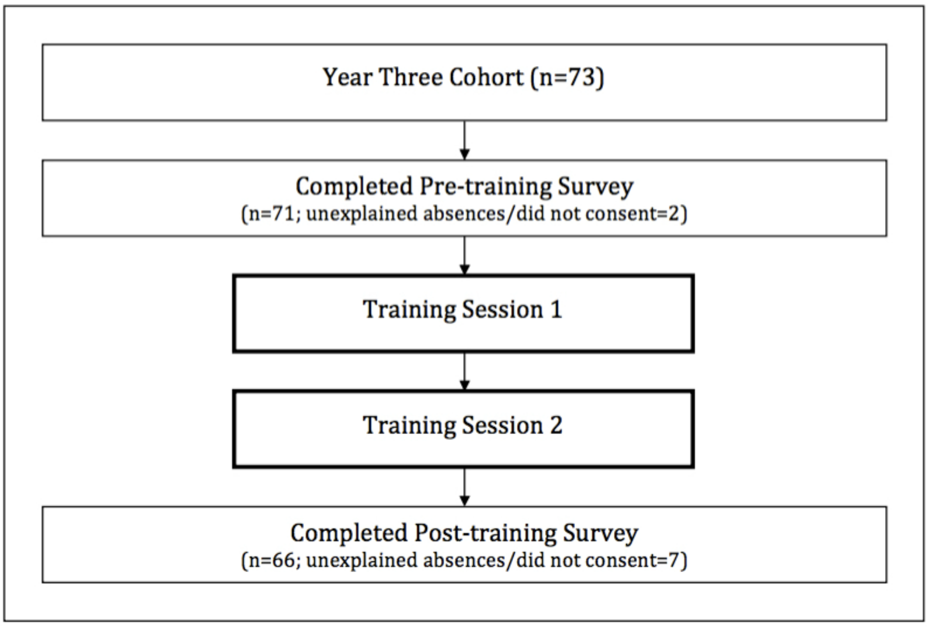
Responses to both open-ended questions (questions 11 and 12) were pooled, coded, and then themed using thematic analysis by 2 researchers working independently. This involved classifying and grouping segments of text to create and define themes that emerged from the data [22]. The emerged themes were then summarized and presented with supporting quotations. Responses to the open-ended question "What are your thoughts on moving to RO-CBL?" collected in the first survey were further categorized into either a positive or negative response. This was achieved via thematic analysis that, again, was completed by 2 researchers working independently. Likert responses that corresponded to the 2 positive and negative subgroups were then extracted and compared for differences in responses using a Kruskal-Wallis rank test.

Results

Participants

All 73 students enrolled in the third year of a Bachelor of Physiotherapy program at Monash University, Victoria, Australia, in 2013 were invited to participate. Of the 73 students, 54 were female and 19 were male. A total of 71 students completed the pretraining survey. Before the RO-CBL training, 61/71 students had participated in a video call and 27/71 had participated in a Web conference. All 73 students were required to attend the 2 training sessions. Of these, 66 students completed the posttraining survey (attrition rate 9.6%). Figure 1 summarizes participants' flow and data collection process.

Figure 1. Participant flowchart and data collection points.



Response to RO-CBL After Training Compared With Preconceptions

Participant responses to pre- and posttraining questionnaires are summarized in Table 1 and compared by Kruskal-Wallis rank test in Table 2.

After training, students were confident using the Web-conferencing software. They understood how RO-CBL worked in practice and felt they could meet CBL learning objectives.

Table 1. Summary data of pre- and posttraining questionnaire responses.

Item	Response[a]									
	1		2		3		4		5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1. I understand what a RO-CBL[b] is, conducted via a Web conference with file sharing	3	0	9	0	10	4	30	19	19	43
2. I understand how RO-CBL will work in practice	8	0	14	0	20	3	22	27	7	36
3. I could meet the CBL's[c] learning objectives via RO-CBL	2	0	3	1	34	17	25	20	7	28
4. I could envisage RO-CBL being used in the future	4	1	6	4	20	15	30	19	11	27
5. I would like RO-CBL to be used in the future	6	3	8	4	32	28	17	19	8	12
6. I am looking forward to trialing RO-CBL	3	2	4	3	16	11	28	26	20	24
7. I am confident using Google documents	5	1	15	4	13	5	25	22	13	34
8. I am confident using Google hangouts	5	0	31	7	18	13	13	25	4	21

[a]Response options: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree.

[b]RO-CBL: remote-online case-based learning.

[c]CBL: case-based learning.

Table 2. Comparison of pre- and posttraining survey responses.

Item	Pretraining[a] (n=71), median	Posttraining[a] (n=66), median	Chi-square	*P*-value[b]
I understand what a RO-CBL[c] is, conducted via a Web conference with file sharing	4	5	24.8	*<.001*
I understand how RO-CBL will work in practice	3	5	52.7	*<.001*
I could meet the CBL's[d] learning objectives via RO-CBL	3	4	18.9	*<.001*
I could envisage RO-CBL being used in the future	4	4	7.6	*.006*
I would like RO-CBL to be used in the future	3	3	3.1	.08
I am confident using Google documents	4	5	21.8	*<.001*
I am confident using Google hangouts	2	4	35.8	*<.001*

[a]Key: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree.

[b]Italicized *P*-value=Bonferroni-adjusted statistically significant value, $P \leq .007$.

[c]RO-CBL: remote-online case-based learning.

[c]CBL: case-based learning.

Student Preconceptions of RO-CBL

Three key themes emerged from the open-ended questions of the pretraining survey: flexibility in time and location of CBL, readiness or hesitation to change to a Web-based format, and the value of training in RO-CBL that included a demonstration and trial run.

Theme 1: Flexibility

Students identified the flexibility that RO-CBL would provide to both students and the delivery of the physiotherapy course content.

> *I think it's a good idea and will be great for future students to have a lot of the course online to offer more flexibility when we study.*

An online format would allow students to complete CBL from home and therefore decrease travel to the university campus. Reducing travel lowers travel-related costs and allows students to allocate this time to alternative activities. Students reported valuing this extra time and money saved in petrol and road tolls.

> *I think it's a good idea, will save a lot of time (transportation) it is very expensive to drive to Frankston and so avoiding that is a plus.*

Students also noted the benefit of not having to travel between campuses to attend other classes on the same day. One student suggested that by completing CBL at home, communication with peers could be affected.

Theme 2: Change

Students were hesitant to test RO-CBL for a range of reasons. Seven students stated that they preferred face-to-face CBL before experiencing RO-CBL. Face-to-face enables participants to discuss the case in person, potentially allowing for greater interaction between students and a chance to develop interpersonal skills.

> *I prefer f2f [face-to-face] CBL so we can interact and feed off each other's ideas more easily and use the whiteboard to help brainstorm.*

Students were concerned that communicating with microphones and cameras would make conversations difficult.

> *Could be problematic with regards to computer failure and getting the webcam and mic set up and working.*

Six students were concerned with other technology-related problems such as interruptions with the Internet connection. Nine students were looking forward to testing the RO-CBL, with one stating that they were "optimistic about its success." Twelve students were unsure about how it would go but were "happy to try," with 3 of these 12 stating they preferred face-to-face CBL.

> *Good idea in theory - haven't had the practical experience yet to judge.*

Potential benefits of RO-CBL perceived by the students included greater efficiency and easier collaboration once students adapt to the online learning environment.

Theme 3: Training Requirements

Two methods of training were recognized by the students—a demonstration and a trial run. Twelve students identified that the only training they would require was a demonstration or tutorial.

> *A step-by-step tute to understand the software, how to use it best.*

The content of the demonstration proposed by students included how to conduct an RO-CBL, set up and check the microphone and camera are working, navigate the Web-conferencing software, invite people to the Web conference, and upload documents and share with group members. Other students suggested that a trial run would be sufficient. This would allow students to familiarize themselves with the program.

> *I think it would be fine, once we start doing it, it will click into place.*

Students also expressed the need to troubleshoot issues before commencing the RO-CBL, regardless of the format. One student also suggested that more practice was required to concentrate and learn in an online environment.

> *I don't think I will need much training in relation to the technical side of it, however maybe more practice in concentrating and learning through such means.*

Response to Open-Ended Questions Compared With Pretraining Likert Scales

The positive and negative responses to the open-ended question "What are your thoughts on moving to RO-CBL?" were assembled and compared using Likert responses to questions in the pretraining assessment responses (Table 3).

We found no significant relationship between confidence using the Web-conferencing program and preconceptions of RO-CBL. There were significant differences between those positively and negatively disposed toward RO-CBL to the questions "I would like RO-CBL to be used in the future" and "I am looking forward to trialing RO-CBL" in favor of positive responders, but not in responses to questions regarding use of the online medium.

Table 3. Pretraining assessment responses compared for those who wrote free-text responses that were classified as either positively or negatively disposed toward RO-CBL and compared using Kruskal-Wallis rank test (significance set at *P*<.008).

Item	Positive subgroup[a] (n=39), median	Negative subgroup[a] (n=20), median	Chi-square	*P*-value[b]
I understand what a RO-CBL[c] is, conducted via a Web conference with file sharing	4	4	<0.01	.78
I understand how RO-CBL will work in practice	3	3	0.3	.59
I could meet the CBL's[d] learning objectives via RO-CBL	4	3	1.2	.26
I could envisage RO-CBL being used in the future	4	3	4.9	.03
I would like RO-CBL to be used in the future	4	3	15.3	*<.001*
I am looking forward to trialing RO-CBL	4	3	8.8	*.003*
I am confident using Google documents	4	3	1.0	.31
I am confident using Google hangouts	2	2	2.4	.12

[a]Key: Response options 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree.

[b]Italicized *P*value=statistically significant value.

[c]RO-CBL: remote-online case-based learning.

[d]CBL: case-based learning.

Discussion

This study explored students' preconceptions of Web-based learning and evaluated the change in their attitudes after training. Assumptions are frequently made about the information and communication technology literacy of students because of experience with, and accessibility to, Web-enabled devices. However, educational designers should not assume that students are confident and competent in applying these technologies to professional educational activities that require them to interact with their peers.

Approximately a third of the participants (23/71, 32%) did not agree with the statement "I am looking forward to trialing RO-CBL." This hesitation to move to an online format may be due to a number of reasons. Before the training session, students reported that they understood how RO-CBL worked but were unsure how it would work in practice. They were unsure if learning objectives could be achieved in the online format, and, interestingly, 51% (36/71) of participants were not confident with the Web-conferencing software "Google Hangouts" before training. These factors might account for the hesitation to move to the online format.

There were several reasons identified by students that account for the apparent resistance to the adoption of RO-CBL including the risk of social isolation, potential technical difficulties, and anticipated difficulties with communication among CBL peers. Six participants (6/71, 8.5%) were concerned before training about potential technology-related problems such as interruptions with Internet connection. As students were able to complete CBL at home, they may not have been in the physical company of their peers, which might cause a perception of social isolation [23]. This was also recognized by Greenhalgh [4] who suggested that students may experience social isolation depending on their preferred style of learning or their stage in the development of online learning skills. Inadequate technology is an important concern for learners [16], and technical difficulties are commonly reported during Web-based programs [6,7,24]. This can also result in difficulties with communication [3,7,24]. This hesitation might not be unique to Web-based learning, but to change itself. Participants did, however, recognize that there could be benefits associated with moving to an online platform.

Flexibility is a commonly recognized benefit of Web-based learning—not only in relation to time, but also to travel demands [4,23]. Others have noted that the flexibility provided by Web-based learning applies to RO-CBL [3,24]. Participants in this study acknowledged that RO-CBL would reduce travel-related time and cost, which could be a possible motivator for adopting a Web-based format. Participants also recognized that RO-CBL may allow greater efficiency and easier collaboration once students adapted to the online learning environment. This finding was apparent in a similar study [24] where participants reported that even though the conferencing system was easy to use, a period of adaptation was experienced when moving to the online environment. Despite these identified benefits, students remained hesitant to move to a Web-based format before training.

Given this hesitation, we assume that some students may not be comfortable working in an online environment and therefore may require specific skill development. After the training sessions, there was a significant shift in participant responses to the Likert scales. Participants understood what RO-CBL was, how it would work in practice, how they could meet the learning objectives using this new mode of learning, and that they could see it used effectively in the future. Despite a positive shift toward the "strongly agree" end of the Likert response options, to "I would like RO-CBL to be used in the future," this was not significant. Importantly, participants were also confident in the use of both "Google Docs" and "Google Hangouts." This highlights the importance of targeted training sessions.

McLinden et al [11] found that participants with limited computer experience felt out of their depth when engaging with e-learning. However, we did not find a significant relationship between negativity toward Web-based learning and reported perceptions of ability. Regardless, it is still important that training is designed to meet the learner's needs, as highlighted by Childs et al [16]. This ensures that training provides the required information technology skills to effectively learn in the Web-conference environment. Although most participants suggested a demonstration or tutorial would be sufficient, a small group of students expressed their preference to troubleshoot issues before testing the RO-CBL. This variation may again be due to different stages in the development of online learning skills or a sense that they needed to test their skills in real application to better anticipate obstacles that might be encountered. Greenhalgh [4] also suggested that students regularly use "just in time learning," that is, only learning skills when they are immediately required. This may suggest theoretical training needs to be supported by training in real-time skill application.

Limitations

Our participants had 2 years of previous face-to-face CBL experience, which means they understood how CBL worked in practice, even though they were new to the Web-based delivery. This may potentially reduce the transferability of our results with those less experienced with CBL. The validity and reliability of the surveys are unknown. However, the questions had face validity for gathering data on the construct of interest. This needs to be considered when interpreting our findings. Sample size was determined by students' availability. We invited all available students in a single year level to participate in the study. For repeated measures analysis sample sizes of 30 or more are likely to provide normally distributed change scores. The sample was specific, as all participants had prior exposure to CBLs and were completing a course in which lecture content aligned with CBL content. The data obtained are therefore sample specific and the findings warrant validation in independent samples. Finally, one particular software program was used, and although only features common to other Web-conferencing programs were utilized, the transferability of results may still be affected.

Conclusions

By identifying student needs before implementation, training sessions can be designed to target these needs, improving the understanding of RO-CBL and how it works in practice. This may reduce resistance to change when introducing Web-based learning, enhance student satisfaction with Web-based activities, and ultimately improve the learning experience. The findings of this research apply in the context of implementing a Web-conferenced RO-CBL to those already familiar with the CBL format.

On the basis of student-reported training needs and preconceived concerns, training might include how to log on and navigate the Web-conferencing software, how the CBL elements will be carried out in a Web-conference format, that is, what will change and what will remain the same, how to utilize functions of the Web-conferencing software required for RO-CBL, how to troubleshoot technical issues, and how to utilize synchronous and asynchronous communication methods.

Conflicts of Interest

None declared.

References

1. Crawford TR. Using problem-based learning in web-based components of nurse education. Nurse Educ Pract 2011 Mar;11(2):124-130. [doi: 10.1016/j.nepr.2010.10.010] [Medline: 21111680]
2. Hmelo-Silver CE. Problem-Based Learning: What and How Do Students Learn? Educational Psychology Review 2004;16(3):235-266.
3. Stromso H, Grottum P, Lycke KH. Content and processes in problem-based learning: a comparison of computer-mediated and face-to-face communication. Journal of Computer Assisted Learning 2007;23(3):271-282.
4. Greenhalgh T. Computer assisted learning in undergraduate medical education. BMJ 2001 Jan 6;322(7277):40-44 [FREE Full text] [Medline: 11141156]
5. Lewis MJ, Davies R, Jenkins D, Tait MI. A review of evaluative studies of computer-based learning in nursing education. Nurse Educ Today 2001 Jan;21(1):26-37. [doi: 10.1054/nedt.2000.0494] [Medline: 11162255]
6. Dennis JK. Problem-based learning in online vs. face-to-face environments. Educ Health (Abingdon) 2003 Jul;16(2):198-209. [doi: 10.1080/1357628031000116907] [Medline: 14741905]
7. Moeller S, Spitzer K, Spreckelsen C. How to configure blended problem based learning-results of a randomized trial. Med Teach 2010;32(8):e328-e346. [doi: 10.3109/0142159X.2010.490860] [Medline: 20662568]
8. Raupach T, Muenscher C, Anders S, Steinbach R, Pukrop T, Hege I, et al. Web-based collaborative training of clinical reasoning: a randomized trial. Med Teach 2009 Sep;31(9):e431-e437. [Medline: 19811180]
9. Taradi SK, Taradi M, Radic K, Pokrajac N. Blending problem-based learning with Web technology positively impacts student learning outcomes in acid-base physiology. Adv Physiol Educ 2005 Mar;29(1):35-39 [FREE Full text] [doi: 10.1152/advan.00026.2004] [Medline: 15718381]
10. Bower M. Redesigning a web-conferencing environment to scaffold computing students' creative design processes. Educational Technology and Society 2011;14(1):2742.
11. McLinden M. Participation in online problem-based learning: insights from postgraduate teachers studying through open and distance education. Distance Education 2006;27(3):331-353.
12. McInnerney JM, Roberts TS. Online Learning: Social Interaction and the Creation of a Sense of Community. Journal of Educational Technology & Society 2004;7(3):73-81.
13. Rheingold H. The Virtual Community. London: Minerva; 1995.
14. Keller B, Labrique A, Jain KM, Pekosz A, Levine O. Mind the gap: social media engagement by public health researchers. J Med Internet Res 2014;16(1):e8 [FREE Full text] [doi: 10.2196/jmir.2982] [Medline: 24425670]
15. Grajales FJ, Sheps S, Ho KH, Novak-Lauscher H, Eysenbach G. Social media: a review and tutorial of applications in medicine and health care. J Med Internet Res 2014;16(2):e13 [FREE Full text] [doi: 10.2196/jmir.2912] [Medline: 24518354]
16. Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students - barriers and their solutions. A systematic review of the literature - findings from the HeXL project. Health Information and Libraries Journal 2005;22(Supplement s2):20-32.
17. Huang HW, McConnell R. The Relationship between Synchronous Web ConferencingCourse Satisfaction in a Blended Online Class. In: Proceeding of Society for Information Technology & Teacher Education International Conference.: Association for the Advancement of Computing in Education (AACE); 2010 Presented at: Society for Information Technology & Teacher Education International Conference; 2010; Chesapeake, VA p. 546-551.
18. Leh SK. Preconceptions: a concept analysis for nursing. Nurs Forum 2007;42(3):109-122. [doi: 10.1111/j.1744-6198.2007.00075.x] [Medline: 17661803]
19. Stromso HI, Grottum P, Lycke KH. Changes in student approaches to learning with the introduction of computer-supported problem-based learning. Med Educ 2004 Apr;38(4):390-398. [doi: 10.1046/j.1365-2923.2004.01786.x] [Medline: 15025640]
20. McLean M, Murrell K. WebCT: integrating computer-mediated communication and resource delivery into a new problem-based curriculum. J Audiov Media Med 2002 Mar;25(1):8-15. [doi: 10.1080/01405110220118365] [Medline: 12025491]

21. Stata. Stata: Data Analysis and Statistical Software2012 URL: http://www.stata.com/ [accessed 2016-04-20] [WebCite Cache ID 6gvLC4zNy]
22. Fossey E, Harvey C, McDermott F, Davidson L. Understanding and evaluating qualitative research. Aust N Z J Psychiatry 2002 Dec;36(6):717-732. [Medline: 12406114]
23. Cook DA. Web-based learning: pros, cons and controversies. Clin Med (Lond) 2007;7(1):37-42. [Medline: 17348573]
24. Valaitis RK, Sword WA, Jones B, Hodges A. Problem-based learning online: perceptions of health science students. Adv Health Sci Educ Theory Pract 2005 Aug;10(3):231-252. [doi: 10.1007/s10459-005-6705-3] [Medline: 16193403]

Abbreviations

CAL: computer-assisted learning
CBL: case-based learning
RO-CBL: remote-online case-based learning

Edited by A Shachak; submitted 16.11.15; peer-reviewed by A Macznik, L Woodham, B Worm; comments to author 11.12.15; revised version received 24.02.16; accepted 12.03.16; published 28.04.16.

Please cite as:
Nicklen P, Keating JL, Maloney S
Exploring Student Preconceptions of Readiness for Remote-Online Case-Based Learning: A Case Study
JMIR Medical Education 2016;2(1):e5
URL: http://mededu.jmir.org/2016/1/e5/
doi:10.2196/mededu.5348
PMID:27731854

Original Paper

Students' Perceptions of and Experiences With Educational Technology: A Survey

Kenneth Royal[1], MSEd, PhD; Mari-Wells Hedgpeth[2], MEd; Dan McWhorter[3], MA

[1]College of Veterinary Medicine, Department of Clinical Sciences, North Carolina State University, Raleigh, NC, United States
[2]College of Veterinary Medicine, Office of Academic Affairs, North Carolina State University, Raleigh, NC, United States
[3]College of Veterinary Medicine, Educational Support Services, North Carolina State University, Raleigh, NC, United States

Corresponding Author:
Kenneth Royal, MSEd, PhD
College of Veterinary Medicine
Department of Clinical Sciences
North Carolina State University
1060 William Moore Dr.
Raleigh, NC, 27607
United States
Phone: 1 919 513 6100
Fax: 1 919 515 2011
Email: kdroyal2@ncsu.edu

Abstract

Background: It is generally assumed that incoming students in medical education programs will be better equipped for the "digital age" given their younger age and an educational upbringing in which technology was seemingly omnipresent. In particular, many assume that today's medical students are more likely to hold positive attitudes and increased comfortability with technology and possess greater information technology (IT) skills.

Objective: The purpose of this study was to compare responses of incoming veterinary medical students to a series of IT-related questions contained in a common questionnaire over the course of a 10-year period (2005-2015) to discern whether students' attitudes have improved and uses and comfortability with technology have increased as anticipated.

Methods: A survey measuring attitudes and preferences, computing experience, and technology ownership was administered each year for the past 10 years to incoming veterinary medical students at a large veterinary school in the United States. Students' responses to survey items were compared at 3 data points (2005, 2010, and 2015).

Results: Today's incoming veterinary medical students tend to indicate the same desire to improve skills using spreadsheets and web page design as incoming students from 10 years ago. It seems that despite technological advances and increased exposure to such applications and skills, there remains a challenge for students to "keep up" with the ever evolving technology. Moreover, although students continue to report they are very comfortable with using a computer (and related devices), many use their computers as typewriters or word processors, as opposed to a means for performing more advanced computing functions.

Conclusions: In general, today's medical students are not expert computer users as many assume. Despite an upbringing in a digitized world, many students still lack many basic computing skills.

(JMIR Medical Education 2016;2(1):e4) doi:10.2196/mededu.5135

KEYWORDS

medical education; veterinary education; information literacy; experience; attitudes; preferences; technology

Introduction

Comparing 10 Years of Veterinary Medicine Students' Attitudes Toward, Uses of, and Comfortability With Technology

Strong information technology (IT) and computing skills are essential for students across virtually every medical education program (eg, medicine, pharmacy, dentistry, veterinary, and so forth). Given the increased emphasis of electric medical records and efforts to digitize information for quicker and easier retrieval [1-2], the need has never been more pressing. Furthermore, for medical program graduates to promote their practice, they will need to be relatively savvy with IT for marketing and management or administration purposes [3-4].

At the same time, technology is ever-evolving. As incoming students enter various medical programs throughout the world, there is often an assumption that because these students are typically younger, they will be better equipped for the “digital age.” For example, Facebook was released in 2004; thus, one might assume that virtually every modern medical student would be fluent in web page design. One might assert that today's medical students are more likely to hold positive attitudes and experience increased comfortability with technology, as well as possess greater IT skills [5-6]. The purpose of this study was to compare responses of incoming veterinary medical students to a series of IT-related questions contained in a common questionnaire over the course of a 10-year period (2005-2015) to discern whether students’ attitudes have improved and uses and comfortability with technology have increased as anticipated.

Methods

Instrumentation

A technology survey was administered each year for the past 10 years to all incoming freshmen in the Doctor of Veterinary Medicine program at a large veterinary medical school in the United States. The survey consisted of 6 items measuring students' attitudes and preferences, 2 items pertaining to technology ownership and usage, and 11 items measuring computing experience. The survey format was anonymous and voluntary in nature.

Recruitment and Design

For the present study, we sought to compare students' responses over the last decade by comparing responses at 3 data points: 10 years ago (graduating class of 2009), 5 years ago (graduating class of 2014), and the present year (graduating Class of 2019). The following statistics provide an overview of class sizes and response rates: class of 2009 had 38 of 75 (50.6%) participants; class of 2014 had 51 of 80 (63.8%) participants; and the class of 2019 had 99 of 100 (99.0%) participants. SPSS statistical software was used to perform all data analyses.

Results

Demographics

As noted previously, demographic data were not collected for survey respondents. This was due in part to the potential for social desirability bias among subpopulations as the veterinary student demographic largely includes females, which is a national trend. However, demographic data are available for the entire incoming class cohorts during these years. Table 1 provides a breakdown by year according to gender, race or ethnicity, and age.

Reliability

Cronbach alpha estimates were generated to evaluate internal consistency. Overall reliability was .86 when evaluating all 17 quantitative items. Cronbach alpha estimates for attitude and preference items and computing experience items were .67 and .89, respectively. These values indicate low-moderate to moderate statistical reproducibility [7].

Attitudes and Preferences

Students were asked to provide their agreement with 6 items measuring attitudes and preferences using a 5-point Likert-type scale (1 = strongly disagree; 5 = strongly agree). Descriptive statistics were produced for each item (see Table 2). Analysis of variance (ANOVA) results indicated that no statistically significant differences (P<.05) were discernible when comparing responses to each item based on class year.

Table 1. Demographic characteristics on incoming class by graduating year.

Characteristic		2009, N=75, n(%)	2014, N=80, n(%)	2019, N=100, n(%)
Sex				
	Male	15 (20.0)	12 (15.0)	24 (24.0)
	Female	60 (80.0)	68 (85.0)	76 (76.0)
Race or ethnicity				
	White	61 (81.3)	52 (65.0)	71 (71.0)
	Black	7 (9.3)	7 (8.8)	8 (8.0)
	Hispanic	3 (4.0)	3 (3.8)	4 (4.0)
	Other	4 (5.3)	18 (22.5)	16 (16.0)
Age (mean), years		24.4	23.4	24.5

Table 2. Responses to attitudes and preferences items.

Item	Class	N	Mean	SD[a]	CI[b] (95%)
I am confident about my ability to use a computer for general course work	2009	38	4.79	0.577	4.60-4.98
	2014	51	4.92	0.272	4.85-5.00
	2019	98	4.83	0.381	4.75-4.90
I want the opportunity to use computers as much as possible in my course work	2009	38	3.89	1.060	3.55-4.24
	2014	51	3.84	0.925	3.58-4.10
	2019	99	4.01	0.851	3.84-4.18
I want to access course materials online	2009	38	4.58	0.683	4.35-4.80
	2014	51	4.69	0.583	4.52-4.85
	2019	99	4.79	0.500	4.69-4.89
I would be interested in taking some courses designed to use web, video, email, and other technologies so that I can work from home rather than attend class (or attend class less often)	2009	38	3.26	1.349	2.82-3.71
	2014	51	3.10	1.330	2.72-3.47
	2019	99	3.47	1.358	3.20-3.75
I want my instructors to use technology in the classroom for presentations and demonstrations	2009	38	4.42	0.722	4.18-4.66
	2014	51	4.33	0.554	4.18-4.49
	2019	99	4.39	0.682	4.26-4.53
I prefer to answer this type of survey online as opposed to paper	2009	38	4.71	0.565	4.52-4.90
	2014	51	4.63	0.799	4.40-4.85
	2019	98	4.47	0.976	4.27-4.67

[a]SD: standard deviation.

[b]CI: confidence interval.

Computing Experience

Students were asked to rate their proficiency with respect to 11 items measuring computing experience by using the following scale: 1 = poor; 2 = below average; 3 = average; 4 = good; 5 = excellent. Descriptive statistics were produced for each item (see Table 3). An ANOVA was initially performed, but a Levene's test of homogeneity of variances indicated that 6 of the 11 items possessed significantly different variances ($P<.05$), thus indicating that parametric statistical procedures should not be used. A Kruskal-Wallis nonparametric test was instead performed to investigate potential differences in responses across the class year variable. Because SPSS does not report effect size estimates for Kruskal-Wallis tests, eta square estimates were computed manually using the formula: $\eta^2 = \chi^2 / N - 1$, where χ^2 is the chi-square value and N is the total number of cases. Results indicate that 3 of the 11 items yielded statistically significant differences. Furthermore, effect size estimates for each item were medium in magnitude, indicating a moderate "practical significance" [8].

Technology Ownership

Students were asked "what operating system(s) do you run on your computer?" and "what web browser do you primarily use on your computer?" The results are summarized in Table 4.

Table 3. Responses to computing experience items.

Item	Class	N	Mean	SD[a]	CI[b] (95%)	*P*	η^2
Delete, move, rename, or copy files	2009	38	4.24	0.97	3.92-4.56	.001	.08
	2014	50	4.84	0.42	4.72-4.96		
	2019	99	4.67	0.69	4.53-4.80		
Create and manage folders and directories	2009	38	3.97	1.13	3.60-4.34	.011	.05
	2014	51	4.53	0.64	4.35-4.71		
	2019	99	4.57	0.70	4.43-4.71		
Perform general formatting on text (change font sizes, select, copy, move, center, underline, bold, number pages, and so forth)	2009	38	4.68	0.74	4.44-4.93	.946	.00
	2014	51	4.82	0.39	4.72-4.93		
	2019	99	4.76	0.57	4.64-4.87		
Insert and modify figures, images, tables, and so forth	2009	38	4.05	0.99	3.73-4.38	.030	.04
	2014	50	4.34	0.66	4.15-4.53		
	2019	98	4.47	0.76	4.32-4.62		
Perform general data entry (use different numeric formats, change column widths, insert rows or columns, cut or paste values, and so forth)	2009	38	4.13	1.26	3.72-4.54	.587	.01
	2014	51	4.45	0.832	4.22-4.69		
	2019	97	4.38	0.90	4.20-4.56		
Use functions and formulas for common tasks (sum and average ranges of cells, apply simple financial functions, specify absolute and relative cell addresses)	2009	38	3.50	1.29	3.08-3.92	.757	.00
	2014	51	3.75	1.06	3.45-4.04		
	2019	99	3.67	1.06	3.46-3.88		
Create spreadsheet charts (pie charts, bar charts, and so forth)	2009	38	3.71	1.23	3.31-4.11	.327	.01
	2014	51	4.12	0.91	3.86-4.37		
	2019	99	3.90	1.04	3.69-4.11		
Send, receive, copy, and forward email	2009	38	4.76	0.54	4.59, 4.94	.472	.01
	2014	51	4.90	0.30	4.82-4.99		
	2019	99	4.81	0.53	4.70-4.91		
Send and receive attachments	2009	38	4.71	0.57	4.52-4.90	.160	.02
	2014	51	4.90	0.30	4.82-4.99		
	2019	99	4.82	0.50	4.72, 4.92		
Use the Internet for searching for and locating specific information	2009	38	4.58	0.64	4.37-4.79	.109	.02
	2014	51	4.73	0.57	4.57-4.89		
	2019	99	4.78	0.53	4.67-4.88		
Create your own web pages	2009	38	2.29	1.25	1.88-2.70	.467	.01
	2014	51	2.63	1.28	2.27-2.99		
	2019	99	2.46	1.27	2.21-2.72		

[a]SD: standard deviation.

[b]CI: confidence interval.

Table 4. Responses to technology ownership and usage items.

Response		2009, N (%)	2014, N (%)	2019, N (%)
Operating system				
	Windows	37 (97.4)	33 (64.7)	49 (49.5)
	Mac	1 (2.6)	13 (25.5)	40 (40.4)
	Dual or Other	0 (0.0)	5 (9.8)	10 (10.1)
Primary browser				
	Internet Explorer	28 (73.7)	12 (23.5)	8 (8.1)
	Mozilla Firefox	6 (15.8)	30 (58.8)	15 (15.2)
	Chrome	0 (0.0)	0 (0.0)	54 (54.5)
	Safari	1 (2.6)	8 (15.7)	22 (22.2)
	Other	3 (7.9)	1 (2.0)	0 (0.0)

Most Desirable Computer Skill to Learn

Responses to the open-ended item asking “What computer skills would you like to learn?” varied considerably across class years. With respect to the class of 2009, 28 of the 38 participants provided responses and 17 (60.7%) of them indicated interest in web page design, and 15 (53.6%) expressed an interest in increasing familiarity with Microsoft Excel. With respect to the class of 2014, 27 of 51 participants provided responses and 10 (37.0%) of them indicated interest in Excel, 7 (25.9%) were interested in web page design, and 4 (14.8%) indicated interest in becoming more competent with the use of Microsoft PowerPoint. With respect to the class of 2019, 63 of 99 participants provided responses and 30 (47.6%) of them expressed interest in Excel, and 18 (28.6%) of them were interested in web page design.

Discussion

Principal Findings

With regard to students' attitudes and preferences about technology, multiple measures over a 10-year period suggest that little has changed as students indicated comparable levels of agreement to each item over time. With respect to computing experience, a similar trend was discernible with exception to items pertaining to file management (eg, deleting, moving, copying), folder management (eg, creating and managing folders and directories), and data or image manipulation (eg, inserting and modifying figures, tables, images, and so forth). Students' perceived competence with these skills has increased over time.

A review of qualitative comments regarding most desirable computer skills to learn reveals an interesting trend. Ten years ago, most students wanted to learn more about web page design and increase their proficiency with Microsoft Excel. Five years ago, interest in Excel and web page design remained the most sought-after skills, but the percentage of students expressing interest in these skills declined considerably over the previous 5 years. Today, students again express a strong interest in Excel and web page design, but the focus seems to be on more advanced applications using each of these platforms. These findings may suggest that despite technological advances and increased exposure to such applications and skills, there remains a challenge for students to “keep up.”

Perhaps one of the most glaring findings of this study was that the vast majority of students indicated that they were very confident about their ability to use a computer for general course work but still lacked proficiency in some rather basic computing skills (eg, working with spreadsheets, basic web design, and so forth). We contend that these findings suggest students primarily use computers as typewriters, as opposed to a means for performing more advanced computing functions. That is, although virtually every student is familiar with computing devices, there is a significant proportion of students who do not possess skills beyond basic word processing, email, and information retrieval.

Other Considerations

It is undeniable that medical students must possess a minimum level of computing competence to be successful in today's workplace. However, the question is where do students develop these skills? Medical schools are known to have rigid curricula, in which there is little flexibility to make changes. Much has been written about the difficulties of identifying where curricular cuts and changes should be made and the politics surrounding such implementations [9]. Thus, it seems that offering IT training as part of the medical curriculum is a less-than-ideal solution. Furthermore, incoming medical students come from a wide variety of disciplinary backgrounds, making it unlikely that all students have received adequate formal training as part of their undergraduate education. Should medical schools require a demonstration of technological competence before admission? If so, what might these requirements be, especially in light of the fast-paced and evolving nature of technological advances? Some medical schools provide IT information sessions during student orientation, but are these sessions enough? At present, there is little published research indicating the effectiveness of such sessions.

One potential solution is for medical schools to provide “brown bag” luncheons and workshops to facilitate these skills. Such meetings routinely occur in medical schools where students discuss career specialties, future employment opportunities, research opportunities, and so forth. It seems reasonable for medical education programs to include matters of educational technology as part of such meetings. Another possibility is for educational technology groups, or perhaps campus teaching and learning centers, to produce video or web-based tutorials and have Academic Affairs units with medical schools to require students to complete IT-related training sessions at some point during the curriculum. Each of these possibilities would be quite realistic and should result in little faculty resistance, as they would occur outside the classroom and would not interfere with instructional time. Faculty wishing to incorporate advanced technology skills into their courses (eg, data manipulation in Excel, and so forth) might simply direct students to external resources (eg, online tutorials, and so forth) when assigning work, as this will ensure that students devote requisite time and attention to acquiring necessary IT-related skills while generating work products.

There is also an inescapable ethical element involving medical students and technology. Much has been written about students' perceptions, attitudes, and uses of social media and various aspects of professional behaviors [10], but little has been discussed regarding the potential consequences that may result from a lack of competence with computers and various aspects of IT. For example, unscrupulous individuals are constantly searching for security vulnerabilities to exploit users. Phishing scams, sophisticated viruses, and a host of other issues can wreak havoc on one's career, especially in instances in which sensitive information (eg, patient data) are compromised. Furthermore, medical education faculty are not usually the best models for how to use technology; thus, when students see faculty struggle with technology, it could potentially further deter them from taking action to improving their own technological skills. For these reasons, we argue medical schools have a moral obligation to, at the very least, inform students (and faculty) of the potential consequences that may result from a host of security threats and offer some “best practices” advice for safe computing.

Wu et al [11] noted that students in medical programs possess a wide array of devices; thus, it is critical to continually monitor this information each year to better forecast future needs in related areas, such as libraries. Understanding students' attitudes, preferences, and the types of devices they use can help library staff remain flexible and ensure that timely resources are available for students. We also anticipate information from surveys such as the one described in this paper will be of use to some faculty and key administrators (eg, academic deans, research deans, and so forth) as they begin efforts to plan a course, try a new instructional approach (eg, online testing, project-based learning activity, and so forth), create policies pertaining to academic conduct and professional expectations, and so forth.

Limitations

A potential limitation of this study is that demographic data were not collected from respondents; thus, we are unable to compare responses to various items by key demographic criteria. However, we believe offering anonymity to complete the survey likely improved the accuracy of the findings. More specifically, most student populations in veterinary medical schools are predominantly female; thus, acquiring demographic information may have caused some students from underrepresented groups (eg, males) to respond in a socially desirable manner given it would there would be a greater possibility of identifying these students. Another potential limitation is sample size. Despite respectable response rates, student cohorts across the 10-year period ranged from 75 to 100 students.

Conclusions

It is generally assumed that incoming students in medical education programs will be better equipped for the “digital age” given their young age and an educational upbringing in which technology was pervasive. Consequently, many assume that today's medical students are more likely to have a positive attitude toward and increased comfortability with technology and possess greater IT skills. We sought to test this assumption by comparing students' responses obtained from an IT-related survey administered to incoming freshmen each year for the past 10 years. Results indicate that today's incoming students express the same deficiency in IT-related skills as students from previous years, suggesting that it is a challenge for students to “keep up” with technological advances. Furthermore, although it is true that students typically report being comfortable with the use of computers (and similar devices), there is evidence to suggest that students primarily use these devices as typewriters, as opposed to a platform for performing advanced operations. We conclude that it is an erroneous assumption that today's students are much more skilled in the area of IT than students from past years. The good news, however, is that modern medical students recognize the need for increased IT-related skills and indicate a desire to learn these skills.

Conflicts of Interest

None declared.

References

1. Hammoud MM, Margo K, Christner JG, Fisher J, Fischer SH, Pangaro LN. Opportunities and challenges in integrating electronic health records into undergraduate medical education: a national survey of clerkship directors. Teach Learn Med 2012 Jul;24(3):219-224. [doi: 10.1080/10401334.2012.692267] [Medline: 22775785]
2. Spencer DC, Choi D, English C, Girard D. The effects of electronic health record implementation on medical student educators. Teach Learn Med 2012 Apr;24(2):106-110. [doi: 10.1080/10401334.2012.664513] [Medline: 22490089]
3. Hardy B. The business of being a vet. Vet Rec 2013 Jun 8;172(23):602-603. [doi: 10.1136/vr.f3549] [Medline: 23749358]

4. Hauge LS, Frischknecht AC, Gauger PG, Hirshfield LE, Harkins D, Butz DA, et al. Web-based curriculum improves residents' knowledge of health care business. J Am Coll Surg 2010 Dec;211(6):777-783. [doi: 10.1016/j.jamcollsurg.2010.07.011] [Medline: 20851642]
5. Judd T, Kennedy G. A five-year study of on-campus Internet use by undergraduate biomedical students. Computers & Education 2010 Dec;55(4):1564-1571. [doi: 10.1016/j.compedu.2010.06.022]
6. Sieber V. Diagnostic online assessment of basic IT skills in 1st-year undergraduate in the medical sciences division, University of Oxford. Br J Educ Technol 2009;40(2):215-226. [doi: 10.1111/j.1467-8535.2008.00926.x]
7. Royal K, Hecker K. Understanding Reliability: A Review for Veterinary Educators. J Vet Med Educ 2016;43(1):1-4. [doi: 10.3138/jvme.0315-030r]
8. Cohen J. Statistical power analysis for the behavioral sciences (2nd ed). In: Statistical power analysis for the behavioral sciences. Hillsdale, N.J: L. Erlbaum Associates; 1988.
9. Royal KD, Dent GA. A Novel Approach for Investigating Curricular Redundancy. Educ Med J 2014 Dec 01;6(4):91-93. [doi: 10.5959/eimj.v6i4.285]
10. Ross S, Lai K, Walton J, Kirwan P, White J. “I have the right to a private life”: Medical students’ views about professionalism in a digital world. Medical Teacher 2013 Jul 05;35(10):826-831. [doi: 10.3109/0142159x.2013.802301]
11. Wu J, Chatfield A, Hughes A, Kysh L, Rosenbloom M. Measuring patrons' technology habits: an evidence-based approach to tailoring library services. J Med Libr Assoc 2014 Apr;102(2):125-129 [FREE Full text] [doi: 10.3163/1536-5050.102.2.014] [Medline: 24860272]

Abbreviations

IT: information technology

Edited by G Eysenbach; submitted 15.09.15; peer-reviewed by M Lybarger, X Webb; comments to author 07.10.15; revised version received 07.10.15; accepted 25.03.16; published 18.05.16.

Please cite as:
Royal K, Hedgpeth MW, McWhorter D
Students' Perceptions of and Experiences With Educational Technology: A Survey
JMIR Medical Education 2016;2(1):e4
URL: http://mededu.jmir.org/2016/1/e4/
doi:10.2196/mededu.5135
PMID:27731853

Short Paper

Feasibility of Augmented Reality in Clinical Simulations: Using Google Glass With Manikins

Basil Chaballout[1*], B.S.; Margory Molloy[2*], RN, DNP; Jacqueline Vaughn[2*], RN, BSN; Raymond Brisson III[2*], BS; Ryan Shaw[2*], RN, PhD

[1]Duke University, Trinity College of Arts & Sciences, Durham, NC, United States

[2]Duke University, School of Nursing, Durham, NC, United States

[*]all authors contributed equally

Corresponding Author:
Ryan Shaw, RN, PhD
Duke University
School of Nursing
307 Trent Dr.
DUMC3322
Durham, NC,
United States
Phone: 1 919 684 9434
Fax: 1 919 684 9434
Email: ryan.shaw@duke.edu

Abstract

Background: Studies show that students who use fidelity-based simulation technology perform better and have higher retention rates than peers who learn in traditional paper-based training. Augmented reality is increasingly being used as a teaching and learning tool in a continual effort to make simulations more realistic for students.

Objective: The aim of this project was to assess the feasibility and acceptability of using augmented reality via Google Glass during clinical simulation scenarios for training health science students.

Methods: Students performed a clinical simulation while watching a video through Google Glass of a patient actor simulating respiratory distress. Following participation in the scenarios students completed two surveys and were questioned if they would recommend continued use of this technology in clinical simulation experiences.

Results: We were able to have students watch a video in their field of vision of a patient who mimicked the simulated manikin. Students were overall positive about the implications for being able to view a patient during the simulations, and most students recommended using the technology in the future. Overall, students reported perceived realism with augmented reality using Google Glass. However, there were technical and usability challenges with the device.

Conclusions: As newer portable and consumer-focused technologies become available, augmented reality is increasingly being used as a teaching and learning tool to make clinical simulations more realistic for health science students. We found Google Glass feasible and acceptable as a tool for augmented reality in clinical simulations.

(JMIR Medical Education 2016;2(1):e2) doi:10.2196/mededu.5159

KEYWORDS

clinical simulation; augmented reality; feasibility; student learning; Google Glass

Introduction

Patient simulation is a useful tool for training students and ascertaining competency prior to students entering clinical environments [1]. Simulations using patient manikins allow students to acquire necessary skills and practice without fear of harming patients. In order for knowledge gained during patient simulations to translate into clinical practice, scenarios must feel realistic to students.

Studies show that students who use fidelity-based simulation technology perform better and have higher retention rates than peers who learn in traditional paper-based training [2]. Using medium- and high-fidelity simulation manikins is an effective teaching and learning method for health science education [3].

Developing care delivery skills in a simulation practice setting enables students to focus on performance, which can enhance patient safety [4].

Augmented reality, which combines virtual reality with physical materials, instruments, and feedback, is increasingly being used as a teaching and learning tool to make simulations even more realistic for students. Studies show that this level of realism is good for medical training and results in significantly improved skills transfer in students [5,6].

The aim of this feasibility and acceptability trial was to assess the use of Google Glass as a tool to enhance the realism of high-fidelity simulations for training health science students.

Methods

Development

Students watched a video while wearing Google Glass (see Multimedia Appendix 1) of a patient actor simulating respiratory distress. Google Glass is a head-mounted device with a built-in camera, display, touchpad, battery, and microphone worn like a set of spectacles. It allows data to be free from desktop or laptop computers and portable devices and places a nonobstructive video image in the upper right-hand corner of the user's field of vision.

In this project, Google Glass allowed for a video to appear in each student's field of view without the need to look at a separate video screen while delivering care to a manikin. The video was that of a standardized patient portraying a patient experiencing respiratory distress.

An actor who strongly resembles the manikin acted out the specific scenario the students would be responding to in the simulation. The video presented a car accident victim who was having difficulty breathing while simultaneously panicking. It was filmed with high definition cameras outside the use of Google Glass and shot as a constant stream to be played entirely from start to finish during the simulation. It was produced to match the expected duration and procedure of the simulation to reflect what the students were performing on the manikin. This video was placed on the video-sharing website YouTube and was viewed through the Glass prism during the simulation experience.

After the trial received approval from the university's institutional review board, student volunteers were recruited to participate in the scenarios while wearing Google Glass. The video of the patient was played in each student's field of vision to augment the clinical changes the manikin was programed to display. The intent was for the patient in the video to show in real time what the manikin was displaying. Instructors sat behind a one-way mirror in a control room to view the scenario and witness what the participants were viewing by watching the video at the same time on a computer. A debriefing followed the simulation experience. During the debriefing, students were given the opportunity to reflect on the simulation experience.

Measures

Feasibility

Feasibility was assessed as our ability to set up Google Glass, play a video of the patient actor in the student's field of vision during a simulation, and overcome technical challenges.

Acceptability

Following the scenarios, participants were asked if they would recommend continued use of this technology in clinical simulation experiences. In addition, they completed two surveys and answered an open-ended question about their experience. The 13-item Student Satisfaction and Self-Confidence in Learning Scale was designed to measure these outcomes using a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). Reliability was previously reported as a Cronbach alpha of .94 to .92 for the satisfaction subscale and .87 to .83 for the self-confidence subscale [7,8]. The 20-item Simulation Design Scale evaluates objectives and information, support, problem solving, feedback, and fidelity of a clinical simulation. Reliability was previously reported as a Cronbach alpha of .96 for the overall scale [8].

Statistical Analysis

Descriptive statistics were calculated from the survey data and analyzed using SPSS version 23.0 (IBM Corp). Qualitative data from the open-ended question were interpreted using content analysis.

Results

Feasibility

The quality of the video was realistic. We were able to upload the video to YouTube without difficulties, and students were able to watch it in Google Glass during the simulations.

There were a few challenges. Due to security measures put in place by our hospital, it was difficult to connect the device to a wireless network in order to view the video on YouTube. The students faced a large learning curve when attempting to use the device for the first time, and it was hard to coordinate the video to start as soon as the actual simulation began. Google Glass had a short battery life and a tendency to overheat when used for a long duration. Nevertheless, the video played during all simulations.

Acceptability

Most students recommended we continue using the Google Glass technology in clinical simulations (10/12, 80%). The remaining students reported they were unsure about continued use of the technology. Students reported high mean scores on the design of the simulation and satisfaction with the simulation to promote learning, and self-confidence in learning. Table 1 shows the results from the Simulation Design Scale and Student Satisfaction and Self-Confidence in Learning surveys.

Table 1. Acceptability of Google Glass in a clinical simulation.

Measures		Mean (SD)
Simulation Design Scale		
	Objectives and information	4.65 (0.18)
	Support	4.85 (0.04)
	Problem solving	4.53 (0.30)
	Feedback/guided reflection	4.85 (0.14)
	Fidelity (realism)	4.67 (0.12)
Student Satisfaction and Self-Confidence in Learning		
	Satisfaction with current learning	4.67 (0.13)
	Self-confidence in learning	4.35 (0.60)

The mix of opinions, however, was more directly seen in the answers to the open-ended questions. One student reported, “It was kind of distracting. I think I might just have to get used to [it]. The reason why is because my eyes have to look at two things.” Another student indicated that the video actually helped him understand the respiratory distress of the patient by stating, “After it [the video] got going it just became part of the simulation.” Students expressed a desire to have more information presented in Google Glass and asked for the ability to incorporate live vital signs into the display. Students also wanted prior familiarization with the technology and preparation for technological difficulties.

Discussion

Google Glass has been used in clinical simulation-based training for capturing video during care delivery [9,10] and ultrasound-guided venous access [11] and as a tool for pediatric surgery [9]. This study is the first to our knowledge to use it as a tool to mimic a manikin by displaying the video in the user’s field of vision. We found that it was feasible to use Google Glass as an augmented reality tool for learning in clinical simulations. Students successfully watched a video in their field of vision of a patient that mimicked the simulated manikin they were caring for. The purpose of augmenting reality during the simulation instead of playing the video prior to it was to give a better perception of working with an actual patient in real time. Students spoke of the benefits of being able to view a patient during the simulation, reported perceived realism with the technology, and recommended using the technology in the future.

While it was feasible to use the technology in the simulations, there were challenges. We encountered technical barriers when setting up the devices, and it took time to train students on how to use them. The learning curve may have impacted student perceptions of the usefulness of the technology. For example, one student experienced a delay between the Google Glass video and the live simulation due to technical difficulties and confusion on how to work the device. Attention may have been compromised and problem-solving skills momentarily reduced because students were learning how to use the device while using the device during a simulated clinical experience.

Limitations

Because this was a small sample and our main goal was to discover the feasibility and acceptability of using this technology in a clinical simulation, we cannot make conclusions as to the benefit of this technology on learning outcomes. Nevertheless, the similarity in data and the increased perception of realism point to this being a promising proof of concept worthy of future testing.

Conclusions

As newer portable and consumer-focused technologies become available, augmented reality is increasingly being used as a teaching and learning tool to make clinical simulations more realistic for health science students [11,12,13]. We found Google Glass feasible and acceptable as a tool for augmented reality in clinical simulations.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Duke Google Glass for Clinical Simulations.

[MP4 File (MP4 Video), 18MB - mededu_v2i1e2_app1.mp4]

References

1. Steadman RH, Coates WC, Huang YM, Matevosian R, Larmon BR, McCullough L, et al. Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills. Crit Care Med 2006 Jan;34(1):151-157. [Medline: 16374169]
2. Hunkeler EM, Meresman JF, Hargreaves WA, Fireman B, Berman WH, Kirsch AJ, et al. Efficacy of nurse telehealth care and peer support in augmenting treatment of depression in primary care. Arch Fam Med 2000 Aug;9(8):700-708. [Medline: 10927707]
3. Cant RP, Cooper SJ. Simulation-based learning in nurse education: systematic review. J Adv Nurs 2010 Jan;66(1):3-15. [doi: 10.1111/j.1365-2648.2009.05240.x] [Medline: 20423432]
4. Grantcharov TP, Kristiansen VB, Bendix J, Bardram L, Rosenberg J, Funch-Jensen P. Randomized clinical trial of virtual reality simulation for laparoscopic skills training. Br J Surg 2004 Feb;91(2):146-150. [doi: 10.1002/bjs.4407] [Medline: 14760660]
5. Kilmon CA, Brown L, Ghosh S, Mikitiuk A. Immersive virtual reality simulations in nursing education. Nurs Educ Perspect 2010;31(5):314-317. [Medline: 21086871]
6. Kim HK, Rattner DW, Srinivasan MA. Virtual-reality-based laparoscopic surgical training: the role of simulation fidelity in haptic feedback. Comput Aided Surg 2004;9(5):227-234. [doi: 10.3109/10929080500066997] [Medline: 16192064]
7. Jeffries P, Rizzolo M. Designing and implementing models for the innovative use of simulation to teach nursing care of ill adults and children: A national, multi-site, multi-method study. National League for Nursing 2006.
8. Franklin AE, Burns P, Lee CS. Psychometric testing on the NLN Student Satisfaction and Self-Confidence in Learning, Simulation Design Scale, and Educational Practices Questionnaire using a sample of pre-licensure novice nurses. Nurse Educ Today 2014 Oct;34(10):1298-1304. [doi: 10.1016/j.nedt.2014.06.011] [Medline: 25066650]
9. Muensterer OJ, Lacher M, Zoeller C, Bronstein M, Kübler J. Google Glass in pediatric surgery: an exploratory study. Int J Surg 2014;12(4):281-289. [doi: 10.1016/j.ijsu.2014.02.003] [Medline: 24534776]
10. Goodwin J, Elkattah R, Olsen M. Wearable technology in obstetrical emergency simulation: A pilot study. Intl J Health Sci Educ 2014;2(2):3.
11. Wu TS, Dameff CJ, Tully JL. Ultrasound-guided central venous access using Google Glass. J Emerg Med 2014 Dec;47(6):668-675. [doi: 10.1016/j.jemermed.2014.07.045] [Medline: 25281180]
12. Wu T, Dameff C, Tully J. Integrating Google Glass into simulation-based training: experiences and future directions. J Biomed Graphics Comp 2014 Apr 18;4(2). [doi: 10.5430/jbgc.v4n2p49]
13. Zhu E, Lilienthal A, Shluzas LA, Masiello I, Zary N. Design of mobile augmented reality in health care education: A theory-driven framework. JMIR Med Educ 2015 Sep 18;1(2):e10. [doi: 10.2196/mededu.4443]

Edited by G Eysenbach; submitted 24.09.15; peer-reviewed by T Aungst, J Nosta; comments to author 15.10.15; revised version received 26.11.15; accepted 04.01.16; published 07.03.16.

Please cite as:
Chaballout B, Molloy M, Vaughn J, Brisson III R, Shaw R
Feasibility of Augmented Reality in Clinical Simulations: Using Google Glass With Manikins
JMIR Medical Education 2016;2(1):e2
URL: http://mededu.jmir.org/2016/1/e2/
doi:10.2196/mededu.5159
PMID:27731862

Original Paper

Enabling Access to Medical and Health Education in Rwanda Using Mobile Technology: Needs Assessment for the Development of Mobile Medical Educator Apps

Jean Christophe Rusatira[1], MD; Brian Tomaszewski[2], PhD; Vincent Dusabejambo[1], MD, MMed; Vincent Ndayiragije[1]; Snedden Gonsalves[2], MSc; Aishwarya Sawant[2], MSc; Angeline Mumararungu[1], MD; George Gasana[1], MD; Etienne Amendezo[1], MD, MMed; Anne Haake[2], PhD; Leon Mutesa[1], MD, PhD

[1]College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda

[2]Rochester Institute of Technology, Rochester, NY, United States

Corresponding Author:
Jean Christophe Rusatira, MD
College of Medicine and Health Sciences, University of Rwanda
KN 73 ST
Kigali, 3286
Rwanda
Phone: 250 788665979
Fax: 250 571787
Email: rusatirac2001@gmail.com

Abstract

Background: Lack of access to health and medical education resources for doctors in the developing world is a serious global health problem. In Rwanda, with a population of 11 million, there is only one medical school, hence a shortage in well-trained medical staff. The growth of interactive health technologies has played a role in the improvement of health care in developed countries and has offered alternative ways to offer continuous medical education while improving patient's care. However, low and middle-income countries (LMIC) like Rwanda have struggled to implement medical education technologies adapted to local settings in medical practice and continuing education. Developing a user-centered mobile computing approach for medical and health education programs has potential to bring continuous medical education to doctors in rural and urban areas of Rwanda and influence patient care outcomes.

Objective: The aim of this study is to determine user requirements, currently available resources, and perspectives for potential medical education technologies in Rwanda.

Methods: Information baseline and needs assessments data collection were conducted in all 44 district hospitals (DHs) throughout Rwanda. The research team collected qualitative data through interviews with 16 general practitioners working across Rwanda and 97 self-administered online questionnaires for rural areas. Data were collected and analyzed to address two key questions: (1) what are the currently available tools for the use of mobile-based technology for medical education in Rwanda, and (2) what are user's requirements for the creation of a mobile medical education technology in Rwanda?

Results: General practitioners from different hospitals highlighted that none of the available technologies avail local resources such as the Ministry of Health (MOH) clinical treatment guidelines. Considering the number of patients that doctors see in Rwanda, an average of 32 patients per day, there is need for a locally adapted mobile education app that utilizes specific Rwandan medical education resources. Based on our results, we propose a mobile medical education app that could provide many benefits such as rapid decision making with lower error rates, increasing the quality of data management and accessibility, and improving practice efficiency and knowledge. In areas where Internet access is limited, the proposed mobile medical education app would need to run on a mobile device without Internet access.

Conclusions: A user-centered design approach was adopted, starting with a needs assessment with representative end users, which provided recommendations for the development of a mobile medical education app specific to Rwanda. Specific app features were identified through the needs assessment and it was evident that there will be future benefits to ongoing incorporation of user-centered design methods to better inform the software development and improve its usability. Results of the user-centered design reported here can inform other medical education technology developments in LMIC to ensure that technologies developed are usable by all stakeholders.

(JMIR Med Educ 2016;2(1):e7) doi:10.2196/mededu.5336

KEYWORDS

mobile medical education; technology; user-centered design

Introduction

Over the last 20 years, continuous professional development (CPD) and continuing medical education (CME) have developed significantly. Greater emphasis has been put on the needs of patients and respective needs at different points of care. CME has now been influenced by the expectations of patients towards health care providers rather than individual needs of doctors. This has been an efficient CME model and has strengthened the knowledge of doctors in particular practice areas [1]. In Rwanda, with a population of over 11 million [2], there is only one medical school from which around 100 new doctors graduate every year. Further, medical practitioners have little access to CME and CPD after their studies. However, given the rapid evolution of new research and developments in all areas of medical care and CME, it is imperative that professionals continue to update their knowledge and skills regularly [3].

In many countries, there is interest in improving the health system through CPD, CME, and Web-based education systems for health care professionals and patients [4]. One of the efficient ways that have been used, but not currently in Rwanda, is Web-based systems. The evolution of Internet-based tools for sharing digital information for public access has increased the availability of online resources with the capacity to continuously share updates and CME tools [5]. A good number of health care professionals are using the Internet and mobile phones to locate medical education information and knowledge [4]. It has been suggested that an important range of use is directly related to questions that arise from patient care.

A variety of interactive health technologies are being used to deliver asynchronous and synchronous forms of Web-based CME [4,6]. Various models for Web-based CME learning have also been reported, furthering education and guiding diagnosis based on clinical symptoms [5]. The role of the Internet as a source of information for health care professionals is very significant whether accessed on computers, tablets, or mobile phones in Rwanda. However, one factor that has contributed to this development is the actual increasing information needs of doctors and patients.

The dearth of access to recent updates and evidences from different medical studies around the world is a challenge for the majority of health care professionals who are expected to maintain their knowledge on the most recent advances in medicine. Due to the limited number of specialized health care facilities in Rwanda, a large number of patients consult primary health care facilities. Patients who consult such facilities potentially leave with unanswered questions; while doctors are also left with one question for every 15 patients approximately [7]. For doctors working in low resource settings more questions will also arise not only because of the types of patients but also the diversity of diseases that are encountered [8]. Timely access to relevant information and updates is key for providing timely answers to these questions and offer the best evidence-based medical care [9].

The Rwandan health care system has evolved into patient-centered care and evidence-based medicine practice while improving the quality of medical education. Examples of the latter include a revision of the curriculum of the school of medicine, initiation of post-graduate specialty training in the major medical specialties and sub-specialties, and providing the legal mandate for physician licensing and specialty certification to the Rwanda Medical and Dental Council [3]. Since 1995, some CME events have been available through the annual conferences of the Faculty of Medicine and the Rwanda Medical Association, together with occasional conferences sponsored by professional medical associations [3]. However, many physicians have not been able to participate in these conferences. Furthermore, there have not been any structured and ongoing educational activities based on identified needs of Rwandan health care professionals. Given the rapid evolution and new research in all areas of medical care, physicians, nurses, and other health professionals must continue to update their knowledge and skills on a regular basis to keep up with the benefits of new health technologies as well as applying evidence-based medicine [3].

The evolution of the Internet as a worldwide connectivity tool has been key to the adoption of information and communication technology (ICT) globally. Building on this opportunity, people have designed platforms that allow for the sharing of information and interactions between professionals. While ICT has been explored much more in business, it is now being used more than ever in the domain of medicine (curative and preventive). With the increase of computer literacy and medical knowledge available on the Internet in our communities, health care professionals must be well prepared to cope with changing patient behaviors and knowledge [10]. Information technology has provided medical students and professionals with more user-friendly access to a significant quantity of information. However, computing skill levels have also impeded the use or adoption of ICT and computer-based tools. Worldwide, medical educators now use technology more than ever to deliver learning resources leading to a better understanding on the role of technology in CME and its impact on the point of care [10]. Unfortunately, these ICT developments have not reached low and middle-income countries (LMIC), like Rwanda, despite the ever-ending increase of patients' demands and medical practice that need to remain at the global standard. A good number of technology-based tools are widely available but they are not adapted to the local settings and users have not been consulted for the development of tools [11].

Within this background, we argue that a user-centered development (UCD) approach is needed to ensure that mobile medical education developments are relevant and useful. This method has been proven to increase the usability of computer systems and interactive health technologies (IHTs) in general [12,13]. A variety of tools are designed to address specific challenges and in order to reach their goals they have to fit with the expectations of the users while being comfortably usable [14]. Efficacy, satisfaction, and effectiveness are key factors of the usability of technology-based tools and these factors have to be fulfilled for tools to be tailored to meet the educational needs of users, especially in the health fields [15]. Potential user requirements should be the major focus for mobile software interface design, especially in medical education. Required interface features should dominate the design of the rest of the system [16]. However, not only are there no descriptions on whether or how the apps used for medical education in Rwanda involve users in their developments but also there are no reports on their efficacy in improving their knowledge and practices. It is rare to find reports describing how different IHT tools were developed, especially the methods that were used to involve users in the early stages to design and test their usability [11].

Context

Rwanda is facing a problem of insufficient medical education institutions as well as limited technology-based training tools to provide CME to health care professionals. There is only one medical school with insufficiently qualified medical educators. The doctor to population ratio was 1 to 15,428 in 2012 with an annual population growth of 2.9% [17]. In addition to the geographical distribution of health care facilities and insufficient resources for CME, the previously mentioned factors play a big role in poor health care quality. There is great need in CPD by which health professionals are kept updated to meet the needs of patients, the health care service, and their own professional development. We believe that this can only be achieved as a result of efficient interactive technology-based CME and access to needed information and updates. However, in order to develop a useful CME tool, it is important to determine the needs of health care providers, and the nature, characteristics, and content of the current Web-based tool in the continuous acquisition of new knowledge, skills, and attitudes for graduated and future health care professionals [18]. In this regard, a team of professionals and students from the University of Rwanda and the Rochester Institute of Technology (RIT) undertook a user needs assessment study with the expected end product being a well-functioning user-centered technology-based tool, facilitating CME and better care practices in Rwanda. This paper reports results of the user needs assessment research that is part of the larger study.

User Centered Design Framework

One of the efficient models for developing apps is UCD. This approach involves user-centered activities throughout the whole process of developing the software [19]. UCD is complex and involves a variety of methods. There is a broad spectrum of applying the UCD but the most important factor is involving users in one way or another. On the one hand, some types of UCD consult potential users about their requirements from the early stages of the design process, mostly during user needs gathering and usability testing. On the other hand, there are UCD methods in which users provide a series of feedbacks about the technology under development, hence playing a significant role throughout the whole design process [19]. Studies suggest that the role of users in the design and development of a new technology should not be underestimated because their involvement will improve the technology's quality due to a more accurate assessment of user requirements, recommendations, and potential factors to a higher level of user acceptance [20]. Involving users has also been found to substantially reduce development time because usability problems are identified and resolved before these tools are launched [21]. For example, applying UCD to the development of IHTs for patients has been found to improve functionality and usability, therefore increasing the likelihood of promoting the intended health behaviors and health outcomes [11].

Three principles have been recommended for efficient UCD: (1) focusing on users and expected tasks, (2) empirical measurement, and (3) iterative design. With respect to focusing on users and expected tasks, it is first crucial that designers have a good understanding of who the users will be. This understanding can only be achieved by directly studying user behavioral, anthropometric, and attitudinal characteristics and adapting these characteristics to the respective local settings taking into considerations the work that needs to be accomplished. For the empirical measurement, it is key that early in the development process, intended users should be involved through usability testing and prototypes trials to carry out real work, and their performance and reactions should be observed, recorded, and analyzed. As part of the iterative design, problems found during the usability testing have to be fixed through redesigning [14].

This paper describes the findings from a baseline study and needs assessment for the development of a user-centered mobile medical education tool. The tool is focused on the Rwandan medical education system with a particular focus on satisfying the needs of medical doctors practicing in public hospitals from across Rwanda.

Applying User Centered Design

Throughout the development of the mobile medical educator in Rwanda app, key principles and stages for UCD were applied (Table 1). Participants of the baseline study and the needs assessment were chosen to match the expected end users; medical doctors working in different urban and rural hospitals throughout the country. This model has been proven to be efficient in developing other IHTs [13].

Table1. Principles and stages of the user-centered design and their transfer to the mobile medical educator app.

Table 1.

Number	Principle	Rwanda mobile medical educator app
P1	Understand the user, task, and environment requirements	Choose appropriate metrics: baseline study and needs assessment
P2	Encourage early and active involvement of users	Interaction between users and developers to develop first version of prototype
P3	Be driven and refined by user-centered evaluation	Valid evaluation metrics
P4	Include iteration of design solutions	Continuous interaction between developers and end users in their home environment leading to several prototypes
P5	Address the whole user experience	Evaluation metrics that covers all aspects "usability" (ie, effectiveness, efficiency, satisfaction)
P6	Encourage a multi-disciplinary design	Identify need and potential impact
S1	Understand and specify the context of use	Identify need and potential impact through the baseline study
S2	Specify the user requirements for medical education, knowledge sharing and decision making support	Questionnaires and interviews for needs assessment
S3	Produce design solutions to meet user requirements	Prototypes available for testing of usability
S4	Evaluate the designs against requirements	Evaluation metrics (effectiveness, efficiency, satisfaction)

Methods

A team from the School of Medicine of the College of Medicine and Health Sciences at the University of Rwanda, Medfoster, comprised of senior consultants from different fields of medicine, doctors, and one resident conducted the baseline study through self administered questionnaires and interviews where possible. The needs assessment was conducted in collaboration with a team from the RIT, a university that is well distinguished in technology, consisting of two faculty and two students. The baseline study and needs assessment lasted for two and three months, respectively.

Site Selection and Sampling

For reasons of efficiency in collecting users' requirements, we chose to work in all 44 district hospitals (DHs) of Rwanda. Data collection for the baseline was completed over a 2-month period by the Medfoster team. Two doctors were randomly selected from the list of doctors working in the hospital and they were requested to fill out the online baseline questionnaire through a phone call. All conversations were confidential. Respondents were informed that the conversation will be part of a research project aimed at developing a mobile technology for interactive continuous medical education, knowledge sharing, and decision making support, and not an evaluation or assessment. Participants gave informed consent and agreed to fill out the questionnaire by phone call or online by checking the "Yes" box. For the interviews, the conversations were conducted in the fluent language of the respondent. The baseline questionnaire to doctors dealt with their daily activities and experiences, their training, and work experience; special training programs, availability of medical resources and updates, available forms of medical information, their recommendations and perspective on availability of medical information, and updates potentially via Web- and mobile-based technology. The needs assessment was conducted through guided open-ended interview question to 16 medical doctors from randomly selected hospitals in all five different regions of the country.

Preparation Workshop of the Study Team

To orient the research team members who conducted the interviews, the research director conducted a 1-day training workshop in Kigali. The training included a presentation on the research design and background including (1) a review of the objectives, research questions, and methodology of the baseline study; (2) a discussion of the principles of UCD; and (3) the questionnaire to be used for the baseline study. This questionnaire was discussed and finalized in this workshop. Although all of the participants already had substantial experience in collecting qualitative and quantitative data, they benefited from the discussion of the UCD approach that eventually was very useful and oriented them throughout all the stages of the study.

Organization of Fieldwork

Four weeks before the beginning of fieldwork, the School of Medicine and Pharmacy College of Medicine and Health Sciences Ethics Committee approved the project. Letters were sent to the districts' health offices requesting their support of the project. Randomly selected doctors to participate in the baseline study and the needs assessment were contacted by phone one week before the administration of the questionnaire or the interview. At the same time the leaders of concerned health facilities were contacted for confirmation.

Data Collection

During the 1-day training with the research director, the questionnaire to be used for the baseline study was piloted with three medical doctors working in one Muhima DH located in the capital city, one of the 44 DHs that were covered by the study. After this pilot, the research team met in order to assess the efficiency of the tools and any need of amendments. After the training with the study director, the research assistant led the baseline study data collection online, and other trained Medfoster members conducted interviews in hospitals where the questionnaires could not be filled in online. The focus of the data collection was to gain an understanding of the currently available medical resources and opportunities that are not well explored through the mobile medical educator app. The research team collected baseline information from 97 medical doctors of whom 83 were self-administered online questionnaires and 14 were through interviews. The research team analyzed the Web-based baseline survey to find recurring thematic patterns for further investigation of the themes in face-to-face interviews during the needs assessment interviews.

For the needs assessment, in order to motivate the medical doctors to talk about their experiences, training, and their perspectives about a mobile-based tool in an open-ended way, the research assistants from Rwanda and RIT used a 2-page conversational outline in academic languages (English and French) that showed general introductory questions to be asked in the same way to everyone, as well as a list of related topics to be covered in any way appropriate. After, the audio-recorded interviews collected data were transcribed and the research assistant developed summaries for each respondent. After reviewing the summaries and transcripts, the research team developed a draft outline to guide the writing of the report.

Results

Baseline Survey Findings

A total of 581 medical doctors work in 44 different DHs throughout the country according to the records of the Rwanda Medical and Dental Council (RMDC). The majority of them (66.1%, 384/581) are young with ages that vary between 20 to 30 years, working experience between 2 and 5 years, and predominantly male (81.1%, 471/581). All doctors who filled in the online form reported daily Internet use but not always for medical education purposes. The tools used to check for medical information vary but mobile phones (69%, 67/97) and handbooks (15%, 15/97) are used the most, while tablets are used the least (1%, 1/97) (Figure 1). In addition, accessibility to hospital computers and books is also a big challenge considering that the majority of hospitals do not have computer labs or libraries. The most widely used information resources are the Ministry of Health (MOH) clinical guidelines books but the majority (57%, 55/97) of study respondents indicated they are not satisfied with these resources. Nevertheless, as alternative to library challenges, most doctors (60%, 58/97) reported daily use of the Internet specifically searching for medical resources (Figure 2). Social media is also very frequently used for medical education purposes with 69% (67/97), 18% (17/97), and 10% (10/97) using YouTube, Facebook, and Twitter, respectively.

The average number of patients seen per doctor was found to be 32 patients per day and the mostly used online medical information tools are Medscape, Wikipedia, Google Scholar, Hinari, and UpToDate (Figure 3). Half of respondents (51%, 49/97) had access to wireless Internet (WiFi) in their hospitals and 29% (28/97) could only access online resources by subscriber identification module (SIM)-card powered devices, namely mobile phones, modems, and tablets (Figure 4).

Figure 1. Doctors' means of accessing the Internet in hospitals.

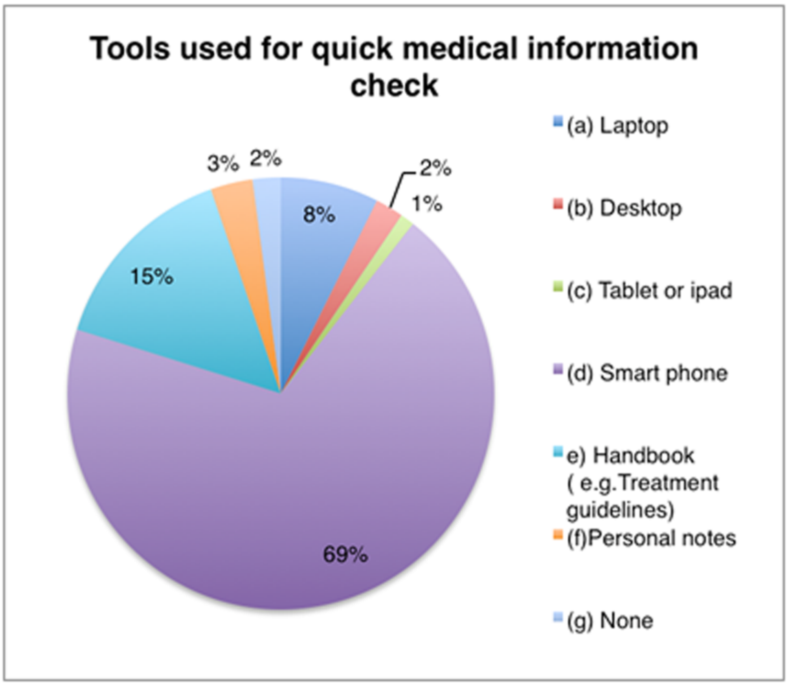


Figure 2. Internet use for medical resources.

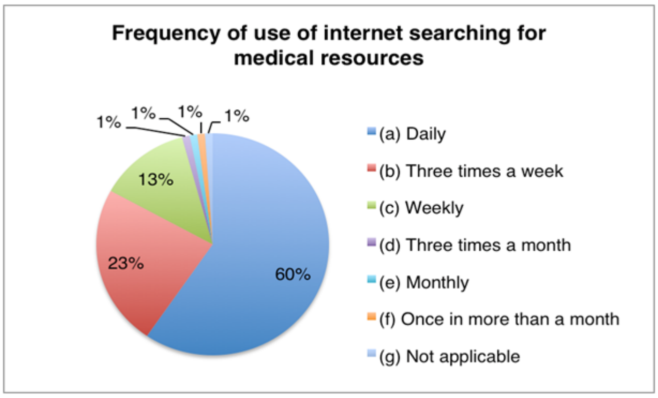


Figure 3. Medical resources used from the Internet.

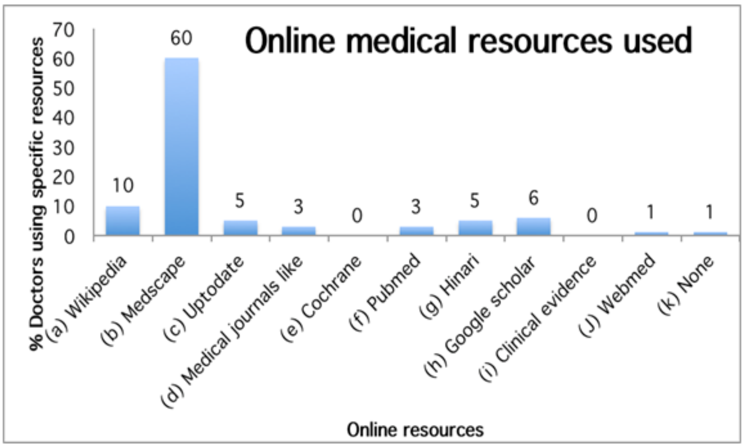
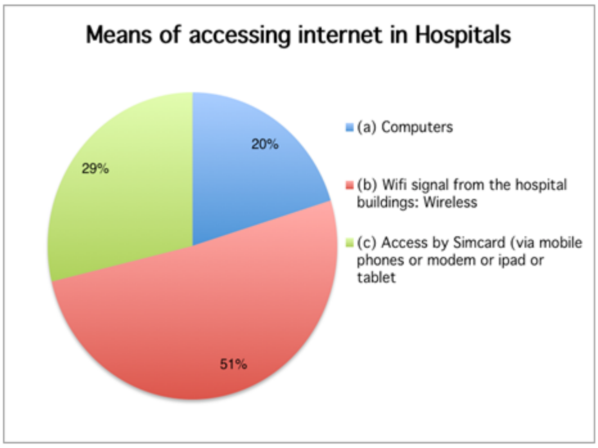


Figure 4. Means of accessing the Internet.



Needs Assessment Interview Findings

In order to collect in depth information on user requirements for potential technology, qualitative information was collected from 16 doctors and interviews were conducted in the languages preferred by respondents. The most common languages used in the Rwandan health care provision system are English and French, and each language was preferred by 8 of the 16 doctors. Interviewed doctors have been working for a span of 2 months to 6 years in a particular hospital and depending on how long they have been there, they were able to give us a bird's eye view of the technological changes, medical education tools, knowledge sharing opportunities, and decision-making support available to them.

Medical Education Tools

Transcription analysis revealed that in one of the hospitals there is a small library, which primarily holds only donated, old, and outdated versions of national treatment guidelines and books (Figure 5). This means that the doctors have limited resources if they want to check out health guidelines or recent treatment options, as the following quote from one 39 years old general practitioner indicates:

> *We have a small library with old books. They are not enough.*

It was revealed that the Internet is not widely available in all hospitals considering the fact that many hospitals do not have stable wireless connections; 10 doctors reported that they have wireless connectivity at their hospitals whereas 6 doctors reported that they don't have Internet access which makes them vulnerable to less frequent updating of medical techniques and resources. In those cases, hospitals have modem connections, which are slow and can cause bottlenecks in accessing information on-demand. Some doctors who heavily rely on the Internet for their medical information use a SIM card on their mobile phones to access information on the go.

The majority of the users (81%, 13/16) primarily prefer soft copies to hard copies of books for accessing medical information because it is fairly easy: "I prefer online and soft copies in general because it's easy to consult many books at the same time and they are carry in one compound."

Of the doctors older than 50 years of age, 3% (3/97) responded to hardly use the Internet and are unaware of the availability of online resources for medical education purposes. Nevertheless, the number of online resources used (Figure 3) clearly demonstrates that doctors seek access to medical information irrespective of their exposure level. The needs assessment interviews revealed that when interacting with patients, Medscape (preferred by 4 doctors) and UpToDate (preferred by 3 doctors) are the most preferred apps for quick information access. Medscape has an edge over UpToDate partly because it can be accessed offline with limited features whereas UpToDate requires Internet connectivity, which makes it undesirable when on the field mentoring patients.

From the baseline study, the following users requirements germane to development of a mobile medical education tool emerged: (1) means to have quick reference for evidence-based consultations, based on symptoms, keywords searches, or direct content access, (2) English and French language support, (3) access and study the most recent medicine practice and knowledge, (4) prefer an organized way of searching and locating information, similar to Medscape, and (6) forum for information exchange and sharing.

Figure 5. Examples of outdated medical books in a Rwandan hospital library.

Knowledge Sharing Opportunities

Most of the users heavily use Android mobile phones and laptop computers as a means of staying connected, and accessing and sharing information. Tablet and iPad usage is now becoming common among doctors and is the preferred gadget or tool for accessing and sharing information on the go (50%, 8/16 doctors). Accessing new knowledge and guidelines is a challenge for practicing doctors. No official track or platform by which new evidence-based practices are communicated was found. Further, respondents were not aware of how frequent the MOH guidelines are updated. Update notifications are mostly sent via group emails among doctors and sometimes through word of mouth through colleagues. The World Health Organization (WHO) Health Guidelines are updated every two years and these updates are communicated through the MOH together with updates through the MOH guidelines.

The following users needs regarding knowledge sharing emerged from the interviews: (1) means to share knowledge about unknown diseases or issues as well as treatments applied and techniques results, (2) platform that connects all doctors in Rwanda to discuss difficult and complicated cases for figuring out the best treatment option for the patient, (3) platform that provides content both with Internet access (Full access) and without Internet Access. (Limited access), (4) forum for information exchange and sharing, and (5) prefer update notifications through emails.

Decision-Making Support

General practitioners reported that they see around 28 to 36 patients on a daily basis and the inpatient stay is around 5 days in a week, on average. Almost all doctors (94%, 15/16) use an Android phone and are currently constantly connected to other doctors through WhatsApp for effective knowledge sharing, gaining support from colleagues, and discussions about unusual or complicated cases. Some other media platforms used in these regards are email and Facebook: "We have an e-group for sharing information."

In addition, the following users needs regarding decision-making support emerged from the interviews with doctors: (1) means to post questions and answer other professionals' questions, (2) forum should potentially support attachment of images (ie, x-rays, echoes, scans) for consultation purposes, (3) list of available doctors nearby to connect with for emergency cases discussions, and (4) rate if a given content or support was helpful.

Discussion

Medical Education Functionality

The baseline study and the needs assessment clearly showed that doctors are eager to easily access medical information irrespective of their available facilities and exposure level. Despite great efforts by the government of Rwanda in availing computers and Internet in different hospitals, the need is still far from being satisfactorily addressed.

While the hospitals do not hold libraries, the doctors often consult, most of the time on their mobile phones, online resources to answer their questions and to keep themselves updated with modern medical techniques. It was found that the main available and accessed tools are Medscape, Wikipedia, Google Scholar, Hinari, and UpToDate. However, these mostly used apps do not conform to the MOH clinical guidelines, and they are accessed separately. For doctors in remote locations, computers with Internet access are not always available; therefore, no access to Internet resources is even possible. The end users need of tools that may ease their access to the national MOH guidelines and updated medical resources was elucidated, with the fact that none of the used apps avail these guidelines and availing these resources on phones or tablets would be ideal for health care professionals: "I would love to know everything through my cell phone."

Knowledge Sharing Functionality

Mobile phones with app capabilities are widely used and Rwandan doctors have been able to access a number of Internet-based tools. Numerous apps are now available to assist health care providers with many of their daily important tasks, such as information, health record, communications and consulting, reference and information gathering, patient management and monitoring, clinical decision-making, and medical education and training [22]. There is a great opportunity of advancing technology in the medical field in Rwanda, considering that the majority of Rwandan doctors are mainly young and of whom 60% reported daily use of the Internet to check for medical information.

Decision-Making Support Functionality

The number of patients per doctor per day is still very high in Rwanda. This also entails the number of unanswered questions they get from those patients. One option for consultants mainly based in cities to offer decision making support especially to doctors in remote areas would be through a technology-based platform that may be able to overcome the challenge of Internet that those doctors face. As the following quote indicates:

> *I wish there was a platform which bring together all medical doctors to share medical information like complicated and interesting cases to learn from each other. This would be a good opportunity for knowledge sharing from generations to generations.*

Mobile technology-based diagnosis and management have been found most relevant to health care providers in developing countries where mobile phones potentially allow clinical support and evidence-based guidance to be delivered to health care professionals working remotely and in circumstances where senior health care professional support or other infrastructure is lacking [23]. This technology will be useful and will not only improve the knowledge it will also prevent outdated practices, reduce medical decision errors, and promote more evidence-based practices as the following quote indicates: "We don't have a specific way or channel through which we can get information about updates (Local) in medicine."

User Classes and Characteristics

A key finding from the baseline study and needs assessment interviews is the identification of user classes and characteristics that can inform the development of a mobile medical education tool. For example, the tool will need a consistent solution that can impact pre-determined user classes differently. Furthermore, elicitation and analysis were made from the previously discussed baseline study and interviews in order to identify how different user classes have interests in using the system and system features. The results of the analysis are presented in Textbox 1.

Textbox 1. User classes and characteristics.

Interests and frequently used functionalities

1. Doctors
   a. Major interests
      i. View and share knowledge on recent developments in Medicine and interesting findings from patient cases and other studies
      ii. Ask for information and opinions
      iii. Consults external resources and platforms pointed by the system
   b. Frequently used functionalities
      i. Discuss cases, view resources, check guidelines
      ii. Communicate with other doctors
      iii. Update recommended resources
2. Administrators
   a. Major interests
      i. Monitor app
      ii. Ensure updated content, resolve user issues, and maintain privileges
   b. Frequently used functionalities
      i. Update user privileges
      ii. Update content (eg, MOH guidelines)

Key User-Required Features for the Mobile Medical Educator Technology

Both the baseline and needs assessment revealed the key features of a much needed Web-based app that can be accessed through the most popular tools used by doctors, mobile phones, computers, and tablets (Textbox 1). The proposed platform will be a central hub for aggregating content from valuable medical practice information to medical education resources that spread the newest and effective techniques starting from the local MOH guidelines.

A list of essential features was identified and the mentioned features are presented in Textbox 2.

Textbox 2. List of essential features.

Feature

- Edit discussion threads
- Search discussion threads with keywords or medical specialty
- Delete discussion threads
- Create patient case discussion record
- Edit patient case record
- Search patient case by keyword or medical specialty
- Delete patient case record
- Provide external resources and platforms with medical content by topics and medical specialties
- Comment discussion threads or patient records

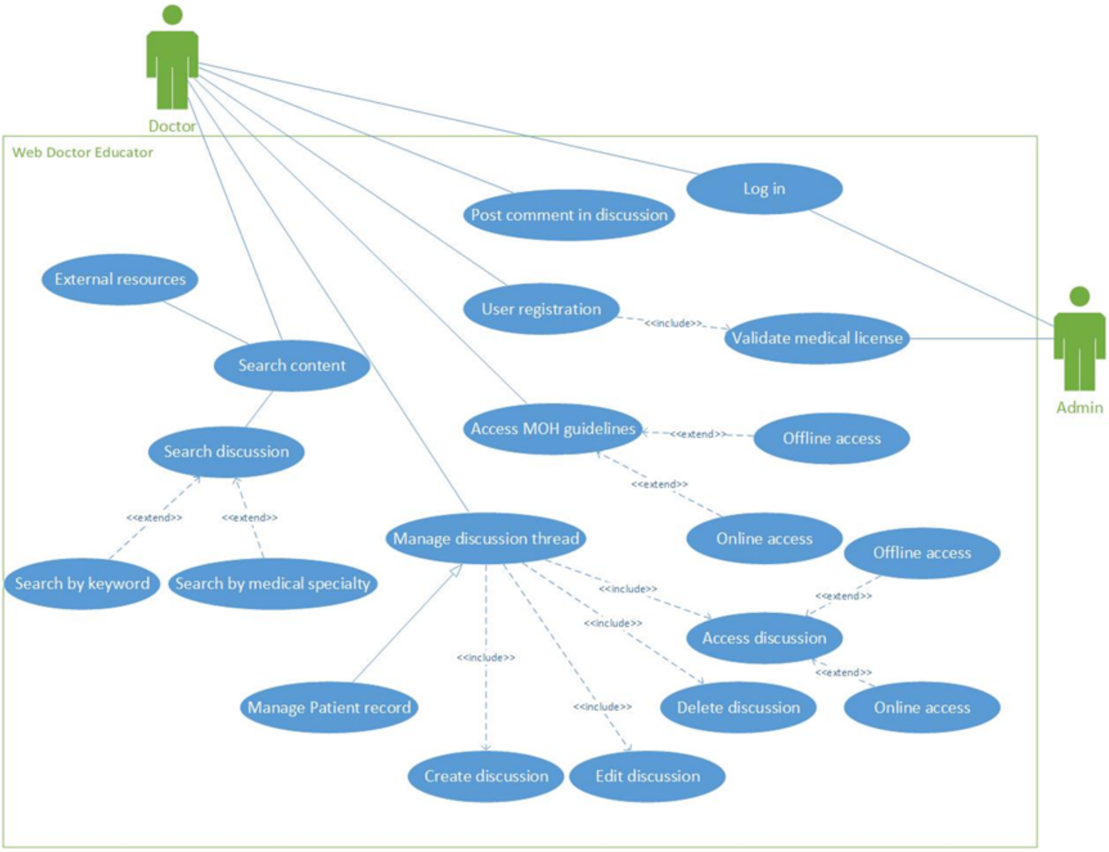
Use Case Model

In order to better analyze the users' interaction with the system features a use case modeling was performed. Our model organizes the features according to the dimensions of the envisioned mobile medical education app. The modeling is presented in Figure 6 and Table 2. Details on UC1 to UC16 can be found in Multimedia Appendix 1.

Table 2. Detailed use cases.

ID	Name	Description
UC1	User registration	This use case describes how to sign up for the app
UC2	User login	This use case describes how to sign in for the app
UC3	Validate medical license	This use case describes how the app will validate doctors credentials with MOH
UC4	Access MOH guideline documentation	This use case describes how a doctor consults the MOH guidelines in the app
UC5	Create discussion thread	This use case describes how a doctor discusses a general topic with fellow doctors
UC6	Search discussion thread	This use case describes how a user searches for a discussion thread
UC7	Access patient case studies	This use case describes how a user accesses a patient discussion thread
UC8	Archive discussions and case studies for offline access	This use case describes how the doctor makes discussion available for offline use
UC9	Update experienced doctor privileges	This use case describes how the app administrator updates the users with experienced doctor privileges
UC10	Edit discussion thread	This describes how to edit existing discussion thread
UC11	Delete discussion thread	This use case describes how a user will delete a discussion thread
UC12	Edit a patient case record	This use case describes how a user can edit a patient case record
UC13	Search a patient case record	This use case describes how a user can search for a patient case record
UC14	Post a comment to a discussion thread	This use case describes how the doctor adds a new post/comment to discussion thread
UC15	Delete a patient case record	This use case describes how the system deletes a patient's case discussion record
UC16	Create a patient case record	This use case describes how a doctor creates a patient record discussion

Figure 6. Use case diagram for the mobile medical educator application for Rwandan medical doctors.



Future Work

The next step in our research is to build and test a mobile medical education tool based on the findings and insights reported in this paper. Unlike previous medical resources and platforms used, the technology we will develop will serve as a viable one-stop shop for daily use by Rwandan doctors, grouping a variety of quality and reliable medical information resources. This platform has potential to reform medical education and practice from a traditional lecture and discussion system to a more learner-centered and evidence-based type of education with many benefits at different points of care. In addition, the system will be specifically targeted to the Rwandan doctors and their need of information and continuous education, as well as being available on the most popular and accessible platforms in the country. It was vital for the study team to assess currently available tools, gaps, and opportunities for improvement. Key user recommended features were identified and deepened through user modeling, and will be the basis for ongoing design and implementation of this technology. Furthermore, considering the number of patients that doctors see in Rwanda, in the long-term this technology has promise to provide many benefits such as enabling more rapid decisions with a lower error rate, increasing the quality of data management and accessibility, and improving practice efficiency and knowledge, especially in areas where access to the Internet is compromised. However, it is vital that throughout the process, principles and stages of UCD are well followed so as to have final software that fulfills the needs of the users.

Conclusions

Through the conducted baseline study and needs assessment, it was determined that almost all Rwandan doctors engage in daily Internet use. The tools used to access the Internet vary but mobile phones and laptops are mostly used, with mobile phones being the most popular. It was also found that very few of the hospitals have libraries and the most used information resources are the MOH guidelines books. However, many survey respondents indicated that they are not satisfied with these resources. The majority of the hospitals do not have computer labs or libraries. Despite this challenge, surveyed doctors reported that they use MOH guidelines books and mobile phones for quick information checks for evidence-based practice. A great need for mobile-based technology for medical education exists for Rwandan doctors and health care professionals throughout the country who need quick and easy access to medical information to answer their daily patient-related questions, and who also need access to updates and information about the most effective and modern medical techniques. An online platform for medical education in Rwanda should aggregate a wide variety of the most used medical resources by Rwandan doctors and health care professionals. It could also direct to external resources of most recent techniques and knowledge in the medical field, accessible via the most popular platforms and devices in Rwanda starting from the MOH clinical guidelines.

Acknowledgments

The research reported here was supported by Grand Challenges Canada. Grand Challenges Canada is funded by the Government of Canada and is dedicated to supporting Bold Ideas with Big Impact in global health.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Details on UC1 to UC16.

[PDF File (Adobe PDF File), 206KB - mededu_v2i1e7_app1.pdf]

References

1. Balmer JT. The transformation of continuing medical education (CME) in the United States. Adv Med Educ Pract 2013;4:171-182 [FREE Full text] [doi: 10.2147/AMEP.S35087] [Medline: 24101887]
2. Rwanda Demographic and Health Survey 2010: Final Report. 2011. URL: http://www.minirena.gov.rw/fileadmin/Media_Center/Documents/ENR_Sector_EDPRS_II_Elaboration/DHS_2010_report-1-2.pdf [accessed 2015-11-11] [WebCite Cache ID 6cxTJbWv8]
3. Continuing Professional Development Strategic Plan (2010–2013). URL: http://rmdc.rw/IMG/pdf/101013CPD_strategic_plan.pdf [accessed 2015-11-11] [WebCite Cache ID 6cxSk2fIo]
4. Curran VR. Tele-education. J Telemed Telecare 2006;12(2):57-63. [doi: 10.1258/135763306776084400] [Medline: 16539750]
5. Curran VR, Fleet L. A review of evaluation outcomes of web-based continuing medical education. Med Educ 2005 Jun;39(6):561-567. [doi: 10.1111/j.1365-2929.2005.02173.x] [Medline: 15910431]
6. Bridges DR, Davidson RA, Odegard P, Maki IV, Tomkowiak J. Interprofessional collaboration: three best practice models of interprofessional education. Med Educ Online 2011;16 [FREE Full text] [doi: 10.3402/meo.v16i0.6035] [Medline: 21519399]
7. Anderson JG, Casebeer LL, Kristofco RE. Medcast: evaluation of an intelligent pull technology to support the information needs of physicians. Proc AMIA Symp 1999:466-470 [FREE Full text] [Medline: 10566402]
8. Peterson MW, Galvin JR, Dayton C, D'Alessandro MP. Realizing the promise: delivering pulmonary continuing medical education over the Internet. Chest 1999 May;115(5):1429-1436. [Medline: 10334164]
9. Barnes BE. Creating the practice-learning environment: using information technology to support a new model of continuing medical education. Acad Med 1998 Mar;73(3):278-281. [Medline: 9526455]
10. Houshyari AB, Bahadorani M, Tootoonchi M, Gardiner JJ, Peña RA, Adibi P. Information and communication technology in medical education: an experience from a developing country. J Pak Med Assoc 2012 Mar;62(3 Suppl 2):S71-S75. [Medline: 22768465]
11. De Vito Dabbs A, Myers BA, Mc Curry KR, Dunbar-Jacob J, Hawkins RP, Begey A, et al. User-centered design and interactive health technologies for patients. Comput Inform Nurs 2009;27(3):175-183 [FREE Full text] [doi: 10.1097/NCN.0b013e31819f7c7c] [Medline: 19411947]
12. Gulliksen J, Göransson B, Boivie I, Blomkvist S, Persson J, Cajander A. Key principles for user-centred systems design. Behav Inform Technol 2003 Nov;22(6):397-409. [doi: 10.1080/01449290310001624329]
13. Kübler A, Holz EM, Riccio A, Zickler C, Kaufmann T, Kleih SC, et al. The user-centered design as novel perspective for evaluating the usability of BCI-controlled applications. PLoS One 2014;9(12):e112392 [FREE Full text] [doi: 10.1371/journal.pone.0112392] [Medline: 25469774]
14. Gould JD, Lewis C. Designing for usability: key principles and what designers think. Commun ACM 1985;28(3):300-311. [doi: 10.1145/3166.3170]
15. Hoyt R, Adler K, Ziesemer B, Palombo G. Evaluating the usability of a free electronic health record for training. Perspect Health Inf Manag 2013;10:1b [FREE Full text] [Medline: 23805062]
16. Norman D, Draper SW. User Centered System Design: New Perspectives on Human-Computer Interaction. Hillsdale, NJ: Lawrence Erlbaum; 1986.
17. Ministry of Health Annual Report 2012-2013. 2013. URL: http://www.moh.gov.rw/fileadmin/templates/Press_release/MoH_Annual_Report_July_2012-June_2013.pdf [accessed 2015-11-11] [WebCite Cache ID 6cxS3kvWk]
18. Peck C, McCall M, McLaren B, Rotem T. Continuing medical education and continuing professional development: international comparisons. BMJ 2000 Feb 12;320(7232):432-435 [FREE Full text] [Medline: 10669451]
19. McLoone HE, Jacobson M, Hegg C, Johnson PW. User-centered design and evaluation of a next generation fixed-split ergonomic keyboard. Work 2010;37(4):445-456. [doi: 10.3233/WOR-2010-1109] [Medline: 21099019]

20. Brown W, Yen PY, Rojas M, Schnall R. Assessment of the Health IT Usability Evaluation Model (Health-ITUEM) for evaluating mobile health (mHealth) technology. J Biomed Inform 2013 Dec;46(6):1080-1087 [FREE Full text] [doi: 10.1016/j.jbi.2013.08.001] [Medline: 23973872]
21. Bias R, Mayhew DJ. Cost-Justifying Usability: An Update for an Internet Age. Amsterdam: Morgan Kaufman; 2005.
22. Ventola C. Mobile devices and apps for health care professionals: uses and benefits. P T 2014 May;39(5):356-364 [FREE Full text] [Medline: 24883008]
23. Free C, Phillips G, Watson L, Galli L, Felix L, Edwards P, et al. The effectiveness of mobile-health technologies to improve health care service delivery processes: a systematic review and meta-analysis. PLoS Med 2013;10(1):e1001363 [FREE Full text] [doi: 10.1371/journal.pmed.1001363] [Medline: 23458994]

Abbreviations

CME: continuing medical education
CPD: continuous professional development
DH: district hospital
ICT: information and communication technology
LMIC: low and middle-income countries
MOH: Ministry of Health
RIT: Rochester Institute of Technology
SIM: subscriber identification module
UCD: user-centered development

Edited by G Eysenbach; submitted 11.11.15; peer-reviewed by AM Almeida, D Davies; comments to author 07.01.16; revised version received 09.04.16; accepted 27.04.16; published 01.06.16.

Please cite as:
Rusatira JC, Tomaszewski B, Dusabejambo V, Ndayiragije V, Gonsalves S, Sawant A, Mumararungu A, Gasana G, Amendezo E, Haake A, Mutesa L
Enabling Access to Medical and Health Education in Rwanda Using Mobile Technology: Needs Assessment for the Development of Mobile Medical Educator Apps
JMIR Med Educ 2016;2(1):e7
URL: http://mededu.jmir.org/2016/1/e7/
doi:10.2196/mededu.5336
PMID:27731861

Original Paper

Does Academic Blogging Enhance Promotion and Tenure? A Survey of US and Canadian Medicine and Pediatric Department Chairs

Christian Blake Cameron[1*], MD; Vinay Nair[2*], DO; Manu Varma[3], DO; Martha Adams[4], MD; Kenar D Jhaveri[5], MD; Matthew A Sparks[6], MD

[1]Duke University Medical Center, Division of Nephrology, Durham, NC, United States
[2]Mount Sinai Medical Center, Division of Nephrology, New York, NY, United States
[3]Newark Beth Israel Medical Center, Newark, NJ, United States
[4]Duke University Medical Center, Division of General Internal Medicine, Durham, NC, United States
[5]Hofstra Northwell School of Medicine, Northwell Health, Division of Kidney Diseases and Hypertension, Great Neck, NY, United States
[6]Duke University and Durham VA Medical Center, Division of Nephrology, Durham, NC, United States
[*]these authors contributed equally

Corresponding Author:
Matthew A Sparks, MD
Duke University and Durham VA Medical Center
Division of Nephrology
MSRB 2 Room 2018
2 Genome Ct
Durham, NC, 27710
United States
Phone: 1 919 684 9737
Fax: 1 919 684 3011
Email: matthew.sparks@duke.edu

Abstract

Background: Electronic educational (e-learning) technology usage continues to grow. Many medical journals operate companion blogs (an application of e-learning technology) that enable rapid dissemination of scientific knowledge and discourse. Faculty members participating in promotion and tenure academic tracks spend valuable time and effort contributing, editing, and directing these medical journal blogs.

Objective: We sought to understand whether chairs of medicine and pediatric departments acknowledge blog authorship as academic achievement.

Methods: The authors surveyed 267 chairs of US and Canadian medicine and pediatric departments regarding their attitudes toward the role of faculty participation in e-learning and blogging in the promotion and tenure process. The survey completion rate was 22.8% (61/267).

Results: A majority of respondents (87%, 53/61) viewed educational scholarship as either important or very important for promotion. However, only 23% (14/61) perceived importance to faculty effort in producing content for journal-based blogs. If faculty were to participate in blog authorship, 72% (44/61) of surveyed chairs favored involvement in a journal-based versus a society-based or a personal (nonaffiliated) blog. We identified a “favorable group” of chairs (19/59, 32%), who rated leadership roles in e-learning tools as important or very important, and an “unfavorable group” of chairs (40/59, 68%), who rated leadership roles in e-learning tools as somewhat important or not important. The favorable group were more likely to be aware of faculty bloggers within their departments (58%, 11/19 vs 25%, 10/40), viewed serving on editorial boards of e-learning tools more favorably (79%, 15/19 vs 31%, 12/39), and were more likely to value effort spent contributing to journal-based blogs (53%, 10/19 vs 10%, 4/40).

Conclusions: Our findings demonstrate that although the majority of department chairs value educational scholarship, only a minority perceive value in faculty blogging effort.

(JMIR Med Educ 2016;2(1):e10) doi:10.2196/mededu.4867

KEYWORDS

social media; blogging; promotion; tenure; survey; medicine; pediatrics

Introduction

Widespread adoption of electronic educational (e-learning) technology has fundamentally changed how information is shared and discussed in learning and teaching environments [1]. Examples of e-learning technologies include blogs, social media (Twitter), video and presentation tools (YouTube, Prezi), and online classroom platforms (Sakai, Khan Academy, Coursera). E-learning tools enable rapid, scalable dissemination of information [2]. Blogs in particular have the potential to establish credibility and reach broad audiences in a way that fosters dialog outside of traditional academic "silos" [3]. Scientific usage of blog media and other e-learning technologies may advance innovation and scholarship by shortening the interval between discovery and publication and by soliciting expert, cross-disciplinary feedback throughout the cycle of hypothesis generation, experimental design, execution, data analysis, and interpretation.

Scholarly communication is shifting toward Internet-based media [4]. The field of medicine follows this trend, but lags behind other disciplines [2,5]. Of the medical journals with an impact factor greater than four, approximately 9% have a companion blog [6]. The low level of blogging (blog authorship) in academic medicine may reflect uncertainty among faculty about the role of blogs in relation to traditional forms of scholarship. Prior research has found that faculty work effort and publication patterns are heavily shaped by promotion and tenure requirements, which traditionally emphasize peer-reviewed publications as the benchmark for career advancement [5]. A survey of academic librarians reported that approximately half of respondents believed that a blog post was considered inferior to a traditional peer-reviewed article [7]. However, the posting of scientific information on blogs has the potential to reach a much wider and diverse audience. A recent analysis of page views on a radiology topic (thyroid nodule detection) showed 10-fold greater readership on the blog Radiopaedia.org compared to two traditional journals (*American Journal of Neuroradiology* and the *American Journal of Roentgenology*) [8]. Thus, many academicians have urged promotion and tenure committees to view these activities as bona fide scholarly output when evaluated appropriately [9-11].

We sought to understand whether faculty participation in blogs is acknowledged as academic achievement. Academic blogging can take several forms. In this survey, we focused on participation in medical journal, medical society, and personal (independently authored) blogs. We surveyed all chairs of medicine and pediatric departments in the United States and Canada about their attitudes toward blogging with respect to promotion and tenure. We chose department chairs, as opposed to promotion and tenure committee members, because we believe chairs define the culture for scholarship and promotion within their departments. We hypothesized that chairs who strongly value leadership in e-learning tools would have a favorable attitude toward faculty blogging efforts and recognize these activities as scholarship for the purpose of promotion and tenure.

Methods

Recruitment

We invited all chairs of medicine and pediatrics at academic and community-based programs in the United States and Canada to participate in this survey (Multimedia Appendix 1). We obtained email contact information through the Alliance for Academic Medicine and the Association of Medical School Pediatric Department Chairs, with verification and completion of the lists from institutional websites. Institutions were classified as public or private based on the organizational descriptions published on their websites. We received exempted institutional review board approval to conduct the survey from both Duke University Medical Center, Durham, NC (Pro00044769) and Northwell Health, Great Neck, NY (13-107B).

Survey Administration

A research management team at Duke University reviewed the survey to refine the content. Study data were collected and managed using Research Electronic Data Capture (REDCap) electronic data capture tools hosted at Duke University [12]. REDCap is a secure, Web-based app designed to support data capture for research studies, providing (1) an intuitive interface for validated data entry, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for importing data from external sources. Surveys were sent to each of the chairs of medicine and pediatrics via email generated by REDCap in June 2013 (with two additional monthly reminders to nonrespondents). The survey closed in August 2013.

Evaluation of Outcomes

Respondents that rated the question "How important is a leadership role as a medical director for an e-learning tool, such as editing a journal-based blog" as important or very important were termed the "favorable group" and the respondents that rated the question as somewhat important or not important were termed the "unfavorable group."

Statistical Analysis

Analysis was performed to compare the two groups. Items with no response were excluded from analysis. Fisher exact test (two-sided alpha=.05) was used to assess the significance of association between categorical variables.

Results

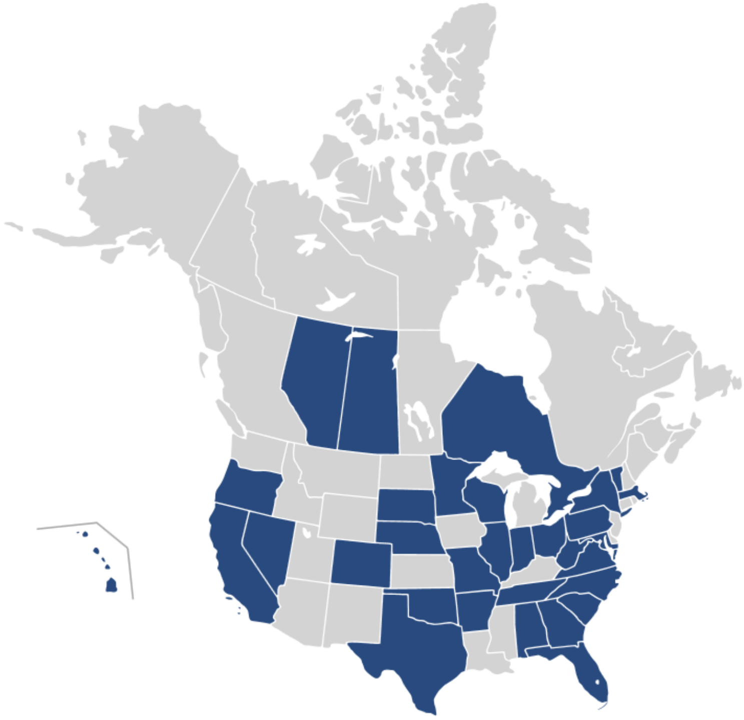
Demographic Data

In total, 61 (22.8%) respondents completed the survey from a total of 267 distributed. There was no significant difference in response rate between chairs of public versus private institutions (38/155, 24.5% vs 23/112, 20.5%; *P*=.50). Demographic characteristics of the respondents are shown in Table 1. In all, 62% (38/61) of respondents belonged to public institutions (including one public-private institution) and the remainder were private institutions (Table 1). Of the respondents, 80% (49/61) were male and 55% (33/60) identified their department as pediatrics, with the remainder from medicine. One respondent did not specify a department. Respondents were geographically diverse with representation from 29 states and three Canadian provinces (Figure 1). The majority of respondents (56/61, 92%) reported a clinician-educator track within their departments (Table 1).

Table 1. Demographics of respondents (N=61).

Demographic	n (%)
Gender (male)	49 (80)
Department	
Medicine	27/60 (45)
Pediatrics	33/60 (55)
No response	1 (2)
Clinician-educator pathway	56 (92)
Medicine	24/56 (43)
Pediatrics	31/56 (55)
No response	1/56 (2)
Institution type	
Public	38 (62)
Private	23 (38)

Figure 1. State/province of respondents. State/province (n): Alabama (2), Alberta (1), Arkansas (1), California (1), Colorado (1), Florida (1), Georgia (1), Hawaii (2), Illinois (1), Indiana (2), Maryland (2), Massachusetts (3), Minnesota (1), Missouri (1), Nebraska (2), Nevada (1), New York (4), North Carolina (2), Ohio (6), Oklahoma (1), Ontario (2), Oregon (2), Pennsylvania (1), Saskatchewan (1), South Carolina (2), South Dakota (2), Tennessee (1), Texas (6), Vermont (1), Virginia (4), West Virginia (1), Wisconsin (2), all other states/provinces had zero respondents.



Attitudes and Opinions

A total of 87% (53/61) of respondents viewed educational scholarship as either important or very important for promotion (Figure 2). However, only 31% (19/61) felt that faculty leadership of an e-learning tool such as a journal-based blog was important or very important for consideration of promotion and tenure. In all, 44% (27/61) felt that serving on an e-learning editorial board was important or very important for promotion and tenure; 23% (14/61) perceived value to faculty effort in producing content for a journal-based blog as important or very important (Figure 2). The vast majority of respondents indicated that they would prefer a faculty member's contribution to a journal-based blog (44/61, 72%) as compared with professional society-based (23/61, 38%) or unaffiliated personal (1/61, 2%) blogs (Figure 3).

In all, 34% (21/61) of respondents were aware of faculty within their departments that were involved in contributing to a journal-based blog and 43% (26/60) designated a specific area in the promotion and tenure application for reporting participation in journal-based blogs or e-learning tools. Although the majority (49/58, 84%) felt that journal-based blogs disseminate medical knowledge, only 25% (14/56) believed that most journal-based blogs were peer reviewed by editors.

Among respondents who rated leadership roles in e-learning tools (eg, directorship of a journal-based blog) as important or very important (the favorable group; n=19/59, 32%), as compared to somewhat important or not important (the unfavorable group; n=40/59, 68%), there was no significant difference in gender or the presence of a clinician-educator track. There was a trend toward a more favorable attitude by medicine chairs versus pediatric chairs (12/19, 63% vs 14/39, 36%; *P*=.09). However, the chairs in the favorable group were more likely to be aware of faculty bloggers within their departments (11/19, 58% vs 10/40, 25%; *P*=.02; Table 2). These respondents viewed serving on editorial boards of e-learning tools more favorably (15/19, 79% vs 12/39, 31%; *P*<.001; Table 2) and were more likely to value effort spent contributing to journal-based blogs (10/19, 53% vs 4/40, 10%; *P*<.001; Table 2). There was no difference in recognition of blogging or e-learning on promotion and tenure applications, belief in peer review of journal-based blogs, belief that journal-based blogs disseminate medical knowledge, or preference for contributions to any particular type of blog.

Table 2. Comparison of attitudes categorized by favorable versus unfavorable chairs.

Characteristic	Overall response, n (%) (n=59)[a]	Favorable group,[b] n (%) (n=19)	Unfavorable group,[c] n (%) (n=40)	*P*
Male	47 (80)	14 (74)	33 (83)	.50
Medicine department	26/58 (45)	12 (63)	14/39 (36)	.09
Have a clinician-educator pathway	54 (92)	19 (100)	35 (88)	.17
Educational scholarship important or very important for promotion	52 (88)	18 (95)	34 (85)	.41
Serving on editorial boards of e-learning tools important or very important	27/58 (47)	15 (79)	12/39 (31)	<.001
Aware of faculty bloggers in department	21 (36)	11 (58)	10 (25)	.02
Promotion and tenure form has field for blogging and e-learning	26/58 (45)	9 (47)	17/39 (44)	>.99
Effort contributing to a journal-based blog important or very important	14 (24)	10 (53)	4 (10)	<.001
Believe most journal-based blogs are peer reviewed	13/55 (24)	6/18 (33)	7/37 (19)	.31
Believe journal-based blogs disseminate knowledge	48/57 (84)	17 (89)	31/38 (82)	.70
Prefer contributions to journal blogs	43 (73)	13 (68)	30 (75)	.76
Prefer contribution to society blogs	22 (37)	10 (53)	12 (30)	.15
Prefer contribution to personal blogs	1 (2)	0 (0)	1 (3)	>.99

[a] Respondents who failed to answer e-learning leadership question were removed from analysis. Likewise, respondents who answered leadership but did not answer question as outlined on the rows were not included in analysis.

[b] E-learning leadership considered very important/important.

[c] E-learning leadership considered somewhat important/not important.

Figure 2. Questionnaire items addressing importance of educational scholarship, leadership in e-learning tools, and valuation of blogging effort.

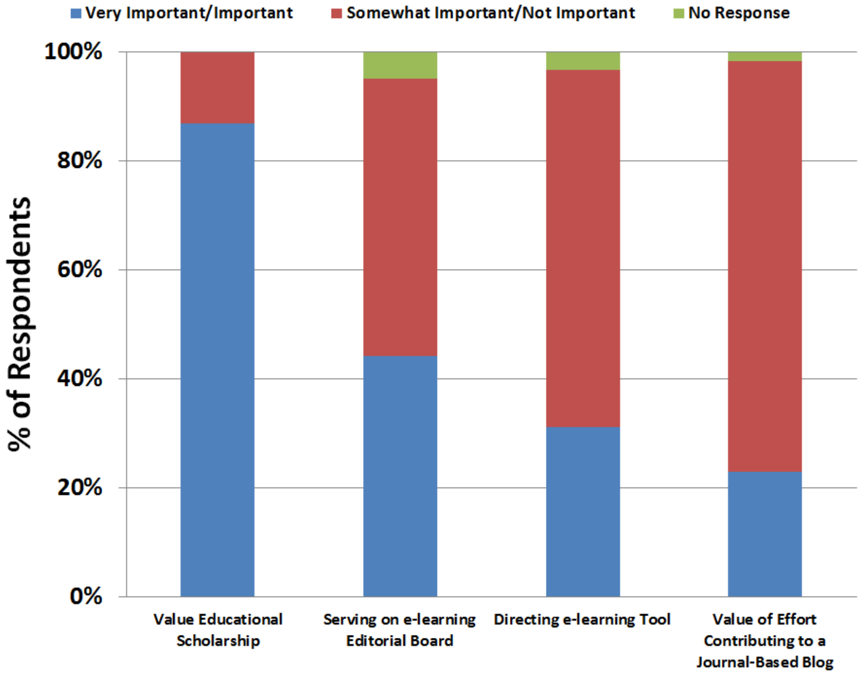
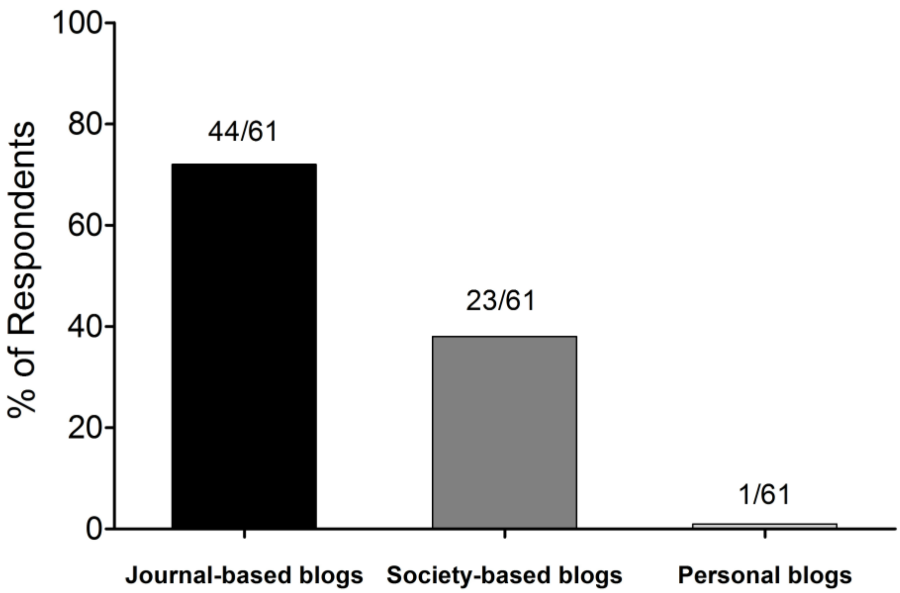


Figure 3. If your faculty member is involved in contributing to an academic blog, which would you value most?



Discussion

Principal Results

In our survey of chairs of medicine and pediatric departments in the United States and Canada, we found that the vast majority valued participation in educational scholarship for promotion in tenure. However, it appears that participation in e-learning activities, as director, board member, or contributor of a blog, was generally viewed less favorably than other traditional publication activities. If faculty chose to participate in blogging, we found that a majority of chairs of medicine and pediatric departments preferred that they do so with journal-based blogs as compared to society and independent personal blogs.

This survey showed that chairs who thought e-learning leadership was very important or important to promotion and tenure (the favorable group) were more likely to be aware of a faculty member engaged in medical blogging, as compared to chairs who indicated that e-learning leadership role was somewhat important or not important (unfavorable group). The favorable group was also more likely to value e-learning for promotion and tenure, faculty service to an editorial board of an e-learning app, and contributions to journal-based blog. The attitudes of the favorable group are similar to a survey of US medical school promotion and tenure committee chairs on attitudes toward e-learning as scholarly activity. A vast majority (76%) recognized e-learning as a meaningful contribution to scholarship and valued output that changed learner outcome [13].

Comparison With Prior Work

Blogging has emerged as a new medium to disseminate scientific findings, spark academic dialog, and complement existing postpublication peer-review mechanisms (eg, journal editorials or letters to the editor). Online resources geared toward critical appraisal of scientific and medical literature have proliferated in the last 5 to 10 years [14], garnering unprecedented readership and complementing traditional scientific communication [15]. However, it is yet to be determined whether the time and effort that faculty spend on these communication activities contributes to promotion and tenure [16]. Our aim was to understand the perceptions and attitudes of medicine and pediatric department chairs toward faculty participation in medical blogs and its influence on academic advancement. We chose to survey department chairs, instead of promotion and tenure committee chairs, because we believe that these individuals (1) possess knowledge of faculty activities and institutional practices, and (2) shape the culture, guidelines, and processes for promotion within their departments. Furthermore, a survey of promotion and tenure committee chairs has already been performed [13]. Physicians and academicians are increasingly utilizing blogs and other e-learning technologies for scientific communication, and we believe it is necessary to recognize these efforts.

Limitations

This survey has several limitations. The relatively low response rate (22.8%, 61/267) of surveyed chairs may not be representative of the entire group's attitudes toward e-learning. It is possible that polarization of attitudes among respondents led to sampling bias. We did not ask chairs to evaluate e-learning and blogging participation against specific comparators, such as research grants or publication in peer-reviewed journals. In addition, respondents' understanding of personal (unaffiliated) medical blogs may have been conflated with nonmedical "hobby" blogs. It is also possible that opinions of department chairs, as opposed to promotion and committee member chairs, are not representative of what is ultimately deemed acceptable scholarly output. However, as previously stated, we intentionally targeted department chairs because we believe they are aware of the scholarly activities their faculty members engage in and help determine the relative importance of such activities. Additionally, we chose to dichotomize the survey respondents as favorable and unfavorable based on their answer to one question ("How important is a leadership role as a medical director for an e-learning tool, such as editing a journal-based blog?"). Conceptual similarities between this question and the other questions could have led to results that are endogenous to our classification.

Conclusions

The findings from our survey indicate that, although academic chairs hold positive views toward educational scholarship, participation by faculty in academic blogs is regarded lukewarmly. Encouragingly for faculty bloggers, chairs that did favorably view e-learning educational output by faculty were indeed more aware of faculty members' blog involvement. Therefore, it is possible that raising awareness about the rigor and reach of e-learning, particularly in regards to journal-based blogs, could lead to greater recognition of e-learning participation in the promotion and tenure process. As more medical societies and journals develop e-learning programs that shift discourse to the digital space, academic institutions, department chairs, and promotion and tenure committees should recognize faculty that contribute significant scholarship through these media.

Acknowledgments

MAS is funded by Career Development Award IK2BX002240 from the Department of Veterans Affairs, Office of Research and Development, Biomedical Laboratory Research and Development Service. CBC is funded by Duke Training Grant in Nephrology (NIH 5T32DK007731).

Conflicts of Interest

KDJ serves as the blog editor for the *American Journal of Kidney Diseases* (*AJKD*) blog. MAS and VN serve as advisory board members for the *AJKD* blog. CBC maintains a wiki for the NIH National Kidney Disease Education Program.

Multimedia Appendix 1

Survey participation letter.

[PDF File (Adobe PDF File), 15KB - mededu_v2i1e10_app1.pdf]

References

1. Moore J, Dickson-Deane C, Galyen K. e-Learning, online learning, and distance learning environments: are they the same? Internet High Educ 2011 Mar 14;14(2):129-135 [FREE Full text] [doi: 10.1016/j.iheduc.2010.10.001]
2. Cheston CC, Flickinger TE, Chisolm MS. Social media use in medical education: a systematic review. Acad Med 2013 Jun;88(6):893-901. [doi: 10.1097/ACM.0b013e31828ffc23] [Medline: 23619071]
3. Gruzd AS, Staves K, Wilk A. Connected scholars: examining the role of social media in research practices of faculty using the UTAUT model. Comput Hum Behav 2012 Nov;28(6):2340-2350 [FREE Full text] [doi: 10.1016/j.chb.2012.07.004]

4. Harley D. Scholarly communication: cultural contexts, evolving models. Science 2013 Oct 4;342(6154):80-82. [doi: 10.1126/science.1243622] [Medline: 24092736]
5. Bonetta L. Scientists enter the blogosphere. Cell 2007 May 4;129(3):443-445 [FREE Full text] [doi: 10.1016/j.cell.2007.04.032] [Medline: 17482534]
6. Nair V, Khan S, Jhaveri KD. Interactive journals and the future of medical publications. Am J Med 2012 Oct;125(10):1038-1042. [doi: 10.1016/j.amjmed.2012.06.012] [Medline: 22998882]
7. Hendricks A. Bloggership, or is publishing a blog scholarship? A survey of academic librarians. Library Hi Tech. 2010 Sep 07. (3) p. 470-477 URL: http://www.emeraldinsight.com/doi/full/10.1108/07378831011076701 [WebCite Cache ID 6iRCf4mvU]
8. Hoang JK, McCall J, Dixon AF, Fitzgerald RT, Gaillard F. Using social media to share your radiology research: how effective is a blog post? J Am Coll Radiol 2015 Jul;12(7):760-765. [doi: 10.1016/j.jacr.2015.03.048] [Medline: 25959491]
9. Biswas A, Kirchherr J. The London School of Economics and Political Science: The Impact Blog. 2014 Apr 23. Citations are not enough: academic promotion panels must take into account a scholar's presence in popular media URL: http://blogs.lse.ac.uk/impactofsocialsciences/2015/04/09/academic-promotion-scholars-popular-media/ [accessed 2016-01-05] [WebCite Cache ID 6ghBMfTuc]
10. Maitzen R. Scholarship 2.0: blogging and/as academic practice. J Victorian Cult 2012 Sep 12;17(3):348-354. [doi: 10.1080/13555502.2012.689502]
11. Van Melle E, Lockyer J, Curran V, Lieff S, St Onge C, Goldszmidt M. Toward a common understanding: supporting and promoting education scholarship for medical school faculty. Med Educ 2014 Dec;48(12):1190-1200. [doi: 10.1111/medu.12543] [Medline: 25413912]
12. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009 Apr;42(2):377-381 [FREE Full text] [doi: 10.1016/j.jbi.2008.08.010] [Medline: 18929686]
13. Ruiz JG, Candler CS, Qadri SS, Roos BA. E-learning as evidence of educational scholarship: a survey of chairs of promotion and tenure committees at U.S. medical schools. Acad Med 2009 Jan;84(1):47-57. [doi: 10.1097/ACM.0b013e3181901004] [Medline: 19116477]
14. Fausto S, Machado FA, Bento Luiz FJ, Iamarino A, Nahas TR, Munger DS. Research blogging: indexing and registering the change in science 2.0. PLoS One 2012;7(12):e50109 [FREE Full text] [doi: 10.1371/journal.pone.0050109] [Medline: 23251358]
15. Mewburn I, Thomson P. The London School of Economics and Political Science: The Impact Blog. 2013 Dec 12. Academic blogging is part of a complex online academic attention economy, leading to unprecedented readership URL: http://blogs.lse.ac.uk/impactofsocialsciences/2013/12/12/academic-attention-economy/ [accessed 2016-04-12] [WebCite Cache ID 6giLObykG]
16. Kieslinger B. Academic peer pressure in social media: experiences from the heavy, the targeted and the restricted user. First Monday 2015 Jun 01;20(6) [FREE Full text] [doi: 10.5210/fm.v20i6.5854]

Edited by N Zary; submitted 25.06.15; peer-reviewed by M Chisolm, S Kumar, T Poder; comments to author 14.07.15; revised version received 18.03.16; accepted 05.06.16; published 23.06.16.

Please cite as:
Cameron CB, Nair V, Varma M, Adams M, Jhaveri KD, Sparks MA
Does Academic Blogging Enhance Promotion and Tenure? A Survey of US and Canadian Medicine and Pediatric Department Chairs
JMIR Med Educ 2016;2(1):e10
URL: http://mededu.jmir.org/2016/1/e10/
doi:10.2196/mededu.4867
PMID:27731858

Original Paper

The Significance of Kinship for Medical Education: Reflections on the Use of a Bespoke Social Network to Support Learners' Professional Identities

Stylianos Hatzipanagos[1], BSc, MSc, MA, PhD; Bernadette John[1*], BSc; Yuan-Li Tiffany Chiu[1*], BA, MSEd, PhD

King's College London, Centre for Technology Enhanced Learning, King's College London, London, United Kingdom

[*]these authors contributed equally

Corresponding Author:
Stylianos Hatzipanagos, BSc, MSc, MA, PhD
King's College London
Centre for Technology Enhanced Learning
King's College London
150 Stamford Street
London,
United Kingdom
Phone: 44 2078483716
Fax: 44 2078483716
Email: s.hatzipanagos@kcl.ac.uk

Abstract

Background: Social media can support and sustain communities much better than previous generations of learning technologies, where institutional barriers undermined any initiatives for embedding formal and informal learning. Some of the many types of social media have already had an impact on student learning, based on empirical evidence. One of these, social networking, has the potential to support communication in formal and informal spaces.

Objective: In this paper we report on the evaluation of an institutional social network—King's Social Harmonisation Project (KINSHIP)—established to foster an improved sense of community, enhance communication, and serve as a space to model digital professionalism for students at King's College London, United Kingdom.

Methods: Our evaluation focused on a study that examined students' needs and perceptions with regard to the provision of a cross-university platform. Data were collected from students, including those in the field of health and social care, in order to recommend a practical way forward to address current needs in this area.

Results: The findings indicate that the majority of the respondents were positive about using a social networking platform to develop their professional voice and profiles. Results suggest that timely promotion of the platform, emphasis on interface and learning design, and a clear identity are required in order to gain acceptance as the institutional social networking site.

Conclusions: Empirical findings in this study project an advantage of an institutional social network such a KINSHIP over other social networks (eg, Facebook) because access is limited to staff and students and the site is mainly being used for academic purposes.

(JMIR Medical Education 2016;2(1):e1) doi:10.2196/mededu.4715

KEYWORDS

institutional social networks; collaborative software; medical education; social media

Introduction

Students entering higher education are increasingly digitally literate and capable of using learning technologies, but they still have concerns about technology-enhanced learning replacing face-to-face teaching [1]. Students (both graduate and undergraduate) have varying levels of digital literacy and exposure to social media and associated technologies. Within this context, there is scope for the use of social media to support both formal and informal learning. This paper reports on an exploratory study that examines King's Social Harmonisation Project (KINSHIP), a social networking platform that meets diverse student needs in health and social care (Medicine and

Dentistry) and contributes to the debate on the impact of social networks in higher education.

Medical Education: a Need for Innovation

Medicine education, with its supporting policies and practices, has a reputation as a conservative discipline, and this is clearly reflected in current/recent educational research [2].

The rather conventional nature of medical education is evidenced by the most common educational practices. Big lecture theater sessions with noninteractive lectures are the dominant practice in many countries (including the United Kingdom). The most frequently used methods of assessing student knowledge are end of term/assessment period examinations and other forms of summative assessment. The hierarchical model of operation can prevent effective interactions and exchange of knowledge between experts and novices. Finally, the lack of links to expert health care professional communities does not support and sustain communities of learners.

On the other hand, research [3] has highlighted aspects of the hidden curriculum for health care practitioners-to-be that are not part of traditional medical educational practice. Leinster [3] points out that clinical and communication skills are common to a range of health care professionals and developing proper attitudes is a major educational goal. Medicine appears to be one of the most appropriate disciplines to become a test bed for alternative educational experiences supported by new learning technologies. These technologies and online social learning, which involve lifelong learners drawing together resources and connections from across the Internet to solve real-life problems often without access to the support of a skilled teacher or accredited learning, are a perfect match for a virtual environment that combines meaningful interaction with realistic challenges [4,5]. Contemporary medical education has been extended to include a variety of digitized learning resources and domain-specific educational activities that offer worldwide access to clinical skills development, independent of time and place [6]. These skills and competencies can be supported or developed by elements of social networking such as Facebook, Second Life, etc [7].

Social Media and Learning Communities

The rise of social media and social networking has been associated with the transition from content-centered to people-centered activities. Social media sites thrive on the assumption that they operate outside formal learning constraints. Quite often, there is resistance to including the successful characteristics of these sites (eg, visibility, transparency, creation of open communities) in an educational setup [8]. Institutions are also frequently reluctant to allow this out-of-bounds exchange that overrides authentication boundaries commonly associated with an institutional virtual learning environment. Educator confidence in and experience with social media is still perceived as a barrier to successful implementation [9]. In addition, there is limited staff and student awareness of issues of ownership of content and intellectual property rights when using commercial platforms (such as Instagram and Facebook) that assert ownership of user-generated content. This raises concerns for academic discussions on digital platforms, where theories can evolve and intellectual property can be created. Finally, learners are often unwilling to engage in formal, institutional learning interactions in spaces that they consider their own and private [10].

Student Communities and Social Media: Opportunities

Overall, social media can support and sustain communities much better than previous generations of learning technologies, where institutional barriers undermined initiatives for embedding formal and informal learning. In particular, social media can help users [2,8] achieve enhanced outcomes in relation to more traditional technologies (see Textbox 1).

Textbox 1. Social media potential for learning and teaching [2].

Social media can help learners to:

- Link to professional communities that can provide feedback, support, and professional identity scaffolding.
- Develop an appropriate, professional digital voice.
- Link to other learner and expert groups, crossing the curriculum horizontally and vertically, so that members are not confined by disciplinary/progression barriers in sharing experiences and learning from others.
- Link to cocurricular and interdisciplinary groups.
- Embed informal and formal lines of communication.
- Create self-help subgroups that can move between boundaries following a “communities of practice” trajectory.
- Embed formal/informal assessment places with an emphasis on formative rather than summative activities.

There are plenty of typologies of social media and a proliferation of tools and services; however, empirical evidence shows that a few key technologies and tools have already had an impact on student learning [11]. Social networking supports communication in formal and informal spaces. Participants in Web-based social networking are immersed in digital environments and engage in acts of computer-mediated communication [12]. Social networking supports virtual communities of people with common interests and exposes articulations of identity [13] through self-representation, performance, and play [14].

Methods

KINSHIP is a King’s College London social networking site and the deliverable of a King’s College-based project of the same name [15]. The aims of the project were to foster an improved sense of community, enhance communication, and serve as a space to model digital professionalism for students at the university. The original version of KINSHIP was launched in October 2012; further development of functions took place before this spring 2014 pilot.

This case study [16] was conducted employing an online survey (SurveyMonkey) that investigated student views and attitudes toward the site. It targeted all students in the university, including those in health care education (Medicine and Dentistry). A total of 1653 students who registered to use KINSHIP were invited to complete the survey via a link in the circulation email. The survey included multiple choice and open-ended questions for eliciting participant-oriented perspectives. The questions addressed 5 key areas: (1) the relationship between KINSHIP and other social networks, (2) students' rationales for using KINSHIP, (3) students' views and attitudes toward the use of KINSHIP (eg, whether they were feeling inhibited about using it, advantages and disadvantages of using KINSHIP, whether the site allowed them to establish a professional digital voice), (4) students' views on the use of KINSHIP for establishing a sense of academic community, and (5) students' views on the use of KINSHIP in line with other institutional platforms that supported student learning (eg, the university virtual learning environment).

The open-ended questions were analyzed using NVivo version 10 qualitative software to systematically identify key themes in relation to the students' views. Only respondents who provided complete responses (ie, answered all questions) were included in our data. In addition, 2 KINSHIP users and medical tutors were interviewed regarding the ability of KINSHIP to support nursing and medical students by putting their skills and knowledge to practice in a health and social care context in undergraduate elective modules. The emerging interview themes were used to complement and triangulate the findings from the survey and helped explore survey themes in depth and gain insights into the use of KINSHIP.

Results

Themes From Data Analysis

Several themes were identified from the open-ended survey questions. The following section explores the themes derived from the respondents (67/1653, 4.05%). Where appropriate, we also draw on the interview data concerning the KINSHIP user experiences and perceptions to complement the discussion. The respondents we were interested in had access to social media, with 82.81% (53/64) using a handheld device such as tablet or smartphone and 95.31% (61/64) using a computer. This is interesting in itself, because when KINSHIP was developed initially in 2012, smartphones were not as ubiquitous and social media required logging on at a desktop or laptop. Functionality and accessibility has evolved during the course of the study.

Theme 1: KINSHIP As an Academic Site to Support Professional Identity

Based on the survey, the majority of respondents (42/65, 64.61%) believed there was merit in the university offering KINSHIP as a space to practice and establish their digital and professional voices.

> *It is getting more important to use the Internet more selectively and professionally—this is a great way of doing so.*
>
> *As most students do seem to use social media I think this may be of help in this respect.*
>
> *Useful for developing a dialogue and professionalism to online debates and/or blogging; useful way to stay linked to societies at King's without crowding up Facebook.*
>
> *It helps to keep work/social separate but provide access to a forum where things can be discussed and debated.*

The comments above indicate that KINSHIP was beneficial to students for interactions with their peers for academic purposes. In addition, when students were asked to share their thoughts on the purpose of using KINSHIP, a high percentage associated its purpose with academic-related activities (see Figure 1).

As can be seen in Figure 1, the majority of respondents thought that the purpose of using KINSHIP was to connect or collaborate with friends from their modules/program (17/31, 54.83%) and find information about social activities in the university (11/31, 35.48%).

Although the student comments revealed how some of the survey respondents used Facebook for academic purposes such as tutorial groups and assignments ("There is already a Facebook group for my course which I find very useful for this purpose"), such a view is not elicited in the interview data. However, interviewees indicated that KINSHIP provides a suitable platform for activities such as clinical discussions because it is a private, institution-affiliated, social network. A disadvantage of Facebook was the public and permanent nature of what is written on Facebook groups—particularly for clinical students who should not discuss confidential, patient-identifiable information on a commercial platform that can be data mined for income generation purposes.

Many students preferred an institutional networking site like KINSHIP to Facebook because the former is more professional and academically oriented while the latter is primarily used for social purposes.

> *...I like having the choice to have certain friends on my Facebook. My course requires us to work with other disciplines of health, ie, medical students, dentists, pharmacists, physiotherapists, et cetera. We have to communicate with them, and for the most part social media such as Facebook is the easiest platform. However, I did not particularly want to add them as friends on Facebook for the simple reason being that we were not friends as such. Having KINSHIP gave me the opportunity to use a different social media for work.*

The comment above points to an advantage in using KINSHIP for academic purposes because Facebook is mainly geared toward social activities. Students expressed their wish to keep their work and social lives separate.

I think it is useful for keeping our personal and professional identities separate. While there are other professional media sites, a university-based site also has the potential benefit of providing us with spaces to meet up virtually. This could be particularly useful for tutor groups and interprofessional development activities. I think it also has the potential to be a space to share information and discuss these [Twitter/blog-style] *with people in our university communities.*

The comment above relates to the use of KINSHIP as a platform for work/academic purposes. When the respondents were asked about using KINSHIP to develop a sense of professional and academic community, more than two-thirds agreed it was a good idea.

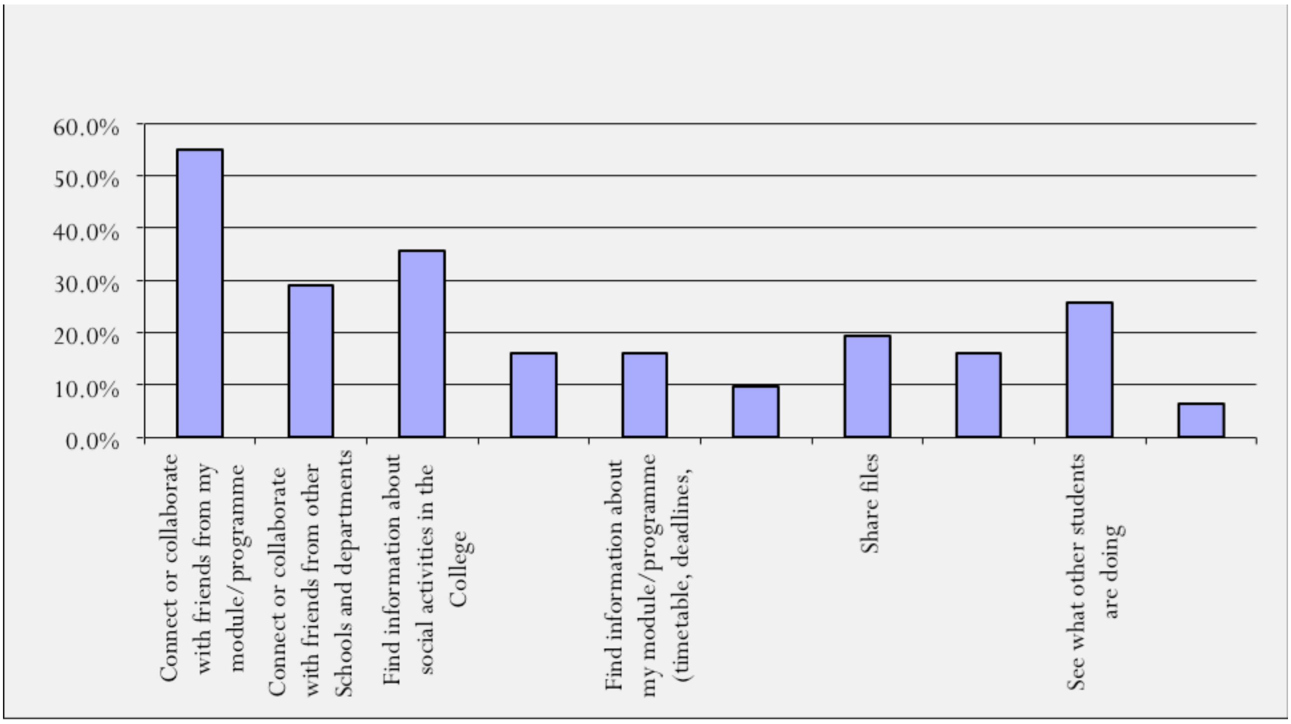
> *You get to know your peers more and would enable you to socialize with more students on the course which may help in study times et cetera.*
>
> *Useful way to stay linked to societies at King's without crowding up Facebook.*
>
> *Useful for society connections and automatically linking people in the same module, firm et cetera.*

However, it should also be noted that a high percentage of respondents commented on the importance of KINSHIP uptake when they were asked about the advantages of establishing KINSHIP.

> *...It's only useful if lots of people are using/contributing to it which at this stage they aren't, so it's currently not of much benefit to me personally. But I can see that as it grows this may change.*
>
> *If more people use it, then it could be useful in communicating news and discussing with our peers.*
>
> *Potentially good as a 'sandpit.' The more people who use it, the better it would be.*
>
> *Yes, but only if the majority of King's students actively use the service.*
>
> *I suppose that is a good opportunity that KINSHIP can provide, as it is a private network, you can make mistakes without it being accessed globally. Maybe it should be used for courses demonstrating how you can use your social network profile to further your career.*
>
> *As an academic network this would be extremely useful. More generally, I feel students should be encouraged to be absolutely professional full stop, rather than given the opportunity to voice unprofessional comments in a closed environment.*

The above statements echo the interview data. For instance, the medical tutors commented that because the conversations in the KINSHIP forum were mainly associated with the clinical discussion on global health issues, the participating students acted professionally, and the way in which they expressed themselves was also in line with the tone that one could find in the classroom discussions. The tutors stated that conducting this kind of academic collaboration in a network such as KINSHIP may help students develop and establish their professional digital voice. In addition, the tutors made the point that this type of online discussion also facilitates critical reflection and supports global health learning.

Figure 1. Purpose of using KINSHIP.



Theme 2: Privacy

When students were asked their opinion on establishing a private social network such as KINSHIP, a majority of respondents were positive as long as it maintained privacy and professionalism standards. Over the course of the study, issues around the security of communications themselves as well as issues around privacy and personal security in general were highlighted in the popular press by the Edward Snowden incident [17]. Respondents voiced concerns about the potential for their communications on KINSHIP being scrutinized by staff, but few had considered the potential for their personal security to be compromised.

> *Makes it comfortable to discuss confidential issues regarding incidents with patients or problems faced, especially when you don't know who to go to for help.*

The interview data highlighted the importance of privacy in clinical discussions in medicine. When the interviewees were asked about their reasons for choosing KINSHIP as a platform for synchronous clinical discussions, they commented:

Certainly students' need...was to have a synchronized discussion and to be able to post resources. We have some basic...resources that we were using in the discussions...Most of all with this sort of private social network,...the content would not have the risk of leaking into the public spaces of the Internet...there were still professional discussions as part of the students' education so we thought that having [this kind] *of security and privacy was good.... Also, KINSHIP was affiliated with King's.*

This account points to an important issue that relates to privacy and patient confidentiality, especially in clinical discussions where confidential information needs to be protected. It was indicated that Facebook might not be an ideal platform for such discussions because it is a commercial network that could be nonsecure.

> *I don't use Facebook. I am concerned about security, privacy, and ownership of content.*

This account shows student awareness of privacy and issues around patient confidentiality in online social networks. However, another key privacy issue that came up was concern about monitoring by the university. When responding to the question regarding their inhibitions in using KINSHIP, some respondents expressed privacy concerns.

> *As it is hosted by King's, there is a worry that the site is being monitored or tapped into.*
>
> *Yes, but this is a forum in which I know I will be scrutinized, at least with FB I can be myself separate from my colleagues.*
>
> *I can carefully control my Facebook privacy settings, as KINSHIP is run by the university I would be reluctant to use something which blurs the boundary between academic/professional and social, in particular with medicine where there should be clear boundary between our work and social side.*

The account above reveals that students may fear that their online activities will be scrutinized by staff. However, such an issue was not reflected in the interview data. When the interviewees were asked whether the student users felt inhibited in using KINSHIP, one of them commented:

> *...They saw us as facilitators so they knew we were reading what they wrote and they also knew what they wrote would be sort of part of this research so they have to consent...There was not a lot sort of personal bits in terms of you know I went here for dinnerFor all the students we had, this was their introduction to KINSHIP so none of them had used KINSHIP previously to this programme...*

The response above relates to the nature of the discussion itself, which had an academic orientation. As such, the aspect of feeling inhibited in using KINSHIP may not be perceived as a salient issue in such a context. These issues have evolved and become more important to members over the life of the project

Theme 3: Visibility and Awareness of KINSHIP

According to the survey data, the KINSHIP platform was unknown to some of the students participating in this pilot. In addition, some of those who were registered stated that they seldom used it.

> *None of my friends use it.*
>
> *I joined but have never used it. I do not see its purpose really.*
>
> *Poor uptake, nobody uses it consistently.*

The students' comments above indicate an important issue that relates to visibility and awareness of social networking sites. These comments may also echo the low response rate in the survey, meaning that a large number of students registered to use KINSHIP, but a smaller number interacted with the site. Promotion and advertisement were recommended to gain a critical mass of users for success. For example, one of the students suggested establishing some events (eg, *KINSHIP Day*) to publicize the site. Students made other recommendations to resolve the issue of low uptake.

> *Provided it kicks off well and many students get interested in using it, I believe it could be one of the key attraction points of the King's community. It can provide a great social background for all kinds of people wanting to get to know people on their course or even beyond!*
>
> *Need to increase membership by encouraging people to use it for university internal socializing and sharing.*
>
> *It might get more use if it was integrated with existing group work.*

KINSHIP was integrated into the Interprofessional education course for all clinical students during the first year of the program, but due to uncertainty with regard to its adoption, this was stopped in the second year. The integration had a clear impact on traffic.

> *More publicity for it, to get more people regularly using it. Maybe if it had more useful data on it.*
>
> *Encourage things such as assessment feedback or course information to be continually updated on there.*

> *This should be closely updated to ensure it is a good source of information. Make threads which would be engaging for students such as feedback regarding course structure et cetera just to start people off talking.*

> *Perhaps set up an event such as KINSHIP Day in which students from across the university are invited to all sign in on KINSHIP and get to meet people across the university, basically a social day starting say at 6pm where people will all get chatting on KINSHIP. Things could be set up in advance and advertised well to ensure it's successful.*

Theme 4: Facebook As a Point of Reference

When the students were asked about the differences between KINSHIP and established public social networks such as Facebook, Instagram, Snapchat, and WhatsApp, they favored the commercial sites over KINSHIP with respect to interface design, including popularity, ease of access, convenience, functionality, and searchability. This might be related to familiarity of the users with the Facebook interface in relation to a new interface and functionality that KINSHIP represented for them.

One key point raised by the respondents was the lack of a system of notifications of activity via email/instant messaging for KINSHIP, and there was a consensus that KINSHIP should have offered this functionality (this type of functionality became mainstream on commercial platforms shortly after the initial launch of KINSHIP). Another key point from the student responses was user uptake. Specifically, compared with commercial social networking platforms, KINSHIP had a lower user uptake. In comparison, Facebook is virtually ubiquitous. According to the student responses, Facebook has a fast search facility to find people and topics. While considering the type of networking that KINSHIP can offer, many students expressed the view that Facebook is universal (open to everybody) and used for social purposes, whereas KINSHIP was used mainly for academic purposes and restricted to the university student body, an attribute of the KINSHIP design which could alienate some users.

> *Facebook is more user-friendly; it's not associated with any particular institution.*

> *The main difference is that KINSHIP isn't as inclusive as Facebook is.*

> *Facebook has a much better interface, it's simpler and it has a wide user base already. It's simple to transfer and share files or make public announcements. It's easy to find people. It's fast, it's ubiquitous, and it's easy to search for groups and content.*

Theme 5: KINSHIP’s Interface Design and Ease of Access

Many respondents expressed their dissatisfaction with the existing design/interface of KINSHIP.

> *You can easily access all of the things you'd like to in an intuitive way through Facebook but not through KINSHIP, where the whole interface feels clunky.*

> *It isn't as spontaneous as Facebook, and the layout is not very appealing.*

The student accounts above indicate that the interface design of KINSHIP could benefit from some improvement. Some students also thought that KINSHIP had a limited target audience and was only used for the university student body whereas platforms such as Facebook, Twitter, Instagram, and WhatsApp have a much wider access to other users.

> *You are more likely to keep in touch with someone on Facebook than KINSHIP. Everyone uses Facebook. KINSHIP is only for university students. I only use one social media [tool], which is Facebook. Twitter and Instagram are being used a lot more now too but Facebook still has the majority of members.*

> *Facebook is full of my friends from outside university as well as university so I never really bothered with KINSHIP as I already have Facebook.*

The students seemed to prefer Facebook as the online platform of choice for communication because it allows users to interact with people both within and outside the university whereas KINSHIP is only designed for King’s people.

Discussion

Principal Findings

Our findings indicate that the majority of the respondents were positive about using KINSHIP to develop their profile and professional voice. Targeting institutional users and using the platform for a mixture of the formal and the informal have been essential KINSHIP learning design characteristics. Users responded favorably to the separation of purely social interactions and any academic informal or semiformal interactions that KINSHIP can provide.

However, KINSHIP requires a stronger identity to build its niche among other popular social networking platforms. Another recommendation in the survey was that KINSHIP could also become available to other groups of users, such as the university’s alumni. “*It should be heavily used by alumni to make connections. It should be incorporated in the alumni network*” to make connections between past and current students and build professional communities through which uptake could be increased.

In response to student feedback from our data, it is recommended that institutional networking platforms must deliver both in terms of access and interface design. Based on the data, it is also recommended that a networking site may get more use if it is integrated with other institutional tools that students use frequently such as the institutional virtual learning environment or communication platforms. A system of notifications of activities by email, such as daily or weekly digests, was suggested because users may not want to check traffic of communication continuously and directly on the environment.

The empirical evidence of our evaluation points toward a set of interface and learning design specifications that should be an integral part of the design of an institutional social networking site:

1. A well-articulated identity for the platform to achieve wider adoption within the institution.
2. Development and evolution of functionality in step with commercial platforms to achieve a smooth experience for the users who have experience using these external sites.
3. Improving access and redeveloping the social network as a mobile application to benefit from current and ongoing advances in mobile technologies.
4. Addressing privacy concerns raised by students about potential monitoring by staff/institution.
5. Raising awareness about issues around intellectual property ownership and the risks of allowing confidential data to be mined by advertisers when using a commercial platform.
6. Active and consistent promotion to students and staff in order to ensure traffic.
7. Simple authentication process and full integration with the institutional virtual learning environment.
8. Support to students by tutors and moderators when establishing their digital voice.

Conclusions

This case study explored the specifics of the deployment of a custom-made social network. The results of this study indicate that institutional social networks such as KINSHIP have potential for supporting formal and informal learning. Teaching and learning in medicine can be social and informal and in this context employing such technologies can really help [10]. Specifically, medical student respondents considered KINSHIP a potentially useful space for them to discuss sensitive clinical issues in relation to their work and studies; such a view was also evident in the interview data we analyzed.

The survey we administered to the registered users of the institutional network, despite the relatively low response, provided a rich set of qualitative data. The empirical findings projected an advantage of KINSHIP over other social networks, because it was exclusively targeting people from the university and mainly being used for academic purposes. This is also supported by the interview data of experiences using KINSHIP for online learning for nursing and medical students. Given the nature and purpose of the activities conducted, KINSHIP offers a space for students to interact with colleagues and tutors; it can also be argued that social networking platforms may give a voice to users and help them to develop their digital identity on a personal and professional level.

The richness of the qualitative aspect of our data has given us confidence in our findings, and our experience points toward outcomes that are generalizable, especially the design recommendations. However, further research would be required to explore the adoption of such systems in higher education, and the approach would benefit from looking at comparative studies in different institutions to explore successful adoption and features. The privacy issue raised by students expressing concern about potential monitoring by staff/institution should be investigated.

Institutional networks need promotion to create awareness and knowledge of their existence among student target audiences in order to succeed. The importance of interface design embedded within a learning design narrative was also brought up by the respondents of this study. Another issue which deserves attention was a need to establish a unique identity for these sites as institutional social networks because they are in competition with existing well-established commercial social networks such as Facebook and LinkedIn. An important theme that has also emerged from our study is the perceived importance of privacy; students raised the issue that the degree of privacy protection in KINSHIP requires further elaboration. Institutional policies should address such privacy issues.

Overall, ongoing development of functionality, improved ease of access via redeveloping the platform as a mobile application, and addressing privacy concerns raised by the students about potential monitoring by staff or the institution would be essential if an institutional social networking platform were to be a success.

Acknowledgments

The development and evaluation of KINSHIP was the focus of a project that received funding from the King’s College Teaching Fund following a joint proposal by staff and students of the Schools of Medicine and Dentistry, Modern Language Centre, and Department of English. We would like to acknowledge our King’s colleagues Professor Pat Reynolds (Dentistry), Dominique Borel (Modern Languages), Catherine Brossard (Modern Languages), Professor Alan Read (Theatre), Elena Hernandez-Martin (Centre for Technology-Enhanced Learning), Professor Eeva Leinonen, and Gary Horrocks.

Conflicts of Interest

None declared.

References

1. Hatzipanagos S, Warburton S, Reedy G. Technology-enhanced learning benchmarking report. London UK: King's College; 2010.
2. Hatzipanagos S. In: Bamidis P, Anastassov V, Despotova-Toleva L, editors. Disrupting Traditional Teaching Practices With Social Media: the Case for Medicine. Plovdiv, Bulgaria: Medical Publishing VAP; 2012.
3. Leinster S. Medical education and the changing face of healthcare delivery. Medical Teacher 2002;24(1).

4. Buckingham Shum S, Ferguson R. Social Learning Analytics. Educational Technology & Society 2012;15(3):3-26.
5. Brown JS, Collins A, Duguid P. Situated Cognition and the Culture of Learning. Educational Researcher 1989;18(1):32-42. [doi: 10.3102/0013189X018001032]
6. Dafli E, Antoniou P, Ioannidis L, Dombros N, Topps D, Bamidis PD. Virtual patients on the semantic Web: a proof-of-application study. J Med Internet Res 2015;17(1) [FREE Full text] [doi: 10.2196/jmir.3933] [Medline: 25616272]
7. Cornford J. Emergent or emerging technologies: What's the difference and does it matter?. 2008. URL: http://jisciret.jiscinvolve.org/wp/2008/11/24/emergent-or-emerging-technologies-whats-the-difference-and-does-it-matter/ [accessed 2015-11-05] [WebCite Cache ID 6aEjuW67L]
8. Hatzipanagos S, Warburton S, editors. Handbook of Research on Social Software and Developing Community Ontologies. London: Information Science Reference; 2009:598.
9. Conole G, Alevizou A. A literature review of the use of Web 2.0 tools in Higher Education. York UK: The Open University; 2010.
10. Buckingham D. Media Education: Literacy, Learning and Contemporary Culture. Cambridge, UK: Polity; 2003.
11. Hatzipanagos S. Disrupting traditional teaching practices with social media: the case for medicine. 2011 Presented at: e-Education and e-Science International Conference; 6 October 2011; Plovdiv, Bulgaria.
12. Hatzipanagos S. HOT and Flaming Spirals: Learning and Empathic Interfaces in Text-based Discussion Forum Dialogues. European Journal of Open, Distance and e-Learning 2006(I).
13. Warburton S, Hatzipanagos S, editors. Digital Identities and Social Media. London: Information Science Reference, an imprint of IGI Global; 2013.
14. Hatzipanagos S, Warburton S. Feedback as Dialogue: Exploring the Links between Formative Assessment and Social Software in Distance Learning. Learning, Media and Technology 2009;34(1):45-59.
15. John B. Kinship--King's Social Harmonisation Project. Pilot phase of a social network for use in higher education. Bull Group Int Rech Sci Stomatol Odontol 2013;51(3):e19-e22. [Medline: 25461124]
16. Yin RK. Case Study Research, Design and Methods 3rd ed. London UK: Sage; 2003.
17. Cohen D. Social Times. 2015. STUDY: How the NSA's Prism Initiative Affected Americans' Social Media Use URL: http://www.adweek.com/socialtimes/study-pew-research-center-americans-privacy-strategies-post-snowden/616989 [accessed 2015-07-23] [WebCite Cache ID 6aElpEPLw]

Abbreviations

KINSHIP: King's Social Harmonisation Project

Edited by P Bamidis; submitted 17.05.15; peer-reviewed by S Brown, E Georgiadou; comments to author 08.06.15; revised version received 22.10.15; accepted 24.11.15; published 03.03.16.

Please cite as:
Hatzipanagos S, John B, Chiu YLT
The Significance of Kinship for Medical Education: Reflections on the Use of a Bespoke Social Network to Support Learners' Professional Identities
JMIR Medical Education 2016;2(1):e1
URL: http://mededu.jmir.org/2016/1/e1/
doi:10.2196/mededu.4715
PMID:27731848

Original Paper

A Critical Review of Mechanical Ventilation Virtual Simulators: Is It Time to Use Them?

Juliana Arcanjo Lino[1], PT, MSc.; Gabriela Carvalho Gomes[1], PT, MSc; Nancy Delma Silva Vega Canjura Sousa[1], PT, BSc; Andrea K Carvalho[1], PT, PhD; Marcelo Emanoel Bezerra Diniz[1], BSc; Antonio Brazil Viana Junior[1], PStat, BSc; Marcelo Alcantara Holanda[1], MD, PhD

Federal University of Ceara, Medicine, Federal University of Ceara, Fortaleza, Brazil

Corresponding Author:
Juliana Arcanjo Lino, PT, MSc.
Federal University of Ceara
Medicine
Federal University of Ceara
4th floor (402), Aldeota
1972 Silva Paulet St
Fortaleza, 60120-021
Brazil
Phone: 55 85 996241243
Fax: 55 85 996241243
Email: juarcanjolino@hotmail.com

Abstract

Background: Teaching mechanical ventilation at the bedside with real patients is difficult with many logistic limitations. Mechanical ventilators virtual simulators (MVVS) may have the potential to facilitate mechanical ventilation (MV) training by allowing Web-based virtual simulation.

Objective: We aimed to identify and describe the current available MVVS, to compare the usability of their interfaces as a teaching tool and to review the literature on validation studies.

Methods: We performed a comparative evaluation of the MVVS, based on a literature/Web review followed by usability tests according to heuristic principles evaluation of their interfaces as performed by professional experts on MV.

Results: Eight MVVS were identified. They showed marked heterogeneity, mainly regarding virtual patient's anthropomorphic parameters, pulmonary gas exchange, respiratory mechanics and muscle effort configurations, ventilator terminology, basic ventilatory modes, settings alarms, monitoring parameters, and design. The Hamilton G5 and the Xlung covered a broader number of parameters, tools, and have easier Web-based access. Except for the Xlung, none of the simulators displayed monitoring of arterial blood gases and alternatives to load and save the simulation. The Xlung obtained the greater scores on heuristic principles assessments and the greater score of easiness of use, being the preferred MVVS for teaching purposes. No strong scientific evidence on the use and validation of the current MVVS was found.

Conclusions: There are only a few MVVS currently available. Among them, the Xlung showed a better usability interface. Validation tests and development of new or improvement of the current MVVS are needed.

(JMIR Med Educ 2016;2(1):e8) doi:10.2196/mededu.5350

KEYWORDS

positive-pressure respiration; medical education; computer simulation; learning

Introduction

Mechanical Ventilation

Mechanical ventilation (MV) is a life support intervention used for patients in acute and/or chronic respiratory failure. The proper use of MV can decrease mortality in many diseases, such as acute respiratory distress syndrome (ARDS), chronic obstructive pulmonary disease, and others. Furthermore, good practices in MV can also reduce the length of intensive care unit (ICU) stay and decrease complications and hospital costs [1-5]. Over the past 20 years, rapid technological developments have led to significant improvements in MV, with the emergence of new microprocessor equipment, ventilatory modes, advanced features, and complex human-machine interfaces. However, this has been accompanied by underutilization of the available tools and difficulties in teaching about the equipment functioning and the handling of these devices by students and health professionals. Errors in mechanical ventilatory support may cause serious adverse events, even death [6,7]. A few studies have shown that medical residents, despite being responsible for the management and care of patients on ventilatory support, have difficulties in applying current knowledge in practical situations. Insufficient training on MV is a possible reason for this problem [5-8]. Teaching MV at the bedside with real patients is always a challenge. There are logistical problems, such as limited space in the ICUs, limited number of patients and clinical scenarios, and intrinsic risks related to the environment of the ICU. Furthermore, related examinations, such as arterial blood gases (ABG) analysis, are not always available at the point of care [7]. Given this context, it is believed that new teaching approaches are needed to contribute to better training in the use of MV.

Simulation as a Powerful Teaching Tool for Health Professionals

Simulation techniques have been increasingly used as a learning method with advantages over the traditional ones [9,10]. Medical simulation can be defined as the use of a device for simulating a real-life situation in a patient for the purpose of education and research [11,12]. Two systematic reviews [13,14] have shown that medical simulation is effective for the acquisition of skills and to encourage better care of patients. Realistic simulations use real ventilators, usually connected to mannequins or mechanical simulators instead of patients. Although this approach reduces the risk for patients and may expand the number of mechanical clinical situations that can be taught, it still has logistic limitations, as the ventilators and the simulators are usually expensive and not easily accessible [9]. Easy access to the Web fostered the emergence of teaching tools as computer-assisted learning. This type of technological resource can improve the learning of medical students, particularly when related to the virtual simulation in health care. In fact, with the current technology, it may be possible to develop and provide Web-based access to virtual MV training to a massive number of students, teachers, and health care professionals worldwide at a relatively low cost [15,16]. Considering the limitations of both, MV training in ICU and even, realistic simulations, a good complementary approach would be to use virtual Web-based simulation of MV.

Therefore, mechanical ventilation virtual simulators (MVVS) arise as potential teaching tools that could help the implementation of ubiquitous learning on MV [17,18,19]. Their main advantages would be to promote student training in complex clinical scenarios, to predict and anticipate failures in procedures, to reduce the cost involved in acquisition and maintenance of medical equipment and materials, and to optimize training time and opportunity for continuous Web-based staff training. In addition, it presents zero risk for patients and provides more efficient and safer learning environments, familiarizing the students with the handling of the devices [9,17,18,20]. Despite that, use of MVVS is not the standard practice in MV training nowadays. Considering the complexity of MV practice and teaching and the fact the virtual simulation is only in its dawn, the hypothesis of this study were (1) there are only a few available Web-based MVVS; (2) they are not yet validated for medical training; and (3) furthermore, their usability as a teaching tool is unknown and may differ substantially. We aimed to identify and describe in detail the current available MVVS, to compare their features regarding their functionalities on usability tests related to their viability as teaching tools and to review the literature on validation studies.

Methods

This is a descriptive, quantitative, and exploratory study, aimed to identify articles that investigated MVVS as a teaching tool. A comparative evaluation of the simulators was performed, based on a literature/Web review followed by usability tests by *experts* users [21,22].

Question

We sought to answer the following questions: What are the current Web-based MVVS available? Are they ready for use in training MV? Are there validation studies on their usefulness for MV training?

Systematic Review

Search Strategy

Electronic searches were performed in the Cochrane Library, PubMed, and Scielo databases, from April 1990 to April 2015. The search included the terms "computer simulation," "simulator," "medical education," "learning," "mechanical ventilation," and the operator "AND" was used in all databases. This review included papers published in 3 languages (Portuguese, English, and Spanish).

Study Selection and Eligibility Criteria

We defined MVVS as the use of a device for simulating a real-life situation in a patient for the purpose of education and research [11,12]. Randomized and controlled clinical assays, prospective studies, and systematic review were preferred to investigate MVVS as a teaching tool.

To determine study eligibility, 3 investigators (GCG, JAL, and NDS) reviewed each article, the study title, and abstract, independently, and thereafter, the full text of the manuscript. The discrepancies were resolved by discussion among the review authors (MAH, AC, and ABV).

Usability Tests

Convenience Sample

The sample was intentional, judgmental, and nonprobable, based on the assumption that the knowledge of the researcher on the population and its elements can be used to select the individuals to constitute the sample. Thus, 6 *experts* were purposively chosen from 2 categories: 3 physicians and 3 physiotherapists. We defined as *experts*, professionals who were university teachers or preceptors, also board-certified specialists in the professional category or who were coursing postgraduate program in critical care/pulmonology, and who have worked daily with mechanically ventilated patients for at least 5 consecutive years.

Study Design

Usability measures the efficacy, the efficiency, and the satisfaction with which the user can perform a specific set of tasks in a particular environment, mainly aiming to evaluate whether simple and basic tasks can be easily performed by the users [23].

First, each expert assessed the simulators by performing tasks, simulating 11 scenarios for invasive MVVS (Multimedia Appendix 1) and 6 scenarios for one noninvasive MVVS (Multimedia Appendix 2).

The second step aimed to assess the usability of each simulator by checking how well 10 heuristic principles [24] were met by the MVVS interface (Multimedia Appendix 3), through the application of a usability test. The experts assessed whether the MVVS meets the heuristics principles by the following scores according to a Likert scale: TD, totally disagree (1 point); D, disagree (2); N, neutral (3); A, agree (4); and TA, totally agree (5). The usability scores were obtained by computing the sum of the scores obtained for each heuristic principle analysis according to the evaluation of 6 experts. The maximum score to be obtained by a specific MVVS for one heuristic principle would be 5 points × 6 experts=30 points, and the minimum, 1 × 6=6 points. The total maximum score to be obtained by summing all scores for the 10 heuristic principles would be 10 heuristic principles × 30 points or each one=300 points and the minimum would be 10 × 6=60 points.

The third step consisted in the application of the Visual Analog Scale (VAS) to evaluate the easiness to use each MVVS. The VAS ranged from 0 (zero, very difficult to use) to 10 (ten, very easy to use) (Multimedia Appendix 4) [22]. Finally, the participants answered the following question: “Which simulator among those you tested would you recommend for teaching? Why?”

Time and Place

This study was performed in the Respiratory Laboratory, in the Biomedicine Center, Internal Medicine Department, Federal University of Ceara, Fortaleza, Ceara, Brazil. All experts assessed the MVVS in the same day, 3 in the morning and 3 in the afternoon. A Sony Vaio notebook with Windows 8 with wireless connection was used for high-speed Internet. During the tests, there were no problems with the Internet connection with no interruptions in the procedures. In the laboratory, the expert was seated in a comfortable chair, and they were acclimatized to the room temperature (22-23° C, special attention to avoid noise or distractions was given. The sequence for testing the MVVS was randomized for each expert. A total time of 2 hours was given for each expert. Considering that only 6 MVVS were tested, a mean time of 20 minutes per simulator was used.

Ethical Precepts

The present study followed the ethical precepts established by the Resolution 466, 2012 by the National Health Council [25], fulfilling the requirements of the Free and Clarified Consent Term; that is, ensuring the rights of the subjects and allowing them to drop out of the study at any time. Therefore, in observance of the ethical principles, the participants were identified as E1, E2, E3, E4, E5, and E6.

Statistical Method

The primary quantitative outcome was the score obtained for the 10 heuristic principles according to the answer of the experts to the usability questionnaire for the MVVS in executing specific predefined tasks. For analysis of each heuristic principle, the Kruskal–Wallis test was used. When a statistically significance was present a post hoc Mann–Whitney test was performed to compare pairs of MVVS, adjusting the significance level by the Bonferroni correction for multiple comparisons. For better visualization of the results concerning the total sum of scores for all heuristic principles, the results were expressed in percentage of the maximum of 300 points. A second quantitative outcome was the mean value for the score obtained in the VAS assessment. The significance level considered was $P<.05$ for a confidence interval of 95%. The statistical software SPSS 22.0 was used for all comparisons.

Results

Systematic Review

Eight MVVS accessible on the Web were found after extensive literature/web review: Beta (University of Pittsburgh, USA), Evita Trainer XL (Drager, Lubeck, Germany), Hamilton G5 (Hamilton Medical AG, Rhazuns, Switzerland), Inter Plus VAPS/GMX (Intermed Hospital Medical Equipment Ltda, Sao Paulo, Brazil), Servo 900C, Besim (Dr. Frank Fischer, Germany), Simulation-Based Educational Tool for Noninvasive Ventilation (NIV) (European Respiratory Society), Virtual Ventilator (Sagamihara/ Kanagawa, Kitasato University, Japan), and Xlung (Xlung, Fortaleza, Brazil).

The Simulation-Based Educational Tool for NIV was the only noninvasive MV simulator included in this study. This ventilation simulator integrates a NIV Competency Course of the European Respiratory Society. All the other MVVS were related to invasive MV.

The MVVS were categorized as brand type or generic (not related to a particular brand), and their interfaces are shown in Figures 1 and 2. Brand-type MVVS (Servo 900C, Besim Evita Trainer XL, Hamilton G5, Inter Plus VAPS/GMX and Simulation-Based Educational Tools for NIV) are those that reproduce a mechanical ventilator interface of a particular company or brand, for training their staff, and disseminating knowledge of their equipment. Generic MVVS (Beta, Virtual Ventilator, and Xlung) are those developed as a teaching tool for improvement of user skills, in the field of MV in general. These simulators can be accessed for free downloads, Web-based use, or paid subscriptions.

Windows (Microsoft Corporation) is the operating system compatible with all the MVVS mentioned previously. The Hamilton G5 simulator, the Simulation-Based Educational Tool for NIV, and the Xlung can also be used in the Mac OS X (Apple Inc.) system. The main characteristics of the MVVS are shown in the Multimedia Appendix 5. All the MVVS provide graphical monitoring of the airway pressure, flow, and volume × time curves. Although most of MVVS provide the F_IO_2 setting, only Xlung allows monitoring of SpO_2 and ABGs of the "patient," enabling the observation of the immediate effects of F_IO_2 changes on pulmonary gas exchange in real time. Monitoring capnography is found only in the Evita Trainer XL. Xlung has the option to display the respiratory muscular pressure and the alveolar pressure, which can be seen optionally in the pressure × time curve. It also shows the ponderal volume (tidal volume per kg of IBW), which is presented graphically with 2 safe zones, for ARDS or non-ARDS patients, that are shown in Figure 3. Regarding the configuration tools, the Hamilton G5 and the Simulation-Based Educational Tool for NIV offer 25 and 19 choices of languages, respectively. The Xlung allows the user to load and save the simulations already carried out to be accessed at a later time.

Figure 1. Screen shots of brand-type MVVS interfaces.

Figure 2. Screen shots of generic MVVS interfaces.

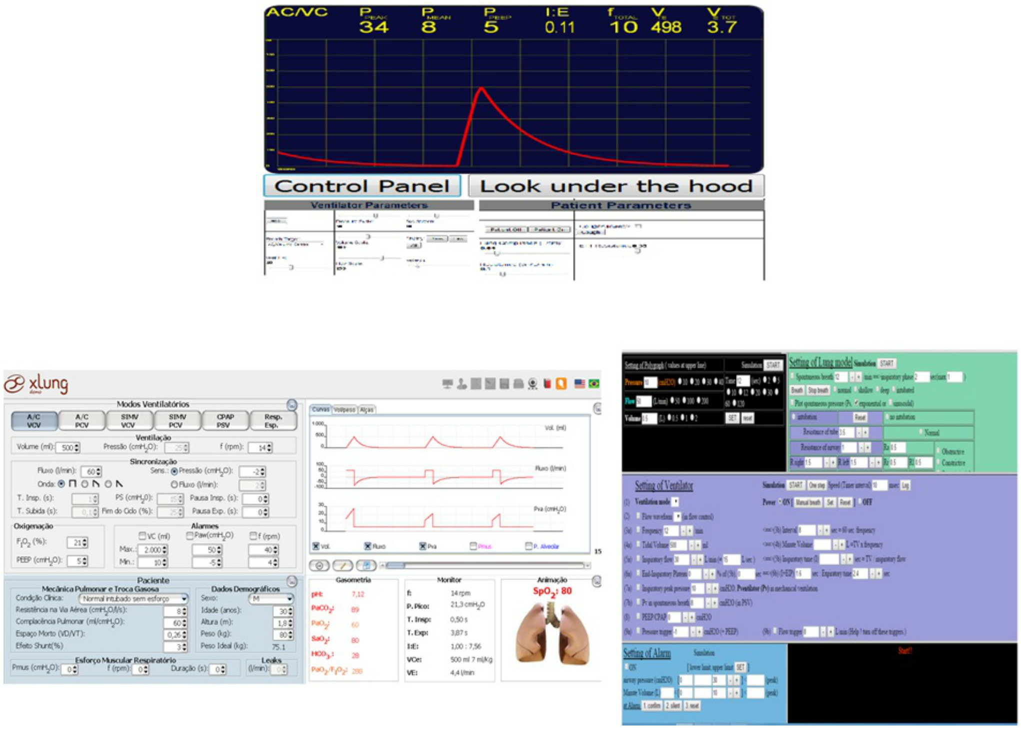
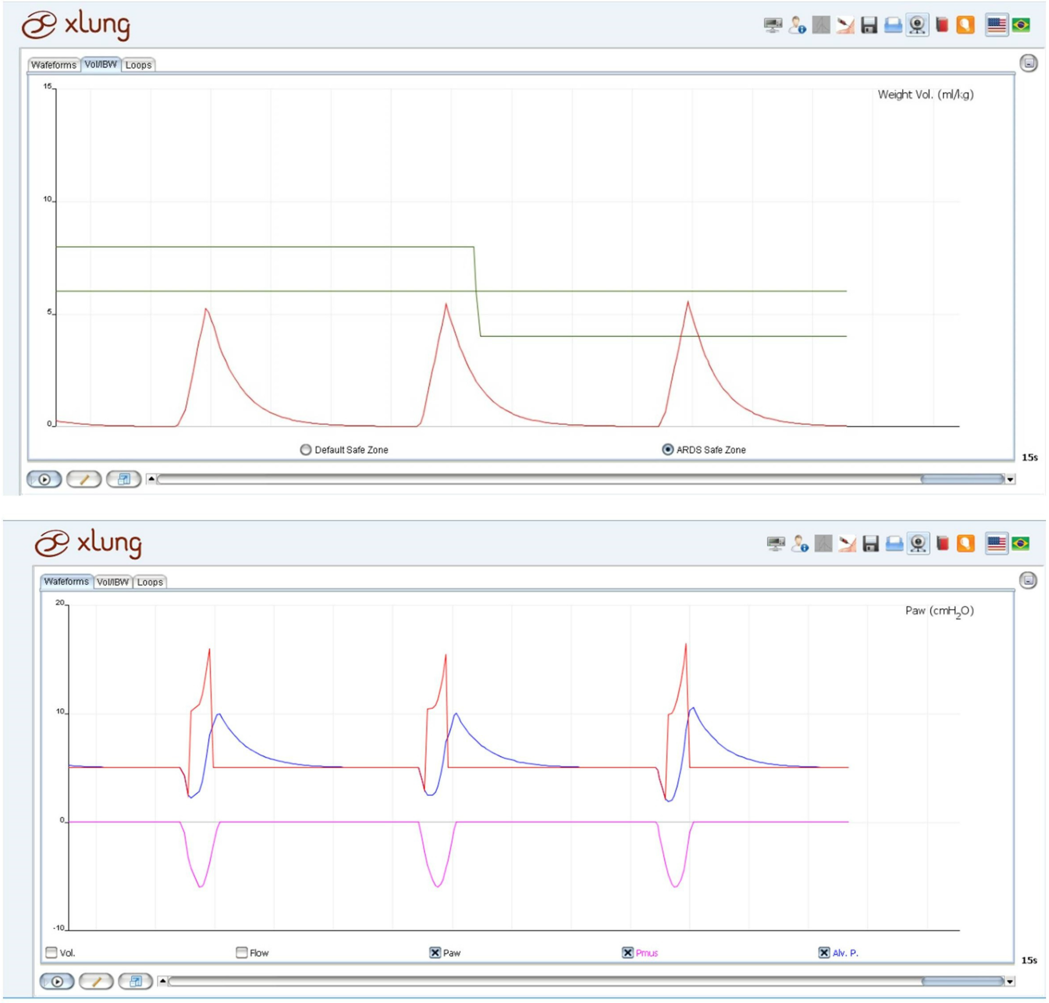


Figure 3. Special graphics of the Xlung MVVS. At the top, ponderal tidal volume according to the ideal body weight (mL/kg) with depicted safe zones and at the bottom, exhibition of airway (red), muscular (pink), and alveolar (blue) pressures altogether.



Usability Tests

Six health professionals participated as *expert* users (3 physicians and 3 physiotherapists). Of the 8 simulators, 6 were evaluated. The Servo 900C, Besim and Virtual Ventilator were excluded from this part of the study. The former would only provide the DEMO version, not allowing the user to perform the necessary tasks; the latter was unavailable at the website http://info.ahs.kitasato-u.ac.jp/tkweb/tklsim2/indexE.html by the time of the usability test (April 15, 2016). Table 1 shows the tasks asked by the experts for usability evaluation of the MVVS performance.

Figure 4 shows the scores obtained by the MVVS for each one of the heuristic principles of their interfaces according to the *experts* assessments. Figure 5 shows the performance of 5 MVVS as a percentage of the maximum obtainable scores (300 points) for the assessment of the 10 heuristic principles altogether. The mean VAS scores for the easiness of use for the MVVS were the following: Xlung=9, Hamilton G5=7, Inter Plus VAPS/GMX and Evita Trainer XL=6, and Beta=4. When asked about the question: "Which simulator among those you tested would you recommend for teaching? Why?" all the experts chose Xlung, with the following answers:

E1: "*It is an easy to manipulate simulator, simulation is realistic and predicts iatrogenic MV complications*"; E2: "*Easy to use, didactic and intuitive design, complete capability of interaction giving the student innumerous possibilities of simulation with feedback by the results obtained on the arterial blood gases*"; E3: "*Easy to access and manipulate, simple and intuitive language with various possibilities of adjustments and includes arterial blood gases and pulse oxymetry, enabling the user a more reliable simulation of a real case scenario*"; E4: "*Simple and complete interface with various possibilities of clinical scenarios and available parameters*"; E5: "*A great teaching tool on MV, good interaction between student and teacher, in different clinical situations*"; and E6: "*It features various parameters and tools, simple language, with important possibilities of adjustments, such as monitoring of gas exchange and respiratory mechanics.*"

Table 1. Usability tasks as evaluated by experts in each simulator.

Tasks	Beta	Evita Trainer XL	Hamilton G5	Inter Plus	Xlung
English language	✓	✓	✓	✓	✓
TV[b]/weight adjustment	✓	✓	✓	✓	✓
AC/VCV[c] adjustment	✓	✓	✓	✓	✓
Calculate plateau	✓	✓	✓	✓	✓
Identify auto-PEEP[d]	X	✓	✓	✓	✓
AC/PCV[e] adjustment	✓	X	✓	✓	✓
F_IO_2[f] adjustment	✓	✓	✓	X	✓
Curves (vol, flow, paw)	✓	✓	✓	✓	✓
Max pressure alarm	X	✓	✓	✓	✓
PSV[g] adjustment	✓	✓	✓	✓	✓
Save simulation	X	X	X	X	✓

[a]✓ denotes accessed by the experts; X denotes not found or accessed by the experts.

[b]TV, tidal volume.

[c]AC/VCV, assist/control with volume cycling.

[d]PEEP, positive end expiratory pressure.

[e]AC/PCV, assist/control with constant pressure, timed cycling.

[f]F_IO_2, fraction of inspired oxygen.

[g]PSV, pressure support ventilation.

Simulation-Based Educational Tool for NIV was also evaluated by *experts*, but was not included in the statistical tests, because there was no other NIV MVVS for comparison. Regarding the tasks, does not allow adjustment of F_IO_2 and does not offer the option to save the simulation. Presented 65% (195 points) of its interface usability for the assessment of the 10 heuristic principles altogether of the maximum obtainable scores (300 points) and obtained mean score 6.9, according to the VAS.

After an extensive search for papers in the literature, no scientific evidence on the use and validation of the current MVVS was found. Only Xlung was tested to evaluate the teaching of MV principles to fourth-year medical students. In that study, 2 educational activities were analyzed. The first one evaluated 23 undergraduate medical students on the usability of the Xlung in a computer laboratory. In the second, 24 other students had simulation-based activities with the software. After the first activity, 75% of the students agreed with the statement: “I learned from the simulation aspects not previously understood in theory and practice”; and 78% of them agreed that: “The simulator creates a better understanding of how to adjust the ventilator.” In the second activity, there was a statistically significant increase in correct answers in a standardized test [26].

Figure 4. Scores obtained by the MVVS for each one of the heuristic principles. * *P*<.05 vs Xlung; + *P*<.05 vs Hamilton G5; 1: visibility of the system status; 2: correspondence between the system and the real world; 3: freedom and control by the user; 4: consistency and standards; 5: error prevention; 6: recognition instead of recall; 7: flexibility and efficiency in the utilization; 8: layout and minimalist design; 9: help the user to recognize, diagnose, and recover errors; and 10: help and documentation.

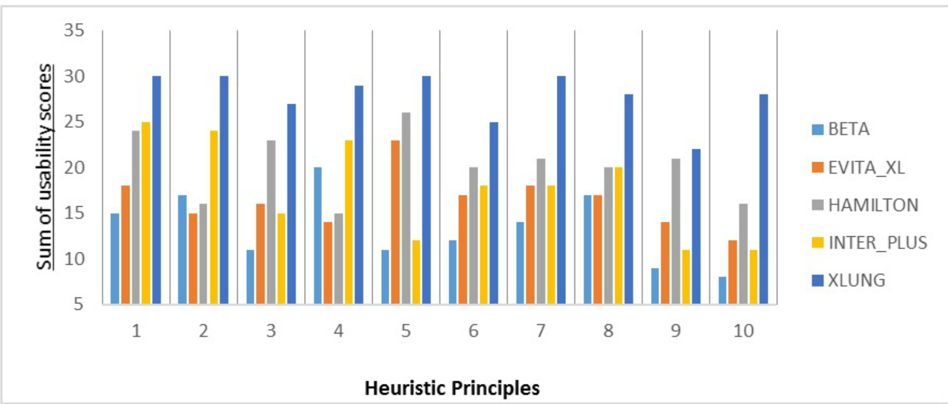
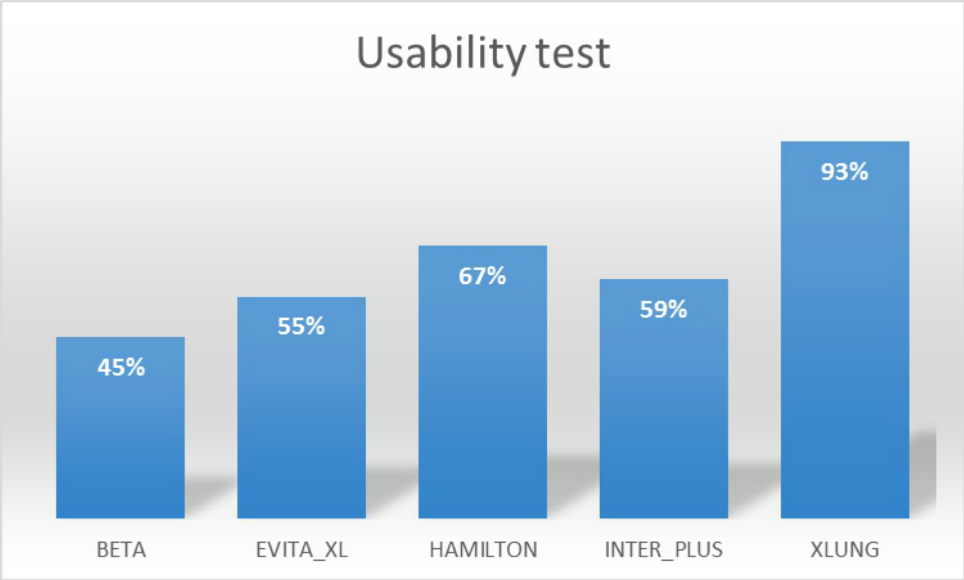


Figure 5. Performance of 5 MVVS as a percentage of the maximum obtainable scores (300 points) of their interfaces usability for the assessment of the 10 heuristic principles altogether.



Discussion

Principal Findings

The literature/web review of the currently available Web-based MVVS identified 8 simulators. They showed diversity, mainly regarding the nomenclature of the ventilatory modes, adjustments of the ventilatory settings, and the monitoring of pulmonary gas exchange parameters. The Hamilton G5 and the Xlung covered a broader number of parameters, tools, and have easier Web-based access. Except for the Xlung, none of the simulators displayed monitoring of ABGs and alternatives to load and save the simulation. The Xlung performed all the usability tasks, obtained the greater scores on heuristic principles and the greater mean score on the VAS, and it was the preferred one for teaching purposes.

To our knowledge, this is the first study that assessed the usability of the interface of Web-based MVVS. It is important to mention that it was not aimed to perform a market analysis. In fact, this type of study addresses the attractiveness and the dynamics of a particular brand within a particular industry [27]. In this investigation, the simulators were classified into brand type and generic. This classification aimed to separate the simulators that could reproduce the mechanical ventilator interface of a particular brand from those developed as a teaching tool for improvement of user skills.

For efficient use of MVVS as a teaching tool, it is essential to set up the typical parameters of the respiratory physiology according to clinical scenarios or diseases that are observed in real life. Except for Evita Trainer XL, the simulators offer options of different clinical scenarios. The great advantage of this is the possibility of modeling patient characteristics, which may assist in the teaching and learning of MV in certain pathologies. The Evita Trainer XL, Hamilton G5, and Xlung allow determination of the IBW. There is no doubt about the importance of calculating the IBW according to the height and gender of the patient. Actually, the utilization of this parameter for promoting safe and effective ventilation is essential. Only Xlung allows monitoring of SpO_2 and ABGs of the "patient," enabling the observation of the effects of F_IO_2 changes on pulmonary gas exchange in real time. This interesting feature makes it possible to calculate the PaO_2/F_IO_2 ratio, which is important to teach how to quantify the severity of lung injury [19]. There is much heterogeneity of the functional characteristics and usability among the MVVS. The test of interface usability displays some methods for analysis: "formal," "automatic," "empiric," and "heuristic" (or "analytic"). The heuristic evaluation is a method for inspection, where an *expert* interacts with the interface and assesses it according to usability principles previously defined, the so-called heuristic principles [24,28,29].

The heuristic evaluation is considered the best inspection method to predict problems, usually serious, faced by the users [30]. It has been also used on *sites*, teaching resources, and *software* [31-38]. When used in mechanical ventilators, it allows the identification of usability problems [21]. In this study, we tested individually each MVVS, regarding the usability tasks, the heuristic principles questionnaire, and the VAS scores. It was noted that all of them still have limitations. There are problems in relation to the absence of important parameters, confusing terminology of the ventilatory modes, and the usability of some functions. In some of them, the layout of the screen frequently has too much information and the location and function of the "buttons" are not always intuitive. For example, the patient ventilation settings, curves, and monitoring data are not always separated for a better view.

The layout of the traditional ventilatory modalities is easier to be handled by the user. Under the classificatory point of view, a consensus or an international standardization is necessary, as a mode can have different names in different ventilators. These new ventilatory modalities emerge for the association of other basic modalities; however, they can be little or poorly used, according to the experience of the professional. Over the last years, some authors have tried to standardize the system for the classification and description of the ventilatory modalities [39-41].

Monitoring the respiratory mechanics was another critical item assessed in the MVVS, for being useful both for the diagnosis of the subjacent condition of the patient and for an individualized adjustment. There is marked heterogeneity among the MVVS. The Beta, Hamilton G5, and Servo 900C, Besim only displayed the value of the plateau pressure during monitoring, not allowing the user to calculate it. However, the other simulators allowed for the adjustment of the inspiratory pause. This parameter is fundamental for the evaluation of the respiratory mechanics, and it is necessary for the measurement of the plateau pressure, which is used in the calculation of compliance, airway resistance, and driving pressure [19].

The real-time cycle-to-cycle monitoring of the flow, volume, and pressure curves, in addition to pressure-volume and volume-flow loops, allows the collection of qualitative data and the accurate calculation of the airflow resistance and compliance of the respiratory system. A differential in the simulators Evita Trainer XL, Hamilton G5, and Xlung is the option pressure × volume and flow × volume loops. Its qualitative analysis allows the diagnosis of problems on respiratory mechanics [42,43].

This study has limitations. It is impossible to be completely sure about not including other existing virtual simulator in this study. However, we believe to have included the most important MVVS considering our thorough search methodology. Great effort was made to reduce the bias of favoring Xlung as we acknowledge that there are conflicts of interest regarding the authors. However, in an attempt to minimize these conflicts, we performed a usability test of all simulators by independent *experts* on MV. Considering that MV is a very complex type of support, we also recognize that only a limited number of relatively simple tasks and scenarios were tested for usability assessment and the number of experts was small. Even so, important and significant differences among the MVVS were detected.

The present work has practical important implications. We now emphasize that, as a tool to MV teaching, the ideal MVVS should offer the following features: facilitate and stimulate the comprehension of the MV handling through the following characteristics: easiness to access, good usability, capability of reproducing the most common scenarios found in practice, have a friendly interface, and allow the user to create, save, and share simulations. To develop a good MVVS, it is necessary to elaborate a design focusing the different types of users, both teachers and students. Training MV with MVVS is essential for students, as it provides them with the opportunity to practice in a safe environment, where MV can be handled reproducing the real life scenarios, with no risks for the user or, even more importantly, for the patients.

Although promising, versatile, and far-reaching it is important to recognize that the use of MVVS as both a computer-assisted learning and a simulation technique, it may still have high costs because the need for technical support from software programmers and critical care specialists consultation and training of faculties. Expand this kind of learning requires cultural changes, planning, financing, multidisciplinary work, and effective quality control [15,44].

Conclusion

In conclusion, there are only a few MVVS currently available. Among them, the Xlung showed a better usability interface. Validation tests and development of new or improvement of the current MVVS are needed.

Conflicts of Interest

The author Marcelo Alcantara Holanda is the owner of the Xlung software platform. The authors Andrea Kelly Carvalho and Marcelo Emanoel Bezerra Diniz work in the Xlung Company. The other authors Juliana Arcanjo Lino, Luiza Gabriela de Carvalho Gomes Frota, Nancy Delma Silva Vega Canjura Sousa, and Antonio Brazil Viana Júnior have no competing interests.

Multimedia Appendix 1

Tasks assessed by the users while handling a MVVS, simulating invasive MV scenarios.

[PDF File (Adobe PDF File), 9KB - mededu_v2i1e8_app1.pdf]

Multimedia Appendix 2

Tasks assessed by the users while handling a MVVS, simulating non-invasive MV scenarios.

[PDF File (Adobe PDF File), 9KB - mededu_v2i1e8_app2.pdf]

Multimedia Appendix 3

Usability test with 10 heuristic principles.

[PDF File (Adobe PDF File), 47KB - mededu_v2i1e8_app3.pdf]

Multimedia Appendix 4

Visual Analog Scale to evaluate easiness to use MVVS.

[PDF File (Adobe PDF File), 86KB - mededu_v2i1e8_app4.pdf]

Multimedia Appendix 5

The main characteristics of the MVVS.

[PDF File (Adobe PDF File), 14KB - mededu_v2i1e8_app5.pdf]

References

1. Singh PM, Borle A, Trikha A. Newer nonconventional modes of mechanical ventilation. J Emerg Trauma Shock 2014 Jul;7(3):222-227 [FREE Full text] [doi: 10.4103/0974-2700.136869] [Medline: 25114434]
2. Suarez-Sipmann F, Acute Respiratory Failure Working Group of the SEMICYUC. New modes of assisted mechanical ventilation. Med Intensiva 2014 May;38(4):249-260 [FREE Full text] [doi: 10.1016/j.medin.2013.10.008] [Medline: 24507472]
3. Al-Hegelan M, MacIntyre NR. Novel modes of mechanical ventilation. Semin Respir Crit Care Med 2013 Aug;34(4):499-507. [doi: 10.1055/s-0033-1351123] [Medline: 23934718]
4. Carvalho CRR, Junior CT, Franca SA. III Brazilian Consensus on Mechanical Ventilation. J Bras Pneumol 2007 Jul;33:54-70.
5. Cox CE, Carson SS, Ely EW, Govert JA, Garrett JM, Brower RG, et al. Effectiveness of medical resident education in mechanical ventilation. Am J Respir Crit Care Med 2003 Jan 1;167(1):32-38. [doi: 10.1164/rccm.200206-624OC] [Medline: 12406827]
6. Richard J, Kacmarek RM. ICU mechanical ventilators, technological advances vs. user friendliness: the right picture is worth a thousand numbers. Intensive Care Med 2009 Oct;35(10):1662-1663. [doi: 10.1007/s00134-009-1581-6] [Medline: 19639301]
7. Vignaux L, Tassaux D, Jolliet P. Evaluation of the user-friendliness of seven new generation intensive care ventilators. Intensive Care Med 2009 Oct;35(10):1687-1691. [doi: 10.1007/s00134-009-1580-7] [Medline: 19639302]
8. Wilcox SR, Seigel TA, Strout TD, Schneider JI, Mitchell PM, Marcolini EG, et al. Emergency medicine residents' knowledge of mechanical ventilation. J Emerg Med 2015 Apr;48(4):481-491. [doi: 10.1016/j.jemermed.2014.09.059] [Medline: 25497896]
9. Wax RS, Kenny L, Burns P. Educating providers of mechanical ventilation: an update. Curr Opin Crit Care 2006 Feb;12(1):61-66. [Medline: 16394786]
10. McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ. A critical review of simulation-based medical education research: 2003-2009. Med Educ 2010 Jan;44(1):50-63. [doi: 10.1111/j.1365-2923.2009.03547.x] [Medline: 20078756]
11. Maran NJ, Glavin RJ. Low- to high-fidelity simulation - a continuum of medical education? Med Educ 2003 Nov;37 Suppl 1:22-28. [Medline: 14641635]
12. Beaubien JM, Baker DP. The use of simulation for training teamwork skills in health care: how low can you go? Qual Saf Health Care 2004 Oct;13 Suppl 1:i51-i56 [FREE Full text] [doi: 10.1136/qhc.13.suppl_1.i51] [Medline: 15465956]
13. Murphy JG, Cremonini F, Kane GC, Dunn W. Is simulation based medicine training the future of clinical medicine? Eur Rev Med Pharmacol Sci 2007;11(1):1-8. [Medline: 17405343]
14. McGaghie WC, Issenberg SB, Cohen ER, Barsuk JH, Wayne DB. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. Acad Med 2011 Jun;86(6):706-711 [FREE Full text] [doi: 10.1097/ACM.0b013e318217e119] [Medline: 21512370]
15. Schurink CA, Lucas PJ, Hoepelman IM, Bonten MJ. Computer-assisted decision support for the diagnosis and treatment of infectious diseases in intensive care units. Lancet Infect Dis 2005 May;5(5):305-312. [doi: 10.1016/S1473-3099(05)70115-8] [Medline: 15854886]
16. Clemmer TP. Computers in the ICU: where we started and where we are now. J Crit Care 2004 Dec;19(4):201-207. [doi: 10.1016/j.jcrc.2004.08.005] [Medline: 15648035]
17. Mariani AW, Pêgo-Fernandes PM. Medical education: simulation and virtual reality. Sao Paulo Med J 2011 Dec;129(6):369-370 [FREE Full text] [Medline: 22249791]
18. Costa e Silva J, Kawamoto LTJ. Development of a 3D simulator of a cardiopulmonary interaction with positive pressure. 2013 Jun 12 Presented at: Proceedings of 10th International Conference on Information Systems and Technology Management (CONTECSI); Jun; 2013; São Paulo, 2013 p. 12-14.
19. Barbas CSV, Isola AM, Farias AMC, Cavalcanti AB, Gama AMC, Duarte ACM, et al. Brazilian recommendations of mechanical ventilation 2013. Part I. Rev Bras Ter Intensiva 2014 Apr-Jun 2014 Apr;26(2):89-121. [doi: 10.5935/0103-507X.20140017]
20. Ypinazar VA, Margolis SA. Clinical simulators: applications and implications for rural medical education. Rural Remote Health 2006;6(2):527 [FREE Full text] [Medline: 16764503]

21. Katre D, Bhutkar G, Karmarkar S. Usability Heuristics Qualitative Indicators for the Usability Evaluation of Touch Screen Ventilator Systems. In: Katre D, Orngreen R, Yammiyavar P, Clemmensen T, editors. Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts: Second IFIP WG 13.6 Conference, HWID 2009, Pune, India, October 7-8, 2009, Revised Selected Papers. v. 316. Berlin: Springer; 2010:83-97.
22. Gonzalez-Bermejo J, Laplanche V, Husseini FE, Duguet A, Derenne JP, Similowski T. Evaluation of the user-friendliness of 11 home mechanical ventilators. Eur Respir J 2006 Jun;27(6):1236-1243 [FREE Full text] [doi: 10.1183/09031936.06.00078805] [Medline: 16481386]
23. Usability Net. International standards for HCI and usability URL: http://www.usabilitynet.org/tools/r_international.htm [accessed 2016-04-24] [WebCite Cache ID 6gzmjNMFl]
24. Nielsen J. Nielsen Norman Group. 10 Usability Heuristics for User Interface Design URL: https://www.nngroup.com/articles/ten-usability-heuristics/ [accessed 2016-04-24] [WebCite Cache ID 6gzpbbGDD]
25. National Health Council, Brazil. Resolution No 466, 2012, Section 1. 2013. Guidelines and Regulatory Standards of research involving human subjects URL: http://www.conselho.saude.gov.br/resolucoes/2012/Reso466.pdf [accessed 2016-06-07] [WebCite Cache ID 6i78pD5nY]
26. Holanda MA, Filho ML, Reis RC, Rangel D, Alcantara DM, Oliveira NH, et al. Efficacy of a computer simulator program (XlungTM) for teaching mechanical ventilation in complex clinical scenarios to medical students. In: Am J Respir Crit Care. 2012 Presented at: American Thoracic Society International Conference; May 12-23, 2012; San Francisco p. A1610. [doi: 10.1164/ajrccm-conference.2012.185.1_MeetingAbstracts.A1610]
27. NetMBA. 2010. Market Analysis URL: http://www.netmba.com/marketing/market/analysis/ [accessed 2016-04-24] [WebCite Cache ID 6gznZvA4I]
28. Nielsen J, Molich R. Heuristic Evaluation of user interfaces. 1990 Presented at: Proceedings of ACM CHI '90 Conference; Apr 1-5, 1990; Seattle, WA.
29. Nielsen J. Finding usability problems through heuristic evaluation. 1992 Presented at: Proceedings of the ACM CHI 92 Human Factors in Computing Systems Conference; June 3-7, 1992; Monterey, CA.
30. Jeffries R, Miller J, Wharton C, Uyeda K. User interface evaluation in the real world: a comparison of four techniques. 1991 Presented at: Proceedings of ACM CHI ´91 Conference; Apr 27-May 2, 1991; New Orleans, LA.
31. Davids MR, Chikte UM, Halperin ML. An efficient approach to improve the usability of e-learning resources: the role of heuristic evaluation. Adv Physiol Educ 2013 Sep;37(3):242-248 [FREE Full text] [doi: 10.1152/advan.00043.2013] [Medline: 24022770]
32. Graham MJ, Kubose TK, Jordan D, Zhang J, Johnson TR, Patel VL. Heuristic evaluation of infusion pumps: implications for patient safety in Intensive Care Units. Int J Med Inform 2004 Nov;73(11-12):771-779. [doi: 10.1016/j.ijmedinf.2004.08.002] [Medline: 15491928]
33. Zhang J, Johnson TR, Patel VL, Paige DL, Kubose T. Using usability heuristics to evaluate patient safety of medical devices. J Biomed Inform 2003;36(1-2):23-30 [FREE Full text] [Medline: 14552844]
34. Chan AJ, Islam MK, Rosewall T, Jaffray DA, Easty AC, Cafazzo JA. Applying usability heuristics to radiotherapy systems. Radiother Oncol 2012 Jan;102(1):142-147. [doi: 10.1016/j.radonc.2011.05.077] [Medline: 21733590]
35. Bond RR, Finlay DD, Nugent CD, Moore G, Guldenring D. A usability evaluation of medical software at an expert conference setting. Comput Methods Programs Biomed 2014;113(1):383-395. [doi: 10.1016/j.cmpb.2013.10.006] [Medline: 24210868]
36. Jaspers Monique W M. A comparison of usability methods for testing interactive health technologies: methodological aspects and empirical evidence. Int J Med Inform 2009 May;78(5):340-353. [doi: 10.1016/j.ijmedinf.2008.10.002] [Medline: 19046928]
37. Hudson J, Nguku SM, Sleiman J, Karlen W, Dumont GA, Petersen CL, et al. Usability testing of a prototype Phone Oximeter with healthcare providers in high- and low-medical resource environments. Anaesthesia 2012 Sep;67(9):957-967 [FREE Full text] [doi: 10.1111/j.1365-2044.2012.07196.x] [Medline: 22861503]
38. Johnson CM, Johnson TR, Zhang J. A user-centered framework for redesigning health care interfaces. J Biomed Inform 2005 Feb;38(1):75-87 [FREE Full text] [doi: 10.1016/j.jbi.2004.11.005] [Medline: 15694887]
39. Laghi F, Segal J, Choe WK, Tobin MJ. Effect of imposed inflation time on respiratory frequency and hyperinflation in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2001 May;163(6):1365-1370. [doi: 10.1164/ajrccm.163.6.2001123] [Medline: 11371402]
40. Iotti GA, Brunner JX, Braschi A, Laubscher T, Olivei MC, Palo A, et al. Closed-loop control of airway occlusion pressure at 0.1 second (P0.1) applied to pressure-support ventilation: algorithm and application in intubated patients. Crit Care Med 1996 May;24(5):771-779. [Medline: 8706452]
41. Muza SR, Silverman MT, Gilmore GC, Hellerstein HK, Kelsen SG. Comparison of scales used to quantitate the sense of effort to breathe in patients with chronic obstructive pulmonary disease. Am Rev Respir Dis 1990 Apr;141(4 Pt 1):909-913. [doi: 10.1164/ajrccm/141.4_Pt_1.909] [Medline: 2327655]
42. Shapiro R, Kacmarek R. Monitoring of the mechanically ventilated patient. In: Marini JJ, Slutsky AS, editors. Physiological basis of ventilatory support. New York: Marcel Dekker; 1998:709-777.

43. Lucangelo U, Bernabé F, Blanch L. Respiratory mechanics derived from signals in the ventilator circuit. Respir Care 2005 Jan;50(1):55-65; discussion 65-7 [FREE Full text] [Medline: 15636645]
44. Greenhalgh T. Computer assisted learning in undergraduate medical education. BMJ 2001 Jan 6;322(7277):40-44 [FREE Full text] [Medline: 11141156]

Abbreviations

ABG: arterial blood gases
ARDS: acute respiratory distress syndrome
FIO2: fraction of inspired oxygen
IBW: ideal body weight
ICU: intensive care unit
MV: mechanical ventilation
MVVS: mechanical ventilation virtual simulators
NIV: noninvasive ventilation
VAS: Visual Analog Scale
SpO2: pulse oxygen saturation

Edited by G Eysenbach; submitted 17.02.16; peer-reviewed by P Jouvet, R Kleinert; comments to author 25.03.16; revised version received 05.05.16; accepted 19.05.16; published 14.06.16.

Please cite as:
Lino JA, Gomes GC, Sousa NDSVC, Carvalho AK, Diniz MEB, Viana Junior AB, Holanda MA
A Critical Review of Mechanical Ventilation Virtual Simulators: Is It Time to Use Them?
JMIR Med Educ 2016;2(1):e8
URL: http://mededu.jmir.org/2016/1/e8/
doi:10.2196/mededu.5350
PMID:27731850

Publisher:
JMIR Publications
130 Queens Quay East.
Toronto, ON, M5A 3Y5
Phone: (+1) 416-583-2040
Email: support@jmir.org