‘How and Why’ Working Group Report

eLearning initiatives, faculty development and current uses of eLearning technology by students and faculty in UMPE, PGME, CPD, Rehabilitation Sciences and Graduate Studies at the University of Toronto.

A scoping literature review to identify key trends, issues and priorities in eLearning.

For the eLearning Task Force, University of Toronto
January 2015

Prepared by Lisa St. Amant

Membership

Dr. Jay Rosenfield, Vice-Dean, Undergraduate Medical Professions Education (Group Co-Lead)

Dr. Marcus Law, Deputy Pre-Clerkship Director, Undergraduate Medical Education (Group Co-Lead)

Nathan Bugden, eLearning Resources Educator, St. Joseph's Health Centre

Dr. Maureen Gottesman, Medical Director, Physician Assistant Program

Susan Glover Takahashi PhD, Director, Education and Research, Postgraduate Medical Education

Judith Hunter PhD, Dept. of Physical Therapy

Shamena Maharaj, Organizational Development Associate, Sunnybrook Health Sciences

Joyce Nyhof-Young PhD, Curriculum Evaluation Coordinator, Undergraduate Medical Education

Dr. Jonathan Ailon, Clinical Associate, St. Michael's Hospital

Christopher Townsend, Director of eLearning and LMS, Sunnybrook Health Sciences

'How and Why' Working Group Report

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Objectives and Strategy

A. Objectives of the eLearning Task Force and the 'How and Why' Working Group

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2. 'How and Why' Working Group Objectives:

    The 'How and Why' working group is focused on examining the current integration of eLearning across the Faculty of Medicine, particularly in terms of process, content, design, implementation and platforms.

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1. Perform an inventory of e-learning initiatives in UMPE, (MRS, PA, UME), PGME, CPD, Rehab.[1] School of Graduate Studies (SGS) and Faculty Development at the University of Toronto.

2. Identify how students and faculty currently use technology in learning/teaching, and their future needs through learner focus groups and a faculty-wide survey, respectively.

3. Conduct a scoping review of literature.

[1] UMPE = undergraduate medical professions education; MRS = medical radiation sciences; PA = Physician Assistant; UME = undergraduate medical education; PGME = postgraduate medical education; CPD = continuing professional development.

eLearning Initiatives, Faculty Development and Perceived Utility of eLearning

A survey of eLearning initiatives, faculty development and current uses of eLearning technology by faculty in UMPE, PGME, CPD, Rehabilitation Sciences and Graduate Studies at the University of Toronto

Faculty Survey Report

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SECTION 2. METHODOLOGY

A. Faculty Survey Instrument

1. Instrument Design

A survey instrument was designed by the working group, having received input and feedback from the eLearning Task Force, to capture eLearning initiatives developed; faculty use of and perspectives on eLearning technologies and barriers to the implementation and development of eLearning resources. Survey questions consisted of a combination of open and closed questions. The majority of close-ended questions used 5-point agreement and frequency Likert response scales (Strongly Agree to Strongly Disagree and Always to Never response scales, respectively), while others used categorical response scales (Yes, No, I don't know). Survey questions included asking participants to rate the utility of different eLearning tools in enabling teaching, descriptive questions on eLearning initiatives developed by participants and degree of support (funding, human resources) from the university, hospital and their program/department/unit.

[2] UMPE = undergraduate medical professions education; MRS = medical radiation sciences; PA = Physician Assistant; UME = undergraduate medical education; PGME = postgraduate medical education; CPD = continuing professional development.

2. Participant Recruitment

A combination of purposive and snowball sampling strategies were used to form the recruitment pool. Individuals were sought for their involvement in eLearning initiatives with the aid of the eLearning Task Force and survey participants. Survey respondents were also asked to provide us with names of additional individuals whose participation would be valuable. The total recruitment pool (N=67) thus consisted of the group purposively sought for their engagement in eLearning (N=56) and those referred to the working group (N=11).

3. Data Collection and 'Clean Up'

Survey data was imported into Excel 2010 software to be cleaned up for analysis. Response scales were recoded into numerical values for descriptive statistical analysis purposes (Appendix A). Survey question data were reorganized to facilitate analysis (primarily with regard to numbering and subtle grouping changes; see Appendix A).

4. Analysis

4.1. Treatment of Missing Data

After survey data was cleaned up, reorganized and recoded, it was analyzed using IBM SPSS Statistics version 20 software. About a third of the survey variables had at least 1 or more missing responses (28%; n=95), and survey data was incomplete for approximately half of the respondents (45%; n=29). However, there was a sparse number of missing values for most of the respondents, as only 38% of respondents with incomplete data (n=13) had two or more missing values. Hence, referring to Schlomer et. al. (2010) for best practices in data management, an analysis of missing values was conducted using SPSS and the MCAR chi-square test to determine whether the missing values were missing completely at random (see Appendix D).

An expectation maximization (EM) technique was used (Little MCAR chi-square test) in SPSS, with a resulting chi-square value of 5.78 and significance of 1.0. Thus, there was weak evidence against the null hypothesis that the data was missing completely at random.

Listwise deletion was not performed for item-non response, as this would reduce the already small sample size by 55%. Overall, the MCAR chi-square test and missing value pattern analysis showed that the data is likely to be missing at random and that there are no significant patterns present. There was not a large enough sample size to merit the replacement of missing values by maximum likelihood (ML) and multiple imputation (MI) methods, as this would introduce bias (Little and Rubin, 1989 and Rubin, 2007). As missing values were shown to be MCAR, the Expectation Maximization algorithm was used to replace missing values. This method has been shown to be more accurate than mean substitution and regression when using small sample sizes and with small proportions of missing data, typically at 2% or less (Rubin, 2007).

4.2. Analysis of Numerical Data

Descriptive statistics, frequency tables and bar charts were all used to summarize and identify trends in the data. Contingency tables were used to assess relationships, using Cramer's V to assess relationship strength if present. Overall, the sample size was too low to draw any meaningful group comparisons, therefore analysis is primarily descriptive. An α value of 0.5 was used for all statistical tests (C.I. of 95%), with $p < 0.5$ considered as statistically significant.

4.3. Analysis of Free Text Data

Qualitative data from the open-ended survey questions were imported into NVivo version 10 software for data organization and analysis. Data intimacy was achieved by reading through the responses, while contributing to analytic memos. A coding scheme was developed around the questions of interest. Using a content analysis method, the data were iteratively coded, and grouped into major themes.

SECTION 3. RESULTS AND DISCUSSION

A. Faculty Survey Response Rate and Participant Summary

A total of 30 faculty member responded to the survey, resulting in a response rate of 45% (n=67). The majority of these participants were from the targeted recruitment list (83%; 25), and 17% were from referrals by these targeted survey participants (5). One response was missing values for all survey variables, thus was deleted from the sample resulting in 29 survey entries to analyze.

There is comparable departmental representation in the survey respondent pool to that of the recruitment list, namely for the top three departments of Medicine, Anesthesia and Pediatrics (table 1). The Departments of Family Medicine and Community Medicine and Rehabilitation Sciences, however, are over and underrepresented in the survey results, respectively. Most of the faculty surveyed are primarily affiliated with the Sunnybrook Health Science Centre (17%, n=29). More survey respondents represent Undergraduate Medical Professions Education (31%; 9) than Postgraduate Medical Education (17%; 5). The majority of respondents are Assistant Professors (41%; 12).

Table 1. Most Represented Departments from Survey Results

Rank Order by Frequency	Department	Number of Respondents	Percentage of Respondents
1	Medicine	7	24%
2	Anesthesia	4	14%
2	Family Medicine and Community Medicine	4	14%
3	Pediatrics	3	10%
3	Surgery	3	10%

Table 2. Most Represented Departments from Recruitment List

Rank Order by Frequency	Department	Number of Respondents	Percentage of Respondents** **(n=56)**
1	Medicine	18	32%
2	Anesthesia	10	18%
2	Rehabilitation Sciences*	5	9%
3	Pediatrics	4	7%
3	Basic Sciences	4	7%

*Includes Occupational Science and Occupational Therapy and Physical Therapy.
**The denominator used was the total number of people recruited via the recruitment list (excludes referrals).

Table 3. Respondent Demographics by Primary Hospital Affiliation

Rank Order by Frequency	Primary Hospital Affiliation	Number of Respondents	Percentage of Respondents
1	Sunnybook Health Sciences Centre	5	17%
2	Hospital for Sick Children	4	14%
2	N/A	4	14%
3	Mount Sinai Hospital	3	10%

Table 4. Respondent Demographics by Education Portfolio

Rank Order by Frequency	Education Portfolio	Number of Respondents	Percentage of Respondents
1	N/A	10	35%
2	Undergraduate Medical Professions Education (UMPE)	9	31%
3	Postgraduate Medical Education (PME)	5	17%

Table 5. Respondent Demographics by University Appointment Status

Rank Order by Frequency	University Appointment Status	Number of Respondents	Percentage of Respondents
1	Assistant Professor	12	41%
2	Lecturer	6	21%
3	Professor	4	14%

B. Faculty Members' Perspectives on the Utility of eLearning in Enabling Teaching

1. Overview of Faculty Perspectives on eLearning

Overall, faculty responded very positively to questions regarding the perceived effectiveness and utility of eLearning resources and technology in providing for student's learning needs and for improving teaching quality and teacher experience. The majority of respondents (87%) feel that the use of eLearning has made teaching more interesting and that it has increased their satisfaction as a teacher (82%). Most (87%) are confident in using eLearning in their teaching and feel that it has improved their teaching effectiveness (76%) primarily by increasing teachers' ability to provide learning resources to students (97%); allowing teachers to tailor their teaching to student's needs (82%); and, to a lesser extent, by facilitating a greater interaction between students (69%).

2. Utility of eLearning Tools and Technologies in Enabling Teaching

2.1. Utility of eLearning Modalities in Enabling Teaching

Most Agreement: Tablets
Least Agreement: Avatars

Table 6. a)

Type of eLearning Modality	Learning Portal (Blackboard) course tools	Digital Media	Stand-alone videos	Webinars	Podcasts	Avatars
Mean	4.31	4.21	4.14	4	4.1	3.17
Median	4	4	4	4	4	3
Mode	4	4	4	4	4	3
Standard Deviation	0.85	0.819	0.742	0.707	0.673	1.071

Table 6. b)

Type of eLearning Modality	Virtual Patients	Augmented Reality	Interactive White Boards	Smart Phones	Tablets	Global Statistics
Mean	4.18	3.34	3.83	4.32	4.41	4.00
Median	4	3	4	4	4	3.82
Mode	4	3	4	4	4	3.82
Standard Deviation	0.71	0.67	0.711	0.601	0.568	0.74

2.2. Utility of Social Media Modalities in Enabling Teaching

Most Agreement: Media Sharing (e.g. YouTube, or Flickr)
Least Agreement: LinkedIn

Table 7.

Type of Social Media Modality	Facebook*	LinkedIn	Twitter	Blog and Online Forums	Bookmarking Sites	Social News Services	Media Sharing	Global Statistics
Mean	2.71	2.86	3.21	3.97	3.62	3.24	4.03	3.38
Median	3	3	3	4	4	3	4	3.43
Mode	3	3	3	4	4	3	4	3.43
Standard Deviation	0.881	0.953	0.86	0.778	0.677	0.511	0.68	0.76

*Facebook was originally in the "eLearning modality" category of the survey but is shown here with other social media modalities, for which I felt it was better suited.

2.3. Utility of Conferencing or Communication Tools in Enabling Teaching

Most Agreement: Web-based video conferencing (e.g. Adobe Connect, WebEx collaboration, Skype, Facetime, Ontario Telemedicine Network)
Least Agreement: Snapchat

Table 8. a)

Type of Conferencing or Communication Tool	Web-based video conferencing	Data Transfer systems	Short Service Messages (SMS)	iMessage	Blackberry Messenger (BBM)
Mean	4.48	4.61	3.14	3.07	2.93
Median	5	5	3	3	3
Mode	5	5	3	3	3
Standard Deviation	0.574	0.557	0.833	0.923	0.998

Table 8. b)

Type of Conferencing or Communication Tool	WhatsApp	Snapchat	Google Hangouts	Hospital-based secure messaging system	Global Statistics
Mean	2.9	2.72	3.28	3.17	3.37
Median	3	3	3	3	3.44
Mode	3	3	3	3	3.44
Standard Deviation	0.86	0.882	0.841	0.805	0.81

C. Current eLearning Initiatives in the Faculty of Medicine

1. Overview

In order of the frequency in which they were selected, undergraduate students (62%; 18), postgraduate trainees (52%; 15) and multidisciplinary health professionals (12; 41%) are the most targeted audiences for eLearning resources created in the Faculty of Medicine. The vast majority of eLearning resources mentioned by respondents (68%) have been created within the last 5 years (from 2010 up to and including 2014) and 51% have been developed in the last 3 years (from 2012 up to and including 2014). Regarding the types of eLearning initiatives being developed, all respondents described their resource as web-based and/or as possessing some online component. Most respondents (86%) have presented the eLearning resources they created, either at the departmental, hospital, university, provincial, national, or international level. Most (45%) responded that they did not have trouble sustaining their innovations past the pilot phase, while 31% said they did. It is important to consider, however, that this sample represents the perspectives of those already actively engaged in eLearning and so is not representative of the types of supports in place for eLearning at the university, department or hospital levels.

2. Types of eLearning Resources Being Created by Faculty

Table 11.

Type	Frequency by Respondent	Percent
Course	7	26.9%
Google Calendar	1	3.8%
Lecture series	1	3.8%
Module	7	26.9%
Online resource/tool	3	11.5%
Platform (mobile)	1	3.8%
Repository/Digital Database/Digital Archive	3	11.5%
Software	1	3.8%
VIC	1	3.8%
Video	1	3.8%
Total	26	100.0%

3. Most Exemplary eLearning Resources Created by Survey Respondents

Table 12.

Department/Program	Primary Hospital Affiliation	Most Exemplary eLearning Resources Created	Modality	Type
Anesthesia	Hospital for Sick Children	Anesthesia eLearning Clerkship Module Series	Web-based and Tablet based	Module
Anesthesia	Sunnybrook Health Sciences Centre	Anesthesia. Impacting Lives- Core Competencies for Undergraduates.	web-based	Module
Anesthesia	N/A	Undergraduate E-Module	Articulate/Hosted on the Portal	Module
Anesthesia	University Health Network	Virtual Interactive Case (VIC) system	Web and iPad	VIC
Family and Community Medicine	N/A	e PBL	Online learning through use of VPs	Module
Family and Community Medicine	North York General Hospital	Program-wide Google Calendars	Google Calendar- embedded in Blackbaord courses and website	Course
Family and Community Medicine	Toronto East General Hospital	Primary Care medicine 2 course	Web based	Google Calendar
Laboratory Medicine and Pathobiology	Sunnybrook Health Sciences Centre	National NP lecture series	web based Portal	Repository
Laboratory Medicine and Pathobiology	Mount Sinai Hospital	Digital Pathology Archive	Web-Based	Lecture series
Medicine	Mount Sinai Hospital	MedEngine	Web-based and mobile platform (iPad: only in pilot stage)	Website
Medicine	Bridgepoint Health	COIL(Collaborative online interprof learning) and Educational Technology course	see below	Course
Medicine	Sunnybrook Health Sciences Centre	EMRad: www.rad.utorontoeit.com	Web based	Repository
Medicine	Sunnybrook Health Sciences Centre	Sleep medicine modular course (in development)	Web based modular course	Platform (mobile)
Medicine	St. Michael's	CDA Guidelines Site (guidelines.diabetes.ca)	Web-based (desktop and mobile) and Mobile App (iOS and Android)	Module
Medicine	St. Michael's	Point of Care Ultrasound	Online Modules and Hands on training	Course
Occupational Science and Occupational Therapy	N/A	Online Orthotic Fabrication Videos	Web-based	Video
Paediatrics	Hospital for Sick Children	ART Accessible Resource for Teaching	web based	Online tool
Paediatrics	Hospital for Sick Children	Lab E-modules	web-based	Module
Paediatrics	Hospital for Sick Children	Pediatric Online Interactive Teaching in Rheumatology (POINTER)	web-based	Module
Pharmacology and Toxicology	N/A	Online course and Animation Series	Web based	Course
Physical Therapy	N/A	Canadian Health Care System for Internationally Educated PTs or Evidence Based Practice for Pediatric Therapists	Both are BB based	Course
Physiology	N/A	On-line sleep education resource	web-based	Course
Physiology	N/A	Fully interactive online course in Physiology	web based	Online resource
Surgery	N/A	Anatomy glove learning system	Web and worn glove	Software
Surgery	N/A	Digital Histology	Web	Repository
Surgery	N/A	Functional Neuroanatomy	Currently web-based, mobile version under construction	Course/ program (multimedia and interactive)

4. Target Audience for the eLearning Resources Created by Respondents*

Table 13.

Rank Order by Frequency	Target Audience	Number of Respondents	Percentage of Respondents
1	Undergraduate Students	18	62%
2	Postgraduate Trainees	15	52%
3	Multidisciplinary Health Professionals	12	41%
4	Continuing Education	11	38%
5	Faculty Development	6	21%

*This was a multiple response survey question, where respondents selected all applicable answers. The majority of respondents chose more than one response.

D. Challenges of eLearning Resource Development and Sustaining Innovation

Issues pertaining to infrastructure, such as a lack of funds, resources, support and time, were commonly reported in the open-ended questions regarding barriers to and funding and faculty support for eLearning development, as well as for difficulties in sustaining innovation. The below word cloud is a visual representation of this finding.

A word frequency query was performed (NVivo version 10) for responses to all open-ended questions (34, 41, 43, 45—see "Question Groupings" in Appendix). The query resulted in 742 words (4-letters and up).

A word cloud was created from the top 10% of word frequencies (74 words in total). The larger the word, the more frequent its presence was in the responses.

Table 14. Top 1% of Word Frequencies from Survey Questions 3

Word	Frequency	Percent of Total Words Used
online	17	0.68
teaching	18	0.72
need	19	0.76
modules	20	0.80
educational	22	0.88
eLearning	23	0.92
time	30	1.20
support	36	1.44
resources	44	1.76
funds	47	1.88
development	51	2.04

The majority of faculty respondents reported that they were the main developers, maintainers and funders of their eLearning projects. A total of 23 respondents (79%) reported that they either "sometimes", "most of the time" or "always" develop their eLearning resources themselves. 62% of respondents (18) report that they are responsible for the maintenance of eLearning resources either "most of the time" or "always". In

addition, most of the respondents reported that they are not reimbursed for working on eLearning projects, with 79% having responded that they work on them either "sometimes", "most of the time" or "always" during their personal time. 73% of faculty report that they self-fund their eLearning projects either "sometimes", most or all of the time (38% said "most of the time" or "always"). And yet, the majority of participant-developed eLearning resources do not generate revenue (72% responded "rarely" to "never"). Respondents from Physiology are the exception, with a median of 4 ("most of the time") and the distribution of responses being all above 3 ("sometimes").

Overall, respondents report not having adequate funding and resources for their eLearning projects from the university, their department/program or their hospital. 65% of respondents report that grants "rarely" to "never "support their projects financially. More people from PGME responded to having received grants (median response of 4) than from UGME (median response of 2, "rarely"). 66% of respondents report that they "rarely" to "never" receive support from the university or their university department, with no major differences between PGME and UGME. The departments of Pharmacology and Biochemistry report greater support than other departments with a median of response of 5 ("always").

Respondents also report challenges in working with the Discovery Commons, with 55% stating that they "rarely" to "never" use their services for the development of eLearning resources, and 17% reporting that they "sometimes" do and 62% reporting that they are "rarely" to "never" used for the up-keep or maintenance of eLearning resources developed (52% reported "never"). One of the participants commented:

> "I felt there was no real support from the University IT department without charges being incurred…asking the faculty who have experienced building these e-modules without the assistance of Discovery Commons would help in the building and the development of future eLearning resources."

SECTION 5. REFERENCES

Little RJA, Rubin DB. (1989). The analysis of social science data with missing values. Sociol Methods Res 18:292-326.

Rubin, LH. (2007). Methods for handling missing data in the behavioral neurosciences: don't throw the baby rat out with the bath water. The Journal of Undergraduate Neuroscience Education (JUNE). 5(2):A71-A77.

Schlomer GL, Bauman S, Card NA. (2010). Best practices for missing data management in counseling psychology. Journal of Counseling Psychology. 57(1):1-10.

SECTION 6. APPENDICES

A. Re-grouping of Survey Questions

Survey questions were grouped differently for analysis than in the survey

- **Columns 1-21:** Demographic Information

- **Q1-12:** To what extent do you agree that the following eLearning modality is useful to enable teaching? (**Strongly Disagree → Strongly Agree**)
    - Learning Portal (Blackboard); Digital media; Stand-alone videos; Webinars; Podcasts; Avatars; Virtual Patients; Augmented Reality; Interactive white boards; Smart phones; Tablets**; Facebook**

- **Q13-18**: To what extent do you believe the following social media modality is useful to enable teaching? (**Strongly Disagree → Strongly Agree**)
    - LinkedIn; Twitter; Blogs and online forums; Bookmarking Sites; Social News; Media Sharing

- **Q19-27**: To what extent do you believe the following conferencing or communication tool is useful to enable teaching? (**Strongly Disagree → Strongly Agree**)
    - Web-based video conferencing; Data transfer systems; SMS; iMessage; Blackberry Messenger; WhatsApp; Snapchat; Google Hangouts; Hospital-based secure messaging system

- **Q28-31**: Please briefly describe the most exemplary eLearning resource you have created (**Open ended**)
    - Title; Modality; Purpose; Year Launched

- **Q32:** Who is the target audience (Check all that apply) (**Multiple response**)
    - Undergrad students 1
    - Postgrad trainees 2
    - Multidisciplinary health prof 3
    - Faculty develop 4
    - Continuing education 5

- **Q33**: Has it been evaluated? (**Y/N/IDK**)
    - Yes; No; I don't know

- **Q34**: What were the barriers, if any, that you encountered when developing the eLearning resources? (**Open-ended**)

- **Q35**: To what extent do you agree with the following statements? (About eLearning)
    - I am confident in using eLearning as part of my teaching
    - Greater interaction between students occurs through use of eLearning

  - Use of eLearning has improved my teaching effectiveness
  - Use of eLearning has made teaching more interesting
  - Use of eLearning has enabled me to tailor my teaching
  - Use of eLearning has increased my satisfaction as a teacher
  - I belong to a community of educators that incorporates technology
  - The Faculty of Medicine supports its educators in developing eLearning teaching skills / resources (2 sep)

- **Q36:** How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? (**Never → Always**)
  - Course instructor or individual faculty
  - Course admin
  - Non-U of T commercial staff
  - U of T Discovery Commons
  - Students

- **Q37**: How often is each of the following business model used for the eLearning resources created by you? (**Never → Always**)
  - Generate revenue; freely available to the public; available freely for anyone in the department; available freely for anyone in the Faculty of Medicinel available within the teach event/course only

- **Q38**: How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you? (**Never → Always**)
  - Self-funded; Grants; Hospital department; University department

- **Q39:** How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? (**Never → Always**)
  - Hospital or Hospital department; University or university department; Grants; Not reimbursed, did during working hours; Not reimbursed, did during personal time
- **Q40**: Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? (**Never → Always**)
  - U of T Discovery Commons; Hospital; University Department; External Commercial Company; Students; I develop the resources myself

- **Q41:** If you have any comments about funding of eLearning resources at UofT, please enter it here (**Open ended**)

- **Q42:** Think about the eLearning resources you have created in the past. Have you ever had trouble sustaining the innovation past the initial pilot phase? (**Y, BC/N/IDK**)
  - Yes, because; No; I don't know

- **Q43:** Think about the eLearning resources you have created in the past. Have you ever had trouble sustaining the innovation past the initial pilot phase? (**Open ended**)

- **Q44:** Have you presented the eLearning resources you have created (at the departmental, hospital, university, provincial, national, or international level)? (**Y/N**)
    - Yes; No

- **Q45:** What could the Faculty of Medicine do to better support our faculty in using and/or developing eLearning resources? List changes you would like to see happen. (**Open ended**)

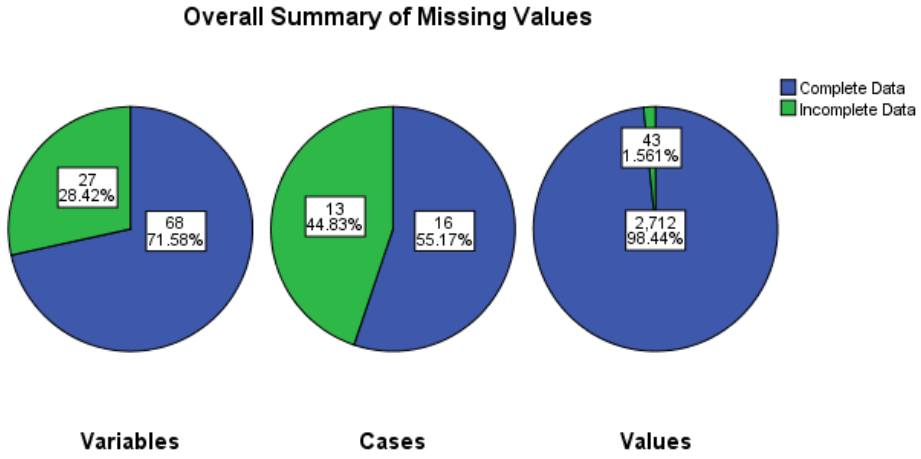
B. Re-coding of Survey Responses

Table 15.

Questions	Response	Code
1-27, 35 a-j	Strongly Disagree	1
	Disagree	2
	Neither Agree nor Disagree	3
	Agree	4
	Strongly Agree	5
32	Undergraduate Students	1
	Postgraduate Trainees	2
	Multidisciplinary Health Professionals	3
	Faculty Development	4
	Continuing Education	5
33	Yes	1
	No	2
36-40	Never	1
	Rarely	2
	Sometimes	3
	Most of the time	4
	Always	5
42	Yes, because	1
	No	2
	I Don't Know	3
44	Yes	1
	No	2
	I Don't Know	3

C. Analysis of Missing Data

Chart 1.



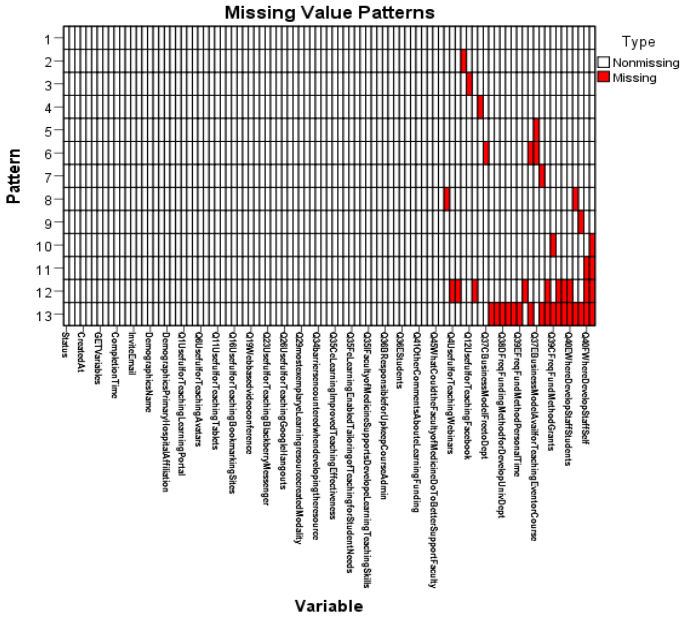
* Minimum percentage of missing values for variable to be included: 0.01%

**Variables refer to survey questions; Cases refer to subjects or participants; Values refer to proportion of total data values missing, where total number of values equals total number of cases x total number of variables

3.2. Missing Value Pattern Analysis

Chart 2.

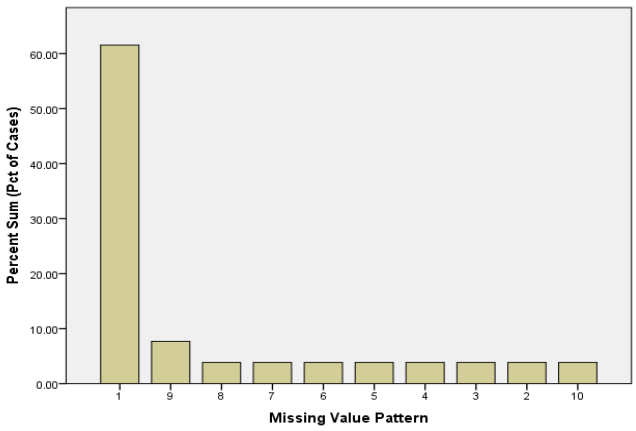
a.



a. This graph lists the variables along the x-axis in order of least (left) to greatest (right) frequency of missing data. Each pattern corresponds to a group of cases with the same pattern of incomplete and complete data.

No monotonicity was observed, indicative that there's likely no underlying structure to the missing data in the survey.

b.



The 10 most frequently occurring patterns are shown in the chart.

b. This bar graph shows the 10 most frequently occurring patterns by percentage of respondents

The most common pattern (1), at over 60%, pertains to cases without any missing values. The second most common pattern (9) involves less than 10% of cases. The remaining patterns are all roughly equal in prevalence and each only account for approximately 5% of cases.

D. Frequency Tables – Demographics and Faculty Use of eLearning Tools and Modalities

]Table 16. Department/Program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Anesthesia	4	13.8	13.8	13.8
	Biochemistry	1	3.4	3.4	17.2
	Family and Community Medicine	4	13.8	13.8	31.0
	Laboratory Medicine and Pathobiology	2	6.9	6.9	37.9
	Medicine	7	24.1	24.1	62.1
	Occupational Science and Occupational Therapy	1	3.4	3.4	65.5
	Paediatrics	3	10.3	10.3	75.9
	Pharmacology and Toxicology	1	3.4	3.4	79.3
	Physical Therapy	1	3.4	3.4	82.8
	Physiology	2	6.9	6.9	89.7
	Surgery	3	10.3	10.3	100.0
	Total	29	100.0	100.0	

Table 17. Primary Hospital Affiliation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		7	24.1	24.1	24.1
	Bridgepoint Health	1	3.4	3.4	27.6
	Hospital for Sick Children	4	13.8	13.8	41.4
	Mount Sinai Hospital	3	10.3	10.3	51.7
	N/A	4	13.8	13.8	65.5
	North York General Hospital	1	3.4	3.4	69.0
	St. Michael's	2	6.9	6.9	75.9
	Sunnybrook Health Sciences Centre	5	17.2	17.2	93.1
	Toronto East General Hospital	1	3.4	3.4	96.6
	University Health Network (includes the Toronto Western Hospital, Princess Margaret Hospital, Toronto General Hospital, and Toronto Rehabilitation Institute)	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 18. University Appointment Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	3.4	3.4	3.4
	Assistant professor	12	41.4	41.4	44.8
	Associate professor	3	10.3	10.3	55.2
	Lecturer	6	20.7	20.7	75.9
	N/A	2	6.9	6.9	82.8
	Professor	4	13.8	13.8	96.6
	Professor Emerita/Emeritus	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 19. Education Portfolio

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	10.3	10.3	10.3
	Graduate and Life Sciences Education (GLSE)	2	6.9	6.9	17.2
	N/A	10	34.5	34.5	51.7
	Postgraduate Medical Education (PME)	5	17.2	17.2	69.0
	Undergraduate Medical Professions Education (UMPE)	9	31.0	31.0	100.0
	Total	29	100.0	100.0	

Table 20. Q1 To what extent do you agree that the following eLearning modality is useful to enable teaching? Learning Portal (Blackboard) course tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	3	1	3.4	3.4	6.9
	4	14	48.3	48.3	55.2
	5	13	44.8	44.8	100.0
	Total	29	100.0	100.0	

Table 21. Q2 To what extent do you agree that the following eLearning modality is useful to enable teaching? Digital media (e.g. digital textbooks)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	3	1	3.4	3.4	6.9
	4	17	58.6	58.6	65.5
	5	10	34.5	34.5	100.0
	Total	29	100.0	100.0	

Table 22. Q3 To what extent do you agree that the following eLearning modality is useful to enable teaching? Stand-alone videos

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	3	10.3	10.3	13.8
	4	15	51.7	51.7	65.5
	4	1	3.4	3.4	69.0
	5	9	31.0	31.0	100.0
	Total	29	100.0	100.0	

Table 23. Q4 To what extent do you agree that the following eLearning modality is useful to enable teaching? Webinars

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	7	24.1	24.1	24.1
	4	14	48.3	48.3	72.4
	4	1	3.4	3.4	75.9
	5	7	24.1	24.1	100.0
	Total	29	100.0	100.0	

Table 24. Q5 To what extent do you agree that the following eLearning modality is useful to enable teaching? Podcasts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	5	17.2	17.2	17.2
	4	16	55.2	55.2	72.4
	5	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

Table 25. Q6 To what extent do you agree that the following eLearning modality is useful to enable teaching? Avatars (i.e. a character that represents an online user; Second Life, Sims Online)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	2	7	24.1	24.1	27.6
	3	11	37.9	37.9	65.5
	4	6	20.7	20.7	86.2
	5	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

Table 26. Q7 To what extent do you agree that the following eLearning modality is useful to enable teaching? Virtual patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	5	17.2	17.2	17.2
	4	13	44.8	44.8	62.1
	4	1	3.4	3.4	65.5
	5	10	34.5	34.5	100.0
	Total	29	100.0	100.0	

Table 27. Q8 To what extent do you agree that the following eLearning modality is useful to enable teaching? Augmented Reality (e.g. Aurasma)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	19	65.5	65.5	69.0
	4	7	24.1	24.1	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 28. Q9 To what extent do you agree that the following eLearning modality is useful to enable teaching? Interactive white boards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	10	34.5	34.5	34.5
	4	14	48.3	48.3	82.8
	5	5	17.2	17.2	100.0
	Total	29	100.0	100.0	

Table 29. Q10 To what extent do you agree that the following eLearning modality is useful to enable teaching? Smart phones

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	2	6.9	6.9	6.9
	4	15	51.7	51.7	58.6
	4	1	3.4	3.4	62.1
	5	11	37.9	37.9	100.0
	Total	29	100.0	100.0	

Table 30. Q11 To what extent do you agree that the following eLearning modality is useful to enable teaching? Tablets

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	3.4	3.4	3.4
	4	15	51.7	51.7	55.2
	5	13	44.8	44.8	100.0
	Total	29	100.0	100.0	

Table 31. Q12 To what extent do you agree that the following eLearning modality is useful to enable teaching? Facebook

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	6.9	6.9	6.9
	2	9	31.0	31.0	37.9
	3	1	3.4	3.4	41.4
	3	13	44.8	44.8	86.2
	4	3	10.3	10.3	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 32. Q13 To what extent do you believe the following social media modality is useful to enable teaching? LinkedIn

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	2	10	34.5	34.5	37.9
	3	12	41.4	41.4	79.3
	4	4	13.8	13.8	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 33. Q14 To what extent do you believe the following social media modality is useful to enable teaching? Twitter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	6	20.7	20.7	20.7
	3	12	41.4	41.4	62.1
	3	1	3.4	3.4	65.5
	4	8	27.6	27.6	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 34. Q15 To what extent do you believe the following social media modality is useful to enable teaching? Blog and online forums

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	6	20.7	20.7	24.1
	4	15	51.7	51.7	75.9
	5	7	24.1	24.1	100.0
	Total	29	100.0	100.0	

Table 35. Q16 To what extent do you believe the following social media modality is useful to enable teaching? Bookmarking Sites (e.g. Delicious and StumblesUpon) - Services that allow people to save, organize and manage links to various websites and internet resources. Most allow users to "tag" links to make them easy to search and share.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	11	37.9	37.9	41.4
	4	15	51.7	51.7	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 36. Q17 To what extent do you believe the following social media modality is useful to enable teaching? Social News (e.g. Digg and Reddit) - Services that allow people to post various news items or links to outside articles. Then the associated community "votes" on the items. Items gaining the most votes are displayed the most prominently and seen by more people.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	20	69.0	69.0	72.4
	4	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

Table 37. Q18 To what extent do you believe the following social media modality is useful to enable teaching? Media sharing (e.g. YouTube, Flickr) - Services that allow people to upload and share various media such as pictures and video. Most services have additional social features such as profiles, commenting, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	6	20.7	20.7	20.7
	4	16	55.2	55.2	75.9
	5	7	24.1	24.1	100.0
	Total	29	100.0	100.0	

Table 38. Q19 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Web-based video conferencing (e.g. Adobe Connect, WebEx collaboration, Skype, Facetime, Ontario Telemedicine Network)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	3.4	3.4	3.4
	4	13	44.8	44.8	48.3
	5	15	51.7	51.7	100.0
	Total	29	100.0	100.0	

Table 39. Q20 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Data transfer systems (e.g. FTP, DropBox, Google Drive, iCloud)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	3.4	3.4	3.4
	4	9	31.0	31.0	34.5
	5	1	3.4	3.4	37.9
	5	18	62.1	62.1	100.0
	Total	29	100.0	100.0	

Table 40. Q21 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Short Message Service (SMS)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	6	20.7	20.7	20.7
	3	15	51.7	51.7	72.4
	4	6	20.7	20.7	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 41. Q22 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? iMessage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	8	27.6	27.6	27.6
	3	14	48.3	48.3	75.9
	4	4	13.8	13.8	89.7
	5	3	10.3	10.3	100.0
	Total	29	100.0	100.0	

Table 42. Q23 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Blackberry Messenger (BBM)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	2	9	31.0	31.0	34.5
	3	13	44.8	44.8	79.3
	4	3	10.3	10.3	89.7
	5	3	10.3	10.3	100.0
	Total	29	100.0	100.0	

Table 43. Q24 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? WhatsApp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	2	7	24.1	24.1	27.6
	3	17	58.6	58.6	86.2
	4	2	6.9	6.9	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 44. Q25 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Snapchat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	10.3	10.3	10.3
	2	6	20.7	20.7	31.0
	3	17	58.6	58.6	89.7
	4	2	6.9	6.9	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 45. Q26 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Google Hangouts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	10.3	10.3	10.3
	3	19	65.5	65.5	75.9
	4	3	10.3	10.3	86.2
	5	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

Table 46. Q27 To what extent do you believe the following conferencing or communication tool is useful to enable teaching? Hospital-based secure messaging system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	5	17.2	17.2	17.2
	3	16	55.2	55.2	72.4
	4	6	20.7	20.7	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

E. Faculty eLearning Initiatives

Table 47. a) Q30 Please briefly describe the most exemplary eLearning resource you have created. | Purpose

Participant	Comment
1	1. CHC for IEPTs - to allow internationally educated PTs to understand practice in the Canadian Health care Context 2. To enhance pediatric PTs knowledge and skill in evidence based practice and to prepare for master level degree
2	An educational emergency medicine radiology database with a "how-to-read-it" portals
3	COIL- asyynchronous (atutorLMS, HTML/flash modules) and synchronous (eunity) collaborative case building for complex chronic disease learning in a team setting EduTech course- multimodality (adobe connect, wordpress, twitter, pepper)- for CE/masters level learners- "how to" use elearning within their teaching
4	Core rotation Anesthesia. Prior to Entry Simulation Day (hands on Simulation)
5	Histology teaching
6	National PGME and CME neuropathologic curriculum developed collaboratively to address educational gaps. Lectures are created and delivered at all 4 residency training sites, recorded using Camtasia, then uploaded to Portal site. Have been implemented into academic half day curricula at all 4 residency training programs, being viewed by many neuropathologists at CME.
7	On-line sleep education resource for undergrad, grad, post-grad, continuing and inter-professional education in sleep health. In Progress
8	Primary care medicine lectures with blogs, quizes and online weekly checkin
9	Provide a course for UG students who use it towards a transfer credit for their program or those second career students who need physiology as a prerequisite for admission into various health science programs

Table 47. b) Q30 Please briefly describe the most exemplary eLearning resource you have created. | Purpose	
Participant	Comment
10	Provide archive of whole slide images with appropriate clinical information
11	Serves multiple audiences for an unmet need in sleep medicine education.
12	Students watch online videos before coming to orthotic fabrication labs. Students also access videos with their laptop computer during lab as needed. Videos are also available to hand therapists.
13	Teach 3D structure and function of the hand
14	Teaching UoT medical students Anesthesia fluids, airway, pain, obstetrics, regional
15	The goal is to create a site that integrates learning resources and medical learners on a mobile digital platform that supports efficient collaborative learning and knowledge sharing.
16	The modules were created to replace the didactic seminars the clerks attended on their Anesthesia rotation. The emodules were been created as part of the flipped classroom model that Dr. Devito wanted implemented to improve the clerks experience whilst on their rotation with Anesthesia.
17	This digital neuroanatomy atlas enables students to learn clinically relevant neural systems in the context of their vascular supply. It is particularly useful for beginning students.
18	This is a tool for creating online problems for assessment of competency in clinical reasoning.
19	to allow each academic course to have its own calendar of events, and overlay with each other, so that one can look at all the courses at the same time, with all the detail necessary. (one simple example of many)
20	To expand our educational reach across different populations. To add and assist learning in the absence of an instructor and to help visualization of material
21	To hep dissemination of the 2013 CDA Guidelines. Utilized many different methods to disseminate the information
22	To provide a flexible resource to be used for faculty development for teaching
23	To provide portable didactic training on the basics of ultrasound
24	To teach basics of haematopathology, flow, specialized Haem testing, genetics to Paed Haem/Onc residents.
25	To teach certain clinical skills online through the use of VPs
26	web-based interactive teaching cases, simulator and resources to teach pediatric rheumatology to medical students and residents

Table 48. Q31 Please briefly describe the most exemplary eLearning resource you have created. | Year launched

Year Launched	Frequency	Percent	Valid Percent	Cumulative Percent
	3	10.3	10.3	10.3
2000	1	3.4	3.4	13.8
2001	1	3.4	3.4	17.2
2006	1	3.4	3.4	20.7
2008	2	6.9	6.9	27.6
2008, 2014	1	3.4	3.4	31.0
2010	2	6.9	6.9	37.9
2011	3	10.3	10.3	48.3
2012	5	17.2	17.2	65.5
2013	6	20.7	20.7	86.2
2014	3	10.3	10.3	96.6
in progress	1	3.4	3.4	100.0
Total	29	100.0	100.0	

Table 49. Q33 Has it been evaluated?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	55.2	55.2	55.2
	1	1	3.4	3.4	58.6
	1	1	3.4	3.4	62.1
	1	1	3.4	3.4	65.5
	1	1	3.4	3.4	69.0
	1	1	3.4	3.4	72.4
	2	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

F. Faculty Perspectives on eLearning

Table 50. Q35A To what extent do you agree with the following statements? | I am confident in using eLearning as part of my teaching.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	4	13.8	13.8	13.8
	4	10	34.5	34.5	48.3
	5	15	51.7	51.7	100.0
	Total	29	100.0	100.0	

Table 51. Q35B To what extent do you agree with the following statements? | Greater interaction between students occurs through the use of technology.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	8	27.6	27.6	31.0
	4	11	37.9	37.9	69.0
	5	9	31.0	31.0	100.0
	Total	29	100.0	100.0	

Table 52. Q35C To what extent do you agree with the following statements? | The use of eLearning has improved my teaching effectiveness.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	7	24.1	24.1	24.1
	4	11	37.9	37.9	62.1
	5	11	37.9	37.9	100.0
	Total	29	100.0	100.0	

Table 53. Q35D To what extent do you agree with the following statements? | The use of eLearning has increased my ability to provide learning resources to students.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	3.4	3.4	3.4
	4	11	37.9	37.9	41.4
	5	17	58.6	58.6	100.0
	Total	29	100.0	100.0	

Table 54. Q35E To what extent do you agree with the following statements? | The use of eLearning has made teaching more interesting for me.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	4	13.8	13.8	13.8
	4	10	34.5	34.5	48.3
	5	15	51.7	51.7	100.0
	Total	29	100.0	100.0	

Table 55. Q35F To what extent do you agree with the following statements? | The use of eLearning has enabled me to tailor my teaching to suit my students' training needs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	5	17.2	17.2	17.2
	4	12	41.4	41.4	58.6
	5	12	41.4	41.4	100.0
	Total	29	100.0	100.0	

Table 56. Q35G To what extent do you agree with the following statements? | The use of eLearning has increased my satisfaction as a teacher.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	3.4	3.4	3.4
	3	4	13.8	13.8	17.2
	4	12	41.4	41.4	58.6
	5	12	41.4	41.4	100.0
	Total	29	100.0	100.0	

Table 57. Q35H To what extent do you agree with the following statements? | I belong to a community of educators that incorporates technology into education.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.4	3.4	3.4
	2	1	3.4	3.4	6.9
	3	4	13.8	13.8	20.7
	4	11	37.9	37.9	58.6
	5	12	41.4	41.4	100.0
	Total	29	100.0	100.0	

Table 58. Q35I To what extent do you agree with the following statements? | The Faculty of Medicine supports its educators in developing eLearning teaching skills.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	13.8	13.8	13.8
	2	3	10.3	10.3	24.1
	3	6	20.7	20.7	44.8
	4	10	34.5	34.5	79.3
	5	6	20.7	20.7	100.0
	Total	29	100.0	100.0	

Table 59. Q35J To what extent do you agree with the following statements? | The Faculty of Medicine supports its educators in developing eLearning resources.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	10.3	10.3	10.3
	2	4	13.8	13.8	24.1
	3	5	17.2	17.2	41.4
	4	12	41.4	41.4	82.8
	5	5	17.2	17.2	100.0
	Total	29	100.0	100.0	

Table 60. Q36A How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? | Course instructor or individual faculty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	13.8	13.8	13.8
	2	3	10.3	10.3	24.1
	3	4	13.8	13.8	37.9
	4	10	34.5	34.5	72.4
	5	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

Table 61. Q36B How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? | Course administrators

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	27.6	27.6	27.6
	2	3	10.3	10.3	37.9
	3	7	24.1	24.1	62.1
	4	7	24.1	24.1	86.2
	5	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

Table 62. Q36C How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? | Non-UofT commercial staff

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	13	44.8	44.8	44.8
	2	4	13.8	13.8	58.6
	3	10	34.5	34.5	93.1
	4	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 63. Q36D How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? | UofT Discovery Commons

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	51.7	51.7	51.7
	2	3	10.3	10.3	62.1
	3	7	24.1	24.1	86.2
	4	3	10.3	10.3	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 64. Q36E How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you? | Students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	51.7	51.7	51.7
	2	7	24.1	24.1	75.9
	3	7	24.1	24.1	100.0
	Total	29	100.0	100.0	

Table 65. Q37A How often is each of the following business model used for the eLearning resources created by you? | The eLearning resources I created generate revenue

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	55.2	55.2	55.2
	2	5	17.2	17.2	72.4
	3	5	17.2	17.2	89.7
	4	1	3.4	3.4	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 66. Q37B How often is each of the following business model used for the eLearning resources created by you? | The eLearning resources I created are freely available to the public

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	12	41.4	41.4	41.4
	2	2	6.9	6.9	48.3
	3	7	24.1	24.1	72.4
	5	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

Table 67. Q37C How often is each of the following business model used for the eLearning resources created by you? | The eLearning resources I created are available freely for anyone in my department only

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	31.0	31.0	31.0
	3	1	3.4	3.4	34.5
	3	9	31.0	31.0	65.5
	4	4	13.8	13.8	79.3
	5	6	20.7	20.7	100.0
	Total	29	100.0	100.0	

Table 68. Q37D How often is each of the following business model used for the eLearning resources created by you? | The eLearning resources I created are available freely for anyone in the Faculty of Medicine only

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	3	1	3.4	3.4	27.6
	3	1	3.4	3.4	31.0
	3	13	44.8	44.8	75.9
	4	3	10.3	10.3	86.2
	5	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

Table 69. Q37E How often is each of the following business model used for the eLearning resources created by you? | The eLearning resources I created are available within the teaching event/course only

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	2	2	6.9	6.9	31.0
	3	6	20.7	20.7	51.7
	3	1	3.4	3.4	55.2
	3	1	3.4	3.4	58.6
	4	2	6.9	6.9	65.5
	5	10	34.5	34.5	100.0
	Total	29	100.0	100.0	

Table 70. Q38A How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you? | Self-funded

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	2	1	3.4	3.4	27.6
	3	9	31.0	31.0	58.6
	3	1	3.4	3.4	62.1
	4	5	17.2	17.2	79.3
	5	6	20.7	20.7	100.0
	Total	29	100.0	100.0	

Table 71. Q38B How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you? | Grants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	2	4	13.8	13.8	37.9
	3	1	3.4	3.4	41.4
	3	1	3.4	3.4	44.8
	3	7	24.1	24.1	69.0
	4	4	13.8	13.8	82.8
	5	5	17.2	17.2	100.0
	Total	29	100.0	100.0	

Table 72. Q38C How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you? | Hospital department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	55.2	55.2	55.2
	2	1	3.4	3.4	58.6
	2	5	17.2	17.2	75.9
	3	5	17.2	17.2	93.1
	4	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 73. Q38D How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you? | University department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	31.0	31.0	31.0
	2	3	10.3	10.3	41.4
	3	1	3.4	3.4	44.8
	3	9	31.0	31.0	75.9
	4	2	6.9	6.9	82.8
	5	5	17.2	17.2	100.0
	Total	29	100.0	100.0	

Table 74. Q39A How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? | My hospital or hospital department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	17	58.6	58.6	58.6
	2	1	3.4	3.4	62.1
	2	1	3.4	3.4	65.5
	2	4	13.8	13.8	79.3
	3	3	10.3	10.3	89.7
	4	2	6.9	6.9	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 75. Q39B How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? | My university or university department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	51.7	51.7	51.7
	2	3	10.3	10.3	62.1
	2	1	3.4	3.4	65.5
	3	3	10.3	10.3	75.9
	4	4	13.8	13.8	89.7
	5	3	10.3	10.3	100.0
	Total	29	100.0	100.0	

Table 76. Q39C How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? | Grants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	55.2	55.2	55.2
	2	1	3.4	3.4	58.6
	2	1	3.4	3.4	62.1
	2	3	10.3	10.3	72.4
	3	6	20.7	20.7	93.1
	4	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 77. Q39D How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? | Not reimbursed; Did within working hours

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	2	2	6.9	6.9	31.0
	3	8	27.6	27.6	58.6
	3	1	3.4	3.4	62.1
	4	6	20.7	20.7	82.8
	5	5	17.2	17.2	100.0
	Total	29	100.0	100.0	

Table 78. Q39E How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you? | Not reimbused; Did on personal time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	5	17.2	17.2	17.2
	3	8	27.6	27.6	44.8
	4	1	3.4	3.4	48.3
	4	6	20.7	20.7	69.0
	5	9	31.0	31.0	100.0
	Total	29	100.0	100.0	

Table 79. Q40A Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | UofT Discovery Commons

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	10	34.5	34.5	34.5
	2	5	17.2	17.2	51.7
	2	1	3.4	3.4	55.2
	3	5	17.2	17.2	72.4
	4	6	20.7	20.7	93.1
	5	2	6.9	6.9	100.0
	Total	29	100.0	100.0	

Table 80. Q40B Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | Hospital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	62.1	62.1	62.1
	2	1	3.4	3.4	65.5
	2	1	3.4	3.4	69.0
	2	1	3.4	3.4	72.4
	2	1	3.4	3.4	75.9
	2	2	6.9	6.9	82.8
	3	4	13.8	13.8	96.6
	4	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 81. Q40C Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | University department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	51.7	51.7	51.7
	2	1	3.4	3.4	55.2
	2	3	10.3	10.3	65.5
	2	1	3.4	3.4	69.0
	3	4	13.8	13.8	82.8
	4	4	13.8	13.8	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 82. Q40D Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | External commercial company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	51.7	51.7	51.7
	2	1	3.4	3.4	55.2
	2	3	10.3	10.3	65.5
	2	1	3.4	3.4	69.0
	3	4	13.8	13.8	82.8
	4	4	13.8	13.8	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 83. Q40E Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | Students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	24.1	24.1	24.1
	2	4	13.8	13.8	37.9
	2	1	3.4	3.4	41.4
	2	1	3.4	3.4	44.8
	3	14	48.3	48.3	93.1
	4	1	3.4	3.4	96.6
	5	1	3.4	3.4	100.0
	Total	29	100.0	100.0	

Table 84. Q40F Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources? | I develop the resources myself

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	13.8	13.8	13.8
	3	6	20.7	20.7	34.5
	4	1	3.4	3.4	37.9
	4	1	3.4	3.4	41.4
	4	1	3.4	3.4	44.8
	4	8	27.6	27.6	72.4
	5	8	27.6	27.6	100.0
	Total	29	100.0	100.0	

Table 85. Q42 Think about the eLearning resources you have created in the past. Have you ever had trouble sustaining the innovation past the initial pilot phase? (Y/N)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	31.0	31.0	31.0
	2	1	3.4	3.4	34.5
	2	1	3.4	3.4	37.9
	2	11	37.9	37.9	75.9
	3	7	24.1	24.1	100.0
	Total	29	100.0	100.0	

Table 86. Q44 Have you presented the eLearning resources you have created (at the departmental, hospital, university, provincial, national, or international level)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	25	86.2	86.2	86.2
	2	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

G. Descriptive Statistics

Table 87. Q35A to E: To what extent do you agree with the following statements?

	I am confident in using eLearning as part of my teaching	Greater interaction between students occurs through the use of technology	The use of eLearning has improved my teaching effectiveness	The use of eLearning has increased my ability to provide learning resources to students	The use of eLearning has made teaching more interesting for me
Mean	4.38	3.97	4.14	4.55	4.38
Median	5	4	4	5	5
Mode	5	4	4[a]	5	5
Std. Deviation	0.728	0.865	0.789	0.572	0.728
Skewness	-0.742	-0.286	-0.257	-0.829	-0.742
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434
Minimum	3	2	3	3	3
Maximum	5	5	5	5	5

a. Multiple modes exist. The smallest value is shown

Table 88. Q35 F to J: To what extent do you agree with the following statements?

	The use of eLearning has enabled me to tailor my teaching to suit my students' training needs	The use of eLearning has increased my satisfaction as a teacher	I belong to a community of educators that incorporates technology into education	The Faculty of Medicine supports its educators in developing eLearning teaching skills	The Faculty of Medicine supports its educators in developing eLearning resources
Mean	4.24	4.21	4.1	3.38	3.41
Median	4	4	4	4	4
Mode	4[a]	4[a]	5	4	4
Std. Deviation	0.739	0.819	1.012	1.321	1.24
Skewness	-0.426	-0.832	-1.329	-0.569	-0.634
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434
Minimum	3	2	1	1	1
Maximum	5	5	5	5	5

Table 89. Q36A to E: How often is each of the following responsible for the upkeep/maintenance of the eLearning resources created by you?

	Course instructor or individual faculty	Course administrators	Non-UofT commercial staff	UofT Discovery Commons	Students
Mean	3.52	2.86	2.03	2.03	1.72
Median	4	3	2	1	1
Mode	4	1	1	1	1
Std. Deviation	1.379	1.432	1.052	1.239	0.841
Skewness	-0.697	-0.054	0.323	0.778	0.58
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434
Minimum	1	1	1	1	1
Maximum	5	5	4	5	3

Table 90. Q37A to E: How often is each of the following business model used for the eLearning resources created by you?

	The eLearning resources I created generate revenue	The eLearning resources I created are freely available to the public	The eLearning resources I created are available freely for anyone in my department only	The eLearning resources I created are available freely for anyone in the Faculty of Medicine only	The eLearning resources I created are available within the teaching event/course only
Mean	1.9	2.66	2.93	2.89	3.22
Median	1	3	3	3	3
Mode	1	1	1[a]	3	5
Std. Deviation	1.235	1.675	1.51	1.291	1.589
Skewness	1.31	0.396	-0.07	-0.095	-0.213
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5

a. Multiple modes exist. The smallest value is shown

Table 91. Q38A to D: How often is each of the following funding method used to pay for the development (e.g. hardware, software, and/or staff) of the eLearning resources created by you?

	Self-funded	Grants	Hospital department	University department
Mean	3.07	2.85	1.75	2.68
Median	3	3	1	3
Mode	3	1[a]	1	1[a]
Std. Deviation	1.437	1.407	0.987	1.441
Skewness	-0.212	0.119	1.032	0.307
Std. Error of Skewness	0.434	0.434	0.434	0.434
Minimum	1	1	1	1
Maximum	5	5	4	5

a. Multiple modes exist. The smallest value is shown

Table 92. Q39A to E: How often does each of the following funding method support your time in the design, development, implementation, and/or evaluation of the eLearning resources created by you?

	My hospital or hospital department	My university or university department	Grants	Not reimbursed; Did within working hours	Not reimbused; Did on personal time
Mean	1.74	2.18	1.78	3	3.5
Median	1	1	1	3	4
Mode	1	1	1	3	5
Std. Deviation	1.121	1.465	1.012	1.414	1.402
Skewness	1.545	0.836	0.935	-0.165	-0.67
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434
Minimum	1	1	1	1	1
Maximum	5	5	4	5	5

Table 93. Q40A to F: Where do you usually find development staff (e.g. programmer, eLearning designer, videographer, etc.) to create your eLearning resources?

	U of T Discovery Commons	Hospital	University department	External commercial company	Students	I develop the resources myself
Mean	2.46	1.52	2	2	2.44	3.61
Median	2	1	1	1	3	4
Mode	1	1	1	1	3	4a
Std. Deviation	1.349	0.85	1.254	1.254	1.012	1.284
Skewness	0.363	1.609	0.934	0.937	0.052	-0.927
Std. Error of Skewness	0.434	0.434	0.434	0.434	0.434	0.434
Minimum	1	1	1	1	1	1
Maximum	5	4	5	5	5	5

Table 94. Major Themes from Open-Ended Response Questions 34, 41, 43, 45 (see "Question Groupings" in Appendix)

Major Themes	Blackboard issues	Lack of financial Support	Lack of Time	Lack of skilled labour
Description	-not appropriate LMS for hosting modules -doesn't support multi-media rich content -slow -glitches	-for resource development -for buying software, stock imagery -for video editing -for data gathering -for maintenance	-for developing content -no protected time to develop projects -creating storyline cases is time-consuming -better to spend time on augmentation then invention -would use students but trouble with commitment due to time constraints	-to work with software -to develop modules -for maintenance of resources -for tech support
Examples from Text	"[the need for]a better information management system than Blackboard-really."	"…my colleague and I have been working for free…"	"As always – time and money…" (regarding barriers)	"…having a team of support staff to assist medical staff transform content expertise into an interactive product"

eLearning Scoping Review

Insights from the evidence informing medical and health professions education

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Table of Contents

Section 1. Introduction

A. General overview of eLearning use in medical education

eLearning is an approach to engaging faculty of medicine learners in a form of education that applies technological approaches to teaching, learning and scholarship and may include asynchronous and synchronous learning and interactions, which assist in the communication of knowledge and skills and their development and exchange.[3]

A large component of eLearning is online learning, which includes live and webcast lectures, full or partial online courses, online simulation, video, etc. (Means et al., 2010). Online learning is praised mostly for its ability to improve access to learning materials and educational content, without the restrictions of time, space or distance (Means et al., 2010). The focus of online learning is to increase the type and number of learning opportunities, enable greater student participation without sacrificing educational quality and enable cost-efficient distribution of learning materials (Means et al., 2010).

While no single eLearning tool or strategy may be able to serve as a solution to all educational dilemmas, eLearning can add value to traditional educational methods (Cook and Triola, 2014). It is suggested that medical school, in particular, should not use solely online-learning methods, and that, rather, a blended learning approach should be adopted (Cook and Triola, 2014). The complexity of the curriculum demands a diversity of teaching and learning methods, only some of which include educational technology.

From an environmental scan and literature review on the impact of online learning on cost, productivity and quality of higher education in Ontario, online instruction was found to be at least as effective as face-to-face instruction (Carey and Trick, 2013). The benefits of online learning were found to be highly dependent upon learner characteristics, such as motivation (Carey and Trick, 2013). In a meta-analysis conducted by the United States Department of Education in 2010, that focused on best practices in online learning, blended or hybrid learning—in which online and face-to-face instruction were combined—was found to produce better learning outcomes than face-to-face instruction alone (Means et al., 2010). The results suggest, however, that improved learning outcomes are not necessarily reflective of any inherent benefits of the eLearning tool but, rather, may be a consequence of pedagogy and other factors associated with blended learning, in particular (Means et al., 2010). This is evidenced by the fact that fully online instruction and fully face-to-face instruction have equivalent effects on learning outcomes (Means et al., 2010).

The evidence base for eLearning methods and their utility in teaching and learning in higher education is not sufficiently robust and more research is required to fully elucidate potential benefits and challenges (Cook and Triola, 2014).

While future research is likely necessary, this scoping review aims to find evidence that informs the Faculty of Medicine in eLearning curricular design and strategic planning.

[3] Definition established by the eLearning Task Force

B. Overview of scoping review methodology

In order to perform a comprehensive search of the literature pertaining to the applications and outcomes of eLearning for education, a scoping review was conducted using the methodology outlined by Arksey and O'Malley (2005).

In comparison to systematic reviews, a scoping review attempts to address topics of interest in a broader fashion (Arksey & O'Malley, 2005). Scoping reviews do not attempt to answer specific research questions but, rather, provide a comprehensive overview of a topic. It does not attempt to assess the quality of evidence and, therefore, is not concerned with the weight of evidence (Arksey & O'Malley, 2005).

The scoping review methodology was, therefore, deemed suitable for collecting and summarizing research findings for application to medical education curriculum planning (Antman, et al., 1992).

The main phases of the methodology used for this scoping review were:

1. Identify the research question
2. Develop a search strategy for capturing literature relevant to the research question
3. Screen literature for inclusion
4. Chart the data, using a 'descriptive-analytical' method. The analytical framework was based on Schwab's algorithm for analyzing educational and curricular problems.[4]
5. Collate, summarize and report results

Schwab's algorithm (Schwab, 1973) was used in this eLearning scoping review to consider the insights each review article provided about:

1. **Learners**, e.g. who are the learners, features, familiarity with eLearning, likes/dislikes about eLearning
2. **Teachers**, e.g. who are the teachers, features, familiarity with eLearning, likes/dislikes about eLearning
3. **Subject Matter**: e.g. what is meant by eLearning, features of the eLearning subject matter
4. **eLearning Strategies:** e.g., where and how and types of teaching and learning methods and eLearning tools used or considered, and their associated outcomes

[4] Analytical framework: Medical education and curricular planning often follows the traditions of important educational writers such as Dewey, Tyler and Schwab. Dewey was one of the very early educational writers about the need and value of practical experience to learning. Tyler's educational scholarship popularized curriculum that employed learning by objectives and Schwab educational scholarship offered curricular planners an algorithm for analyzing educational and curricular problems by a careful understanding and consideration of the key elements of a curriculum: the learner, teacher, subject matter/content, milieu/context.

C. Objectives of the eLearning Task Force, 'How and Why' working group and eLearning Scoping Review

C1. eLearning Task Force Objectives

Make recommendations to the Faculty of Medicine (FOM) leadership at the University of Toronto (U of T) that will help position the FOM as a leader in eLearning (i.e., teaching, learning and scholarship) across the education continuum.

C2. 'How and Why' Working Group Objectives

i. Perform an inventory of e-learning initiatives in UMPE, (MRS, PA, UME), PGME, CPD, [5]Rehab, School of Graduate Studies (SGS) and Faculty Development at the University of Toronto.
ii. Identify how students and faculty currently use technology in learning/teaching, and their future needs.
iii. **Conduct a scoping review of literature**

eLearning Scoping Review Objectives

a. Conduct a focused literature review on eLearning as defined by the task force
b. To allow for evidence informed recommendations by the eLearning task force
c. Identify key trends, issues, priorities and strategies related to learners, teachers, subject matter, learning milieu for eLearning across the medical education continuum

[5] UMPE = undergraduate medical professions education; MRS = medical radiation sciences; PA = Physician Assistant; UME = undergraduate medical education; PGME = postgraduate medical education; CPD = continuing professional development.

Section 2. Methodology

This section provides methodological details on each of the main phases of the scoping review.

A. Identify the research question

This scoping literature review is part of the scope of the How and Why working group. The scope is to identify how students and faculty currently use technology in learning and teaching and their future needs. The research question, as defined by this working group, was:

How is eLearning being used and achieved?

B. Develop a search strategy for capturing relevant literature

1. With the assistance of a Medical Education Librarian, the research team:

    i. Reviewed the definition of eLearning:

    eLearning is an approach to engaging faculty of medicine learners in a form of education that applies technological approaches to teaching, learning and scholarship and may include asynchronous and synchronous learning and interactions, which assist in the communication of knowledge and skills and their development and exchange.

    ii. Scanned gathered documents
    iii. Drafted objectives of focused literature review
    iv. Planned for and drafted search strategy
    v. Conducted a preliminary search and refined the search strategy (See Appendix A for Draft 2 of search strategy – MEDLINE search)

2. Literature searches were conducted in MEDLINE, EMBASE and ERIC databases:
    i. A 5-year search period was chosen (2009-2013, inclusive), resulting in 275 references in total (171 from MEDLINE, 21 from ERIC and 83 from EMBASE)
    ii. Citations were imported into EndNote

C. Study selection: Primary Screening of Article Abstracts and Titles Only

1. Development of selection criteria: the research team developed the selection criteria for screening the 275 articles retrieved in the search (Appendix B).

2. Conducting calibration exercises: Two calibration exercises of 10 articles each were performed to further clarify and expand on the selection criteria and to reach consistency in screening.

3. Completing primary screening: The remaining 255 article abstracts and titles were screened using the refined inclusion criteria protocol (Appendix C).

4. Inventory of results of primary screening: A total of 78 articles met the inclusion criteria (28% inclusion rate).

D. Charting of data (data extraction)

The analytical framework was used to profile all included review articles. A survey instrument was developed using the online survey software Survey Monkey, and it was also used for the abstracting exercise performed by eight reviewers.

1. Abstracting survey instrument: An instrument for summarizing and abstracting the review articles was developed (Appendix D). The survey questions were modeled from the full text review of 10% of the included articles (8 randomly-selected articles in total).
   i. The resulting survey question themes were as follows (Appendix D):
      - Article information (author, publication year, databases searched, references, location, etc.)
      - Eligibility (i.e. does the article still meet the 3 inclusion criteria after reading the full text document?)
      - Conclusions about learners, teachers and subject matter as related to eLearning
      - eLearning strategies used and their outcomes
   ii. A sample abstraction of 3 articles tested the survey functionality and question clarity. Following discussion by the research team, minor adjustments were made to survey.

2. Abstracting protocol: An abstracting protocol was developed for reviewers participating in the abstracting exercise (Appendix E) that contained:
   i. An overview of the literature review and abstracting methodology
   ii. The primary screening criteria, to re-assess the full-text articles for inclusion
   iii. The abstracting survey link
   iv. Clarifications on the meaning and purpose of select survey questions

3. Article assignment: Eight reviewers were recruited to abstract the 78 articles (Appendix F). Each article was reviewed by 2 separate reviewers. Articles were assigned to reviewers in the following manner:
   All 78 citations were exported into Excel
   i. Articles were randomly assigned to reviewers
   ii. Articles were assigned so that each article would be abstracted twice, by two different reviewers
   iii. In total, 4 reviewers were assigned 19 articles and 4 reviewers were assigned 20. However, as were only able to obtain the full text documents for 74 of 78 articles, the four unattainable articles were eliminated from reviewer packages. In addition, one

   article was not abstracted due to having uploaded the incorrect full-text document to two of the reviewers' assigned packages, resulting in a total of 73 articles abstracted.

4. Abstracting timeline: Reviewers were given 3 weeks to complete the abstracting of their assigned articles and all survey results were imported into Excel for analysis.

5. Treatment of article agreements: Articles for which there was agreement in eligibility among both reviewers, either "Yes" or "No", were automatically included and excluded from the review, respectively.

6. Treatment of article disagreements: "Yes", "No" and "Maybe" article disagreements and "Maybe" agreements were reconciled by a third reviewer.
    i. When disagreements involved a member of the research team a different member served as the third reviewer.
    ii. All other disagreements were resolved by the lead research assistant, consulting the team as necessary.

7. Reviewer recommended articles: Reviewers were invited to recommend articles from their assigned pool that did not meet the primary screening criteria but that they viewed were still relevant to the scope of the review. A total of 9 articles were recommended by 3 reviewers. These articles were abstracted by the research team, resulting in the inclusion of 4 of the 9 articles for review.

    Recommended articles were only included if they did not qualify as *systematic* review articles but still met the other two screening criteria.

8. Abstracting results overview:

	Articles Included in Review		
	Number of Articles	Percent of Included Articles (n=32)	Percent of Total Articles (n=73)
Articles with Agreement Between Both Reviewers ("Yes")	24	75%	33%
Articles Included After Arbitration	8	25%	11%
Total Articles Included*	32	100%	44%

*Not including the 4 recommended articles by reviewers following the abstracting exercise

	Articles Excluded From Review		
	Number of Articles	Percent of Excluded Articles (n=41)	Percent of Total Articles (n=73)
Articles with Agreement Between Both Reviewers ("No")	18	44%	25%
Articles Excluded After Arbitration	23	56%	18%
Total Articles Excluded*	41	100%	56%

9. eLearning Task Force recommended articles:

    Members of the broader eLearning Task Force were invited to recommend articles that they felt were relevant to the scope of the review, with the aim of either using them in the analysis if having met the primary inclusion criteria, or informing the composition of the report, if not. A total of 7 articles were recommended, none of which were systematic reviews and 2 of which were outside the cut-off period of the past 5 years. Hence, not were included in the analysis.

E. Collate, summarize and report results

At each step and between the various iterations of collating, summarizing and preparation of reports the research team met and/or consulted to discuss concepts emerging from data, clarify definitions, etc.

The steps to collating, summarizing and preparing report results included:

1. Abstracting data was combined from both reviewers of each included articles.
2. Frequencies were determined for the multiple response survey questions (8, 10, 12 and 14) (Levac et al., 2010).
3. Reviewed data while making notes freely to attain data intimacy.
4. Descriptive codes assigned to text responses of open-ended survey questions (9, 11, 13 and 15).
5. Coded data from all four open-ended questions using the structure of analytical framework.
6. Maintained a codebook and memos to document the coding and analysis process, define codes and provide examples, etc.
7. An iterative content analysis approach was used for analysis.
8. Performed process of re-coding and re-grouping data until saturation was reached and themes emerged.
9. Initial significance of themes and patterns was determined mainly by their percentage representation in review articles.
10. Consensus meeting of reviewers to consider preliminary version of findings and summary.
11. Refinement of findings and summary for clarification.
12. Summary of analysis and findings distributed to reviewers for their input and feedback and request for recommendations that emerge from the findings.

Section 3. Results and findings of eLearning Scoping Review in medical and health professions education

A. Overview of data

A1. A total of 36 articles were included for analysis:
- 32 met the inclusion criteria during the abstracting phase
- 4 were recommended by reviewers

A2. The majority of included review articles (67%) were published within the last 3 years, with the inclusion of 2 articles published this year.

A3. Most of the review articles' primary authors are from North America (61%), with only about a sixth of them from Canada.

A4. The top three databases used for literature searches by the included review articles were PubMed (Medline) (53%), CINAHL (42%) and the Cochrane Collaboration Databases (25%).

B. Results and findings ABOUT LEARNERS and eLearning in medical and health professions education

B1. The **most frequent types of learners** in order of greatest frequency:

1. All levels of physician training:
   a. Learners of undergraduate medical education (UGME)
   a. Learners of postgraduate medical education (PGME)
   b. Learners of continuing medical education (CME)

   --
2. Other health professionals (Nurses, Pharmacists, Dentists)
2. Non-specific**

   --
3. Generalizable information across all learner groups

B2. The demographics of learners across the 36 review articles are found in Table 1.

Table 1. Learner Demographics

	All Levels of Physician Training*	Non-specific**	Other health professionals (Nurses, Pharmacists, Dentists)	Generalizable across domains	Graduate Education (e.g. anatomists, physiologists)	Other (please specify)	Rehabilitation Sciences (OT, PT, SLP)	Not applicable
Frequency by Article (n=36)	36 (100%)	13 (36%)	13 (36%)	8 (22%)	5 (14%)	5 (14%)	3 (8%)	1 (3%)

Notes for Table 1
- *Frequency includes all articles that pertained to learners of one or more groups in this category
- **Of the 13 articles for which learner demographics were said to be "non-specific", 54% were said not to have any applicable messages about learners regarding eLearning

B3. Summary of findings about Learners with regards to eLearning

1. Most articles did not discuss conclusions about learners, such as capacities, best practices, familiarity, likes/dislikes about e-learning (16 articles; 44%).
2. The utility and effectiveness of eLearning is largely dependent on learner population characteristics, such as knowledge base, spatial abilities, training level, specialty and interests (14 articles; 39%).
3. When used, learners have shown greater improvements in knowledge acquisition, clinical skills and clinical reasoning with interactive learning than with didactic learning alone (13 articles; 36%).
4. Some learners value the use of eLearning tools and resources (2 articles; 6%).
5. Some learners are reluctant to engage in eLearning (2 articles; 6%).
6. Many learners value learning technologies that facilitate interaction with peers and instructors. Some of the most common technologies preferred are simulation, social media and interactive media.
7. Learners require information and communication technology (ICT) and digital literacy skills in order to receive maximal benefit from the use of eLearning.
8. Learners can benefit from improved access via eLearning tools and strategies (e.g., geographically distributed, ease of use asynchronous use of eLearning tools to learn or review).

C. Results and findings ABOUT TEACHERS and eLearning in medical and health professions education

C1. The **most frequent types of teachers** in order of greatest frequency:

1. No comments and/or non-specific
   ---
2. All levels of physician training
   a. Teachers of PGME
   b. Teachers of UGME
   c. Teachers of CME
   --
3. Not applicable
3. Other*

C2. The demographics of teachers across the 36 review articles are found in Table 2.

Table 2. Teacher Demographics

	Non-specific**	All Levels of Physician Training	Not applicable	Other (please specify)*	Other health professions (Nurses, Pharmacists, Dentists)	Generalizable across domains	Graduate Education (e.g. anatomists, physiologists)	Self-taught	Rehabilitation Sciences (OT, PT, SLP)
Frequency by Article (n=36)	29 (81%)	25 (69%)	6 (17%)	6 (17%)	3 (8%)	1 (3%)	1 (3%)	1 (3%)	0 (0%)

Notes for Table 2

- *Of the 6 articles classified as "other", 50% were specified as belonging to categories already existent in the question response options, yet these were not selected (such as nurses, pharmacists, etc.). Had these options been selected, "other health professions" would have been the 3rd most common group instead of non-specific.
- **Of 29 articles classified as "non-specific" with regards to teacher demographics, 76% were reported no applicable messages about teachers regarding eLearning

C3. Summary of findings about Teachers with regards to eLearning

1. The vast majority of articles reviewed (27 articles; 75%) were noted to not discuss conclusions such as capacities, best practices, likes/dislikes, etc. about teachers with regards to eLearning.
2. Teachers need to be equipped and/or have resources to: (8 articles; 22%)
   a. Support learners in solving technical problems encountered in use of eLearning.
   b. Educate learners in the proper use of technology.
   c. Use technology-specific privacy issues and security settings.
3. Teachers require a minimal level of digital competency and ICT skills in order for eLearning-based training to be effective and to ensure it is being used appropriately (i.e. including professionally) (5 articles; 14%).
4. Teachers have a role in fostering a culture that is supportive of eLearning innovation (2 articles; 6%).
5. Teachers need to be prepared to face barriers in getting learners to adopt eLearning tools and strategies (2 articles; 6%).

D. Results and findings ABOUT SUBJECT MATTER and eLearning in medical and health professions education

D1. Top **most common types of subject matter** in order of greatest frequency:

1. Generalizable information across all content areas
   --
2. Surgery
   --
3. Other
3. Non-applicable*
   ---
4. Anaesthesia

D2. The details about subject matter across the 36 review articles are found in Table 3

Table 3. Article Subject Matter

	Generalizable across content areas	Surgery	Not applicable*	Other	Anesthesia	Critical Care	Medicine	Basic Sciences (e.g. anatomy, physiology)	Intrinsic roles	Obstetrics & Gynaecology	Medical Imaging
Frequency by Article (n=36)	15 (42%)	13 (36%)	10 (28%)	10 (28%)	8 (22%)	5 (14%)	5 (14%)	3 (8%)	3 (8%)	3 (8%)	2 (6%)

Table 3 (Cont'd) Article Subject Matter

	Lab Medicine & Pathobiology	Paediatrics	Psychiatry	Radiation Oncology	Clinical Investigator Program	Family Medicine	Ophthalmology and Vision Sciences	Otolaryngology - Head and Neck Surgery	Public Health Preventative Medicine	Rehabilitation Sciences
Frequency by Article (n=36)	1 (3%)	1 (3%)	1 (3%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Notes for Table 3
- *Of the 10 "non-applicable" articles for subject matter, 90% were also said not to have any applicable messages about subject matter with regards to eLearning

D3. Summary of findings about Subject Matter with regards to eLearning

1. Majority of articles did not discuss subject matter specifically, as it relates to eLearning (17 articles; 47%)
    a. Explanation: Majority of articles 42% were classified as have generalizable information across all content areas
2. Findings in specific content areas yielded information that the reviewers noted would be generalizable and could reasonably be applied more broadly across other areas.
3. In the specific articles with respect to eLearning in Surgery (12 articles; 33%) and Anaesthesia (2 articles; 6%):
    a. The use of technology assisted simulation and procedures was noted to be an effective and necessary training method for the development of clinical and procedural skills alongside traditional methods (i.e. in operating room, clinic)
    b. Technology enhanced simulation was reported to have better learning outcomes, in comparison to traditional practice or with no intervention.

E. Results and findings ABOUT eLearning Tools and Strategies in medical and health professions education

E1. Top **most common eLearning *tools*** in order of greatest frequency:

1. Multimedia*
---
2. Technology assisted simulation and procedures
---
3. Virtual community

E2. The details about eLearning tools across the 36 review articles are found in Table 4.

Table 4. eLearning Tools

	Multimedia*	Technology assisted simulation and procedures	Virtual community	Virtual classroom	Social media	Hypermedia	Clip Media	Webinar
Frequency by Article (n=36)	20 (56%)	17 (47%)	7 (19%)	6 (17%)	5 (14%)	3 (8%)	2 (6%)	2 (6%)

Notes for Table 4
- *Multimedia also includes interactive media and mixed media tools

E3. Top **most common eLearning *strategies*** in order of greatest frequency:

1. Computer-based and online learning
---
2. Asynchronous
2. Blended learning or hybrid learning
2. Blended instruction or hybrid instruction
2 Collaborative learning
---
3 Synchronous

E4. The details about eLearning strategies across the 36 review articles are found in Table 5.

Table 5. eLearning Strategies

	Computer based (CBL) and online learning*	Asynchronous	Blended learning or blended instruction or hybrid learning or hybrid instruction	Collaborative learning	Synchronous	Performance based instruction
Frequency by Article (n=36)	20 (56%)	11 (31%)	11 (31%)	11 (31%)	9 (25%)	5 (14%)

Notes on Table 5:
- *Frequency includes all articles categorized as having computer based learning **and/or** online learning strategies

Table 5 Cont'd. eLearning Strategies

	Flipped classroom or inverted classroom	Just in time	Advanced distributed learning (ADL)	Information literacy	Information architecture
Frequency by Article (n=36)	3 (8%)	3 (8%)	2 (6%)	1 (3%)	0 (0%)

E5. Summary of findings about eLearning tools

1. **Technology assisted simulation and procedures** (21 articles; 58%)
   a. Simulation is primarily used to develop clinical skills (6 articles; 17%). In particular, it has been demonstrated to be effective for "developing psychomotor skills, clinical-decision making skills" and motor skills and for addressing gaps in learning.
   b. Some of the more common explanations for improved learner outcomes from use of these technologies were the increased exposure to different clinical scenarios and/or patient cases (5 articles; 14%) (via virtual patient programs, for example) and the ability to train to proficiency(4 articles; 11%).
   c. An example of how differences between clinical skills developed through traditional methods versus the use of simulation were evaluated is by pre-test and post-test scores and the OSCE (Wong et al., 2010)

2. **Multimedia** (10 articles; 28%)
   a. Multimedia includes both interactive (e.g. games, user-engaging video and animation) and non-interactive tools (e.g. static text and images).
   b. Multimedia is generally "recommended" or, "suggested" as a set of tools for use in eLearning education (6 articles; 17%).
   c. Animation and image repositories (applying to the fields of pathology, radiology, and the basic sciences) were repeatedly mentioned and noted:
      i. Animation was found to be most effective when it engaged the learner and its effectiveness were found to be dependent upon prior learner knowledge and spatial ability.
      ii. The exposure to vast amounts of visual information through digital image libraries/repositories was considered to be "essential to training in diagnostic skills".

3. **Virtual Communities** (5 articles; 14%)
   a. Consists primarily of forums, discussion boards, wikis and telementoring.
   b. Fosters collaboration and engagement both between teachers and learners and among peers.
   c. Provides greater access to the instructor for ongoing learning support outside of the classroom.

4. **Social media** (4 articles; 11%)
   a. The main benefits associated with social media were active learning, greater learner engagement and interaction, collaboration and increased learner satisfaction.
   b. It was suggested that social media be used to compliment face-to-face learning methods
   c. Privacy breeches were reported as a concern. Establishing guidelines around social media use around the topics of professionalism and patient confidentiality and educating learners in these matters were considered to be of importance.

E6. Summary of findings about eLearning strategies

1. eLearning strategies includes computer assisted learning, web resources, online learning, animation and computer assisted navigation.
2. Including eLearning strategies was found to improve general learning outcomes.
3. Including eLearning strategies was found to specifically enhance knowledge acquisition, clinical decision-making skills and psychomotor skills.
4. Including eLearning strategies was viewed as able to accommodate different learning styles.
5. Including eLearning strategies was viewed to compliment traditional methods very well.
6. Including eLearning strategies could improves access to materials (e.g. after hours, if absent).
7. Participation with eLearning requires a baseline of digital literacy for both learners and teachers in order to be effective.
8. eLearning requ ires that learners acquire or have skills to be able to navigate through large volumes of information in order to select that which is most relevant to their learning objectives.

F. Other findings about eLearning systems and processes in medical and health professions education

F1. eLearning tools and strategies need to be evaluated with respect to their effectiveness (e.g. learner outcomes, impact on educational practices) (12 articles; 33%).

F2. It was noted that benefits such as managing risk and patient safety (10 articles; 28%), reducing length of training (6 articles; 17%), mitigating reduced work hours (5 articles; 14%), limiting or limited clinical site time (e.g. operating room time) need to be factored when costing eLearning.

F3. eLearning tools can be used in the objective monitoring and assessment of learners (8 articles; 22%).
   a. benefits of eLearning can include more accurate assessments of specific skills.
   b. eLearning may can quantify learning progress, need for more time/repetition and readiness for next steps (e.g. basic knowledge, basic skills).
   c. can help establish a baseline of skills in learners for greater standardization of training.

F4. eLearning tools and strategies can allow faculty to focus on achievement of performance and/or performance in the clinical setting after achieving requisite knowledge, skills via eLearning.

F5. Appropriate use of ‘proven-to-be-effective’ eLearning tools and strategies should be included into traditional educational model/curriculums.

F6. There are significant expenses up-front for eLearning tools and strategies (e.g. simulation equipment, eLearning design, staffing support) (4 articles; 11%).

F7. Computer-based, online and, more broadly, blended learning can be more cost-efficient in the long-term by reducing the amount of resources needed to train larger groups of learners particularly when the learners are not co-located and/or where a synchronous learning is beneficial.

F8. The use of eLearning has been effective to reach a larger number of learners without increased resources in areas where teachers are limited (e.g. CPE and Geriatrics).

F9. Development of central multimedia tools, such as virtual microscopy, can reduce equipment, storage, and maintenance costs.

F10. The need for faculty development was discussed primarily with regards to teacher's needs for training in informatics topics (ICT skills, digital professionalism, etc.) and in the effective use and development of eLearning tools and strategies.

Section 4. SUMMARY of key findings in eLearning Scoping Review in medical and health professions education

1. **Learners in medical and health professions education usually benefit from the inclusion of effective use of eLearning tools and strategies with evidence of better learning outcomes than with solely didactic methods.**

    1.1. Learners demonstrated improvements in learning outcomes overall (10 articles; 28%), as well as specifically in knowledge acquisition (6 articles; 17%), clinical skills and clinical reasoning (6 articles; 17%).
    1.2. Learners demonstrated improvement from simulation (13 articles; 36%) including procedural skills (Bashir, 2010; Larson et al., 2012), clinical skills (Harder, 2010) and knowledge (Cook & Triola, 2009).
    1.3. Learners benefitted from improved access (6 articles; 17%) and flexibility (6 articles; 17%) via eLearning tools and strategies (e.g., distance learning (Antoniou et al., 2012; Hamilton, 2012), and asynchronous use of eLearning tools to learn or review (Rowe et al., 2012; Tam et al., 2009).
    1.4 Learners benefitted from a diversity of delivery mediums, application, context, etc. to meet the variety of different learner needs and preferences (Cook et al., 2010; Cook, 2012).

2. **Consideration must be given to both learner preferences and learner readiness for the effective inclusion of eLearning tools and strategies to support and enhance learning outcomes in medical and health professions education.**

    2.1. eLearning is highly dependent on requisite learner motivation (Cook, 2012), eLearning literacy skills (Pinto et al., 2011) and learner characteristics and needs such as: knowledge base, spatial abilities, training level, specialty and interests (9 articles; 25%).
    2.2. Learners reported that they prefer eLearning tools and strategies that enhance interaction and engagement (Cheston et al., 2013; Wong et al., 2010).
    2.3. eLearning is hampered by learner reluctance, resistance, refusal (Cheston et al., 2013; Wong et al., 2010).
    2.4. Timely learner support is central to successful inclusion of eLearning tools and strategies (Kurup & Hersey, 2013).

3. **The reviews yielded surprisingly little information about the needs or best practices for the teacher who designs eLearning, but did identify the additional skills and efforts required of teachers when including eLearning tools and strategies in medical and health professions education.**

3.1. Teachers need eLearning literacy skills (5 articles; 14%) and to be equipped and/or have resources to support learners in solving technical problems encountered in the use of eLearning (5 articles; 14%)
3.2. Teachers can benefit from teaching time saved, (6 articles; 17%) but some tools, such as social media (Cheston et al., 2012), require additional time for teachers (2 articles; 6%).
3.3. Teachers will need to anticipate and manage a range of learner motivation, resistance and requisite eLearning literacy skills for engagement and success (4 articles; 11%)
3.4. Using eLearning tools and strategies requires teachers to "wear many hats", in that their roles and responsibilities differ both between tools and strategies used and between eLearning and traditional education methods (4 articles; 11%).

4. The educational benefits of eLearning tools and strategies in medical and health professions education need to be broadly considered, carefully employed and consistently evaluated to ensure the anticipated educational goals and learner objectives are achieved.

4.1. 'Proven-to-be-effective' eLearning tools and strategies should be included into traditional educational model/curriculums for both the learning and assessment value they provide to meeting educational goals and learner objectives (12 articles; 33%).
4.2. Costs to develop, employ, maintain and refresh eLearning tools and strategies need to be balanced by the noted available benefits to patients, learners, health systems (e.g. managing risk and patient safety, reducing length of training, mitigating reduced work hours, limiting or limited clinical site time (4 articles; 11%).
4.3. eLearning should be considered when it offers cost-efficiencies, improved learner access or lightens the teacher's responsibilities. (3 articles; 8%)
4.4. eLearning tools and strategies can be used to permit faculty to focus on achievement of performance and/or performance in the clinical setting after achieving requisite knowledge, skills via eLearning. (3 articles; 8%)

5. Effective educational outcomes with eLearning require careful consideration of the best 'match' for the learners, teachers and educational aims of the medical and health professions education.

5.1 Learner characteristics (15 articles; 42%)
  i. I.e. learner backgrounds, needs and preferences
  ii. E.g. motivation (Cook, 2012), prior knowledge, spatial ability (Ruiz et al., 2009), training level and individual competencies (Tan et al., 2010)
5.2 Teacher characteristics (6 articles; 17%)
  i. I.e. teacher backgrounds and resources (Kurup & Hersey, 2013)
  ii. E.g. degree of competency in use of hardware and software (Kurup & Hersey, 2013; Cook, 2009), support for innovation (Cook & Triola, 2009),
5.3 Aims of education
  i. Distributed education, improved access and asynchronous learning

Section 5. References

Articles from the review that were included in analysis are asterisked.

Aggarwal, R., & Darzi, A. (2009). From scalpel to simulator: a surgical journey. Surgery, 145(1), 1-4. doi: http://dx.doi.org/10.1016/j.surg.2008.07.010

Al-Hadithy, N. & Ghosh, S. (2013). Smartphones and the plastic surgeon. Journal of Plastic, Reconstructive and Aesthetic Surgery, 66(6), e155-e161. doi: http://dx.doi.org/10.1016/j.bjps.2013.02.014

Allen, I., & Seaman, J. (2014). Grade Change: Tracking Online Education in the United States. Babson Survey Research Group and Quahog Research Group, LLC. Retrieved from http://www.onlinelearningsurvey.com/reports/gradechange.pdf

Antman, E., Lau, J., Kupeinick, B., Mosteller, F., & Chalmers, T. (1992). A comparison of results of meta-analysis of RCTs and recommendations of clinical experts. Journal of American Medical Association, 268, 240-248.

*Antoniou, S. A., Antoniou, G. A., Franzen, J., Bollmann, S., Koch, O. O., Pointner, R., & Granderath, F. A. (2012). A comprehensive review of telementoring applications in laparoscopic general surgery. Surgical Endoscopy and Other Interventional Techniques, 26(8), 2111-2116. doi: http://dx.doi.org/10.1007/s00464-012-2175-x

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. International Journal Of Social Research Methodology, 8(1), 19-32. doi:10.1080/1364557032000119616

Aungst, T. D. (2013). Medical applications for pharmacists using mobile devices. Annals of Pharmacotherapy, 47(7-8), 1088-1095. doi: http://dx.doi.org/10.1345/aph.1S035

Bandukwala, T., Arora, S., & Athreya, S. (2011). Net assets: review of online radiology resources. Part I. Educational resources. Radiology, 261(2), 350-356. doi: http://dx.doi.org/10.1148/radiol.11101426

*Bashir, G. (2010). Technology and medicine: the evolution of virtual reality simulation in laparoscopic training. Medical Teacher, 32(7), 558-561. doi: http://dx.doi.org/10.3109/01421590903447708

Bhasin, B., Estrella, M. M., & Choi, M. J. (2013). Online CKD education for medical students, residents, and fellows: training in a new era. Advances in Chronic Kidney Disease, 20(4), 347-356. doi: http://dx.doi.org/10.1053/j.ackd.2013.04.003

Blackmur, J. P., Clement, R. G. E., Brady, R. R. W., & Oliver, C. W. (2013). Surgical training 2.0: How contemporary developments in information technology can augment surgical training. Surgeon Journal of the Royal Colleges of Surgeons of Edinburgh & Ireland, 11(2), 105-112. doi: http://dx.doi.org/10.1016/j.surge.2012.12.001

*Bluestone, J., Johnson, P., Fullerton, J., Carr, C., Alderman, J., & BonTempo, J. (2013). Effective in-service training design and delivery: evidence from an integrative literature review. Human Resources for Health [Electronic Resource], 11, 51. doi: http://dx.doi.org/10.1186/1478-4491-11-51

Carey, T., & Trick, D. (2013). How Online Learning Affects Productivity, Cost and Quality in Higher Education: An Environmental Scan and Review of the Literature. Toronto, ON, CAN: Higher Education Quality Council of Ontario.

Castanelli, D. J. (2009). The rise of simulation in technical skills teaching and the implications for training novices in anaesthesia. Anaesthesia & Intensive Care, 37(6), 903-910.
The changing landscape of anesthesia education: Is Flipped Classroom the answer? (2013). Current Opinion in Anaesthesiology, 26(6), 726-731. doi: http://dx.doi.org/10.1097/ACO.0000000000000004

*Cheston, C. C., Flickinger, T. E., & Chisolm, M. S. (2013). Social media use in medical education: a systematic review. Academic Medicine, 88(6), 893-901. doi: http://dx.doi.org/10.1097/ACM.0b013e31828ffc23

*Chipps, J., Brysiewicz, P., & Mars, M. (2012). A systematic review of the effectiveness of videoconference-based tele-education for medical and nursing education. Worldviews on Evidence-Based Nursing, 9(2), 78-87. doi: http://dx.doi.org/10.1111/j.1741-6787.2012.00241.x

Chu, L. F., Young, C., Zamora, A., Kurup, V., & Macario, A. (2010). Anesthesia 2.0: internet-based information resources and Web 2.0 applications in anesthesia education. Current Opinion in Anaesthesiology, 23(2), 218-227. doi: http://dx.doi.org/10.1097/ACO.0b013e328337339c

Chu, L. F., Young, C. A., Ngai, L. K., Cun, T., Pearl, R. G., & Macario, A. (2010). Learning management systems and lecture capture in the medical academic environment. International Anesthesiology Clinics, 48(3), 27-51. doi: http://dx.doi.org/10.1097/AIA.0b013e3181e5c1d5

Chandrasekaran, A. R. (2011). Computer aided learning in continuing pharmacy education. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2(3), 505-513.

*Cook, D. A., & Triola, M. M. (2009). Virtual patients: a critical literature review and proposed next steps. Medical Education, 43(4), 303-311. doi: http://dx.doi.org/10.1111/j.1365-2923.2008.03286.x

*Cook, D. A., Garside, S., Levinson, A. J., Dupras, D. M., & Montori, V. M. (2010). What do we mean by web-based learning? A systematic review of the variability of interventions. Medical Education, 44(8), 765-774. doi: http://dx.doi.org/10.1111/j.1365-2923.2010.03723.x

*Cook, D. A., Hatala, R., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., Hamstra, S. J. (2011). Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. JAMA, 306(9), 978-988. doi: http://dx.doi.org/10.1001/jama.2011.1234

*Cook, D. A. (2012). Revisiting cognitive and learning styles in computer-assisted instruction: not so useful after all. Academic Medicine, 87(6), 778-784. doi: ‘ http://dx.doi.org/10.1097/ACM.0b013e3182541286

Cook, D. A., & Triola, M. M. (2014). What is the role of e-learning? Looking past the hype. Medical Education, 48(9), 930-937. doi: 10.1111/medu.12484

Farrell, S. E., Coates, W. C., Khun, G. J., Fisher, J., Shayne, P., & Lin, M. (2009). Highlights in emergency medicine medical education research: 2008. Academic Emergency Medicine, 16(12), 1318-1324. doi: http://dx.doi.org/10.1111/j.1553-2712.2009.00570.x

Fehr, J. J., Honkanen, A., & Murray, D. J. (2012). Simulation in pediatric anesthesiology. Paediatric Anaesthesia, 22(10), 988-994. doi: http://dx.doi.org/10.1111/pan.12001

*Feng, J.-Y., Chang, Y.-T., Chang, H.-Y., Erdley, W. S., Lin, C.-H., & Chang, Y.-J. (2013). Systematic review of effectiveness of situated e-learning on medical and nursing education. Worldviews on Evidence-Based Nursing, 10(3), 174-183. doi: http://dx.doi.org/10.1111/wvn.12005

*Forgie, S. E., Duff, J. P., & Ross, S. (2013). Twelve tips for using Twitter as a learning tool in medical education. Medical Teacher, 35(1), 8-14. doi: http://dx.doi.org/10.3109/0142159X.2012.746448

*Frank, R. M., Erickson, B., Frank, J. M., Bush-Joseph, C. A., Bach, B. R., Jr., Cole, B. J., Verma, N. N. (2014). Utility of modern arthroscopic simulator training models. Arthroscopy, 30(1), 121-133. doi: http://dx.doi.org/10.1016/j.arthro.2013.09.084

*Graafland, M., Schraagen, J. M., & Schijven, M. P. (2012). Systematic review of serious games for medical education and surgical skills training. British Journal of Surgery, 99(10), 1322-1330. doi: http://dx.doi.org/10.1002/bjs.8819

Grech, V. (2009). A review of resources on the internet which can be utilized for medical training. Journal of Visual Communication in Medicine, 32(3-4), 101-104. doi: http://dx.doi.org/10.3109/17453050903402861

*Hamilton, P. W., Wang, Y., & McCullough, S. J. (2012). Virtual microscopy and digital pathology in training and education. APMIS, 120(4), 305-315. doi: http://dx.doi.org/10.1111/j.1600-0463.2011.02869.x

*Harder, B. N. (2010). Use of simulation in teaching and learning in health sciences: a systematic review. Journal of Nursing Education, 49(1), 23-28. doi: http://dx.doi.org/10.3928/01484834-20090828-08

Hills, C., Boshoff, K., & Jewell, K. (2013). Preferred teaching and learning approaches of students considered 'Generation Y' in health professions pre registration education: A comprehensive systematic review protocol. JBI Database of Systematic Reviews and Implementation Reports, 11(5), 140-156.

*Hollinderbaumer, A., Hartz, T., & Uckert, F. (2013). Education 2.0 -- how has social media and Web 2.0 been integrated into medical education? A systematical literature review. GMS Zeitschrift Fur Medizinische Ausbildung, 30(1), Doc14. doi: http://dx.doi.org/10.3205/zma000857

*Houshyari, A. B., Bahadorani, M., Tootoonchi, M., Gardiner, J. J. Z., Pena, R. A., & Adibi, P. (2012). Information and communication technology in medical education: an experience from a developing country. JPMA - Journal of the Pakistan Medical Association, 62(3 Suppl 2), S71-75.

Hughes, M. A., & Brennan, P. M. (2011). The Internet for neurosurgeons: current resources and future challenges. British Journal of Neurosurgery, 25(3), 347-351. doi: http://dx.doi.org/10.3109/02688697.2011.554582

Jhaveri, K. D., Malieckal, D., Israel, E., & Vachharajani, T. (2012). Nephrology education in the electronic era - a case based review. Open Urology and Nephrology Journal, 5(1), 29-32. doi: http://dx.doi.org/10.2174/1874303X01205010029

Johnson, E. O., Charchanti, A. V., & Troupis, T. G. (2012). Modernization of an Anatomy Class: From Conceptualization to Implementation. A Case for Integrated Multimodal-Multidisciplinary Teaching (Vol. 5, pp. 354-366): Wiley-Blackwell. 350 Main Street, Malden, MA 02148.

Mehta, N. B., Hull, A. L., Young, J., & Stoller, J. K. (2013). Just imagine: New paradigms for medical education. Academic Medicine, 88(10), 1418-1423. doi: http://dx.doi.org/10.1097/ACM.0b013e3182a36a07

Just, M. L. (2012). Is literature search training for medical students and residents effective? a literature review. Journal of the Medical Library Association, 100(4), 270-276. doi: http://dx.doi.org/10.3163/1536-5050.100.4.008

Kannan, J., & Kurup, V. (2012). Blended learning in anesthesia education: current state and future model. Current Opinion in Anaesthesiology, 25(6), 692-698. doi: http://dx.doi.org/10.1097/ACO.0b013e32835a1c2a

*Kennedy, C. C., Cannon, E. K., Warner, D. O., & Cook, D. A. (2014). Advanced airway management simulation training in medical education: a systematic review and meta-analysis. Critical Care Medicine, 42(1), 169-178. doi: http://dx.doi.org/10.1097/CCM.0b013e31829a721f

Kind, T. (2009). The Internet as an adjunct for pediatric primary care. Current Opinion in Pediatrics, 21(6), 805-810. doi: http://dx.doi.org/10.1097/MOP.0b013e328331e7b4

*Kleinpell, R., Ely, E. W., Williams, G., Liolios, A., Ward, N., & Tisherman, S. A. (2011). Web-based resources for critical care education. Critical Care Medicine, 39(3), 541-553. doi: http://dx.doi.org/10.1097/CCM.0b013e318206b5b5

*Kurup, V. and Hersey, D. (2013). The changing landscape of anesthesia education. Current Opinion in Anaesthesiology, 26(6), pp.726-731.

*Lam-Antoniades, M., Ratnapalan, S., & Tait, G. (2009). Electronic continuing education in the health professions: an update on evidence from RCTs. Journal of Continuing Education in the Health Professions, 29(1), 44-51. doi: http://dx.doi.org/10.1002/chp.20005

Lam, G., Ayas, N. T., Griesdale, D. E., & Peets, A. D. (2010). Medical simulation in respiratory and critical care medicine. Lung, 188(6), 445-457. doi: http://dx.doi.org/10.1007/s00408-010-9260-5

*Larsen, C. R., Oestergaard, J., Ottesen, B. S., & Soerensen, J. L. (2012). The efficacy of virtual reality simulation training in laparoscopy: a systematic review of randomized trials. Acta Obstetricia et Gynecologica Scandinavica, 91(9), 1015-1028. doi: http://dx.doi.org/10.1111/j.1600-0412.2012.01482.x

Levac, D., Colquhoun, H. & O'Brien, K.K. (2010). Scoping studies: Advancing the methodology. Implementation Science, 5, 69).

Lodge, D., & Grantcharov, T. (2011). Training and assessment of technical skills and competency in cardiac surgery. European Journal of Cardio-Thoracic Surgery, 39(3), 287-293. doi: http://dx.doi.org/10.1016/j.ejcts.2010.06.035

*Mabrey, J. D., Reinig, K. D., & Cannon, W. D. (2010). Virtual reality in orthopaedics: is it a reality? Clinical Orthopaedics & Related Research, 468(10), 2586-2591. doi: http://dx.doi.org/10.1007/s11999-010-1426-1

Magaña-Valladares, L., & Cooper, K. (2011). The National Institute of Public Health: Shaping public policy to advance population health in Mexico. Public Health Reviews, 33(1).

McGaghie, W. C., Siddall, V. J., Mazmanian, P. E., Myers, J., American College of Chest Physicians, H., & Science Policy, C. (2009). Lessons for continuing medical education from simulation research in undergraduate and graduate medical education: effectiveness of continuing medical education: American College of Chest Physicians Evidence-Based Educational Guidelines. Chest, 135(3 Suppl), 62S-68S. doi: http://dx.doi.org/10.1378/chest.08-2521

Nicolaou, M., Watson, P., Lillicrap, M., & Birrell, F. (2013). The use of online health information by arthritis patients: A systematic review. Rheumatology (United Kingdom), Conference, British Society for Rheumatology and British Health Professionals in Rheumatology Annual Meeting 2013, Rheumatology 2013 Birmingham United Kingdom. Conference Start: 20130423 Conference End: 20130425. Conference Publication: (var.pagings). 20130452 (pp i20130111). doi: http://dx.doi.org/10.1093/rheumatology/ket196

Paton, C., Bamidis, P. D., Eysenbach, G., Hansen, M., & Cabrer, M. (2011). Experience in the use of social media in medical and health education. Contribution of the IMIA Social Media Working Group. Yearbook of Medical Informatics, 6(1), 21-29.

Pearce, J., Mann, M. K., Jones, C., van Buschbach, S., Olff, M. & Bisson, J. I. (2012). The most effective way of delivering a Train-the-Trainers program: A systematic review. Journal of Continuing Education in the Health Professions, 32(3), 215-226. doi: http://dx.doi.org/10.1002/chp.21148

*Pinto, A., Brunese, L., Pinto, F., Acampora, C., & Romano, L. (2011). E-learning and education in radiology. European Journal of Radiology, 78(3), 368-371. doi: http://dx.doi.org/10.1016/j.ejrad.2010.12.029

Pratt, S. D. (2012). Focused review: simulation in obstetric anesthesia. Anesthesia & Analgesia, 114(1), 186-190. doi: http://dx.doi.org/10.1213/ANE.0b013e3182377bbc

Rasmussen, A., Lewis, M., & White, J. (2013). The application of wiki technology in medical education. Medical Teacher, 35(2), 109-114. doi: http://dx.doi.org/10.3109/0142159X.2012.733838

Raymond, M., Iliffe, S., & Pickett, J. (2012). Checkists to evaluate an e-learning resource. Education for Primary Care, 23(6), 458-459.

*Rosen, M. A., Hunt, E. A., Pronovost, P. J., Federowicz, M. A., & Weaver, S. J. (2012). In Situ Simulation in Continuing Education for the Health Care Professions: A Systematic Review. Journal of Continuing Education in the Health Professions, 32(4), 243-254.

*Rowe, M., Frantz, J., & Bozalek, V. (2012). The role of blended learning in the clinical education of healthcare students: a systematic review. Medical Teacher, 34(4). doi: http://dx.doi.org/10.3109/0142159X.2012.642831

*Ruiz, J. G., Cook, D. A., & Levinson, A. J. (2009). Computer animations in medical education: a critical literature review. Medical Education, 43(9), 838-846. doi: http://dx.doi.org/10.1111/j.1365-2923.2009.03429.x

*Saithna, A., & Dekker, A. P. (2009). The influence of computer navigation on trainee learning in hip resurfacing arthroplasty. Computer Aided Surgery, 14(4-6), 117-122. doi: http://dx.doi.org/10.3109/10929080903444440

Sarah, G.-R., & Begoña, G. (2011). E-Learning: Confusing Terminology, Research Gaps and Inherent Challenges. Journal of Distance Education (Online), 25(1), 1.

*Satava, R. M. (2010). Emerging trends that herald the future of surgical simulation. Surgical Clinics of North America, 90(3), 623-633. doi: http://dx.doi.org/10.1016/j.suc.2010.02.002

*Shakil, O., Mahmood, F., & Matyal, R. (2012). Simulation in echocardiography: an ever-expanding frontier. Journal of Cardiothoracic & Vascular Anesthesia, 26(3), 476-485. doi: http://dx.doi.org/10.1053/j.jvca.2012.01.019

Sondhi, V. and Devgan, A. (2013). Translating technology into patient care: Smartphone applications in pediatric health care. (2013). Medical Journal Armed Forces India, 69(2), 156-161. doi: http://dx.doi.org/10.1016/j.mjafi.2013.03.003

Sparks, M. A., O'Seaghdha, C. M., Sethi, S. K., & Jhaveri, K. D. (2011). Embracing the Internet as a means of enhancing medical education in nephrology. American Journal of Kidney Diseases, 58(4), 512-518. doi: http://dx.doi.org/10.1053/j.ajkd.2011.06.009

*Tam, M. D. B. S., Hart, A. R., Williams, S., Heylings, D., & Leinster, S. (2009). Is learning anatomy facilitated by computer-aided learning? A review of the literature. Medical Teacher, 31(9), e393-396.

*Tan, Z. S., Mulhausen, P. L., Smith, S. R., & Ruiz, J. G. (2010). Virtual Patients in Geriatric Education. Gerontology & Geriatrics Education, 31(2), 163-173.

Trehan, K., Kemp, C. D., & Yang, S. C. (2014). Simulation in cardiothoracic surgical training: where do we stand? Journal of Thoracic & Cardiovascular Surgery, 147(1), 18-24.e12. doi: http://dx.doi.org/10.1016/j.jtcvs.2013.09.007

Tullo, E., Newton, J., & Clapp, A. (2012). What can e-learning offer geriatric medicine in the UK? Reviews in Clinical Gerontology, 22(3), 235-242. doi: http://dx.doi.org/10.1017/S0959259812000081

Van Nortwick, S. S., Lendvay, T. S., Jensen, A. R., Wright, A. S., Horvath, K. D., & Kim, S. (2010). Methodologies for establishing validity in surgical simulation studies. Surgery, 147(5), 622-630. doi: http://dx.doi.org/10.1016/j.surg.2009.10.068

*Von Muhlen, M., & Ohno-Machado, L. (2012). Reviewing social media use by clinicians. Journal of the American Medical Informatics Association, 19(5), 777-781. doi: http://dx.doi.org/10.1136/amiajnl-2012-000990

Wilkinson, A., While, A. E., & Roberts, J. (2009). Measurement of information and communication technology experience and attitudes to e-learning of students in the healthcare professions: integrative review. Journal of Advanced Nursing, 65(4), 755-772. doi: http://dx.doi.org/10.1111/j.1365-2648.2008.04924.x

*Willaert, W. I. M., Aggarwal, R., Van Herzeele, I., Cheshire, N. J., & Vermassen, F. E. (2012). Recent advancements in medical simulation: patient-specific virtual reality simulation. World Journal of Surgery, 36(7), 1703-1712. doi: http://dx.doi.org/10.1007/s00268-012-1489-0

*Wolbrink, T. A., & Burns, J. P. (2012). Internet-based learning and applications for critical care medicine. Journal of Intensive Care Medicine, 27(5), 322-332. doi: http://dx.doi.org/10.1177/0885066611429539

*Wong, G., Greenhalgh, T., & Pawson, R. (2010). Internet-based medical education: a realist review of what works, for whom and in what circumstances. BMC Medical Education, 10, 12. doi: http://dx.doi.org/10.1186/1472-6920-10-12

Section 6. Appendices

Appendix A. Search strategy Version 2 (MEDLINE)

Database(s): **Ovid MEDLINE(R)** 1946 to May Week 4 2014

#	Searches	Results
1	Computer-Assisted Instruction/	9307
2	(blended learning or blended instruction or hybrid learning or hybrid instruction or flipped classroom or eLearning or e-learning or e learning or inverted classroom or advanced distributed learning or computer based learning or computer based teaching online learning or online teaching).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1427
3	Multimedia/	1471
4	(hypermedia or interactive media or interactive multimedia or mixed media).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	841
5	exp Videoconferencing/	1010
6	exp Students, Medical/	21602
7	exp Education, Medical/	129112
8	(medical education or medical school* or medical student*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	60284
9	6 or 7 or 8	158541
10	medical laboratory science/ or occupational therapy/ or physical therapy specialty/ or speech-language pathology/	23621
11	education/ or curriculum/ or education, professional/ or students/ or teaching/	140369
12	9 and 10	723
13	10 and 11	1444
14	9 or 12	158541
15	simulation*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	227831
16	(virtual classroom* or virtual communit*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	207
17	exp internet/	50251
18	1 or 2 or 3 or 4 or 5 or 16 or 17	59680
19	14 and 18	5273
20	limit 19 to (meta analysis or "review" or systematic reviews)	496
21	limit 20 to yr="2009 -Current"	185
22	limit 21 to yr="2010 -Current"	150
23	limit 22 to yr="2011 -Current"	109

Appendix B. Screening protocol for calibration exercise #1

eLearning Literature Review Screening Criteria Draft: July 10, 2014

Overview:
The next phase of the e-learning literature review is to further narrow the pool of 275 references. In order to calibrate the screening process, 10 articles have been randomly selected from the 275 references to be screened for inclusion using the following criteria. The titles and abstracts of the articles will be viewed using EndNote. After the exercise has been completed, we'll meet to discuss any discrepancies and further refine the screening criteria as*I*if necessary.

Instructions:
- Read through each of the titles and abstracts of the 10 articles to determine whether they meet the 3 criteria below.
- Write your initials in the "Research Notes" section of each article
- Write your screening conclusions in the following manner within the "Research Notes" section of each article:
    - If article meets all 3 inclusion criteria, write "**Y**", to indicate **yes**
    - If article has 1 or more exclusion criteria, write "**N**" and "**-1, -2, or -3**", to indicate **no** and which criteria that it was excluded from

***Example*:**	**Article 1**	**Article 2**
Research Notes:		**Research Notes:**
Y - LS		N -1, 2 – LS

Screening Criteria:

1. This study is a review article
Include: Yes
Exclude: No

2. This study matches our definition of e-learning, as follows:

E-learning *is an approach to engaging faculty of medicine learners in a form of education that applies technological approached to teaching, learning and scholarship and may include asynchronous and synchronous learning and interactions, which assist in the communication of knowledge and skills and their development and exchange.*
Include: Yes
Exclude: No

3. This study is about education
Include: Yes
- Include all forms of education (not just medical education)

Exclude: No

Appendix C. Screening protocols for calibration exercise #2

E-Learning Literature Review Screening Criteria July 18, 2014

Overview:
The next phase of the e-learning literature review is to further narrow the pool of 275 references. In order to calibrate the screening process, 10 articles have been randomly selected from the 275 references to be screened for inclusion using the following criteria. The titles and abstracts of the articles will be viewed using EndNote. After the exercise has been completed, we'll meet to discuss any discrepancies and further refine the screening criteria as*/*if necessary.

Instructions:
- Read through each of the titles and abstracts of the 10 articles to determine whether they meet the 3 criteria below.
- Write your initials in the "Research Notes" section of each article
- Write your screening conclusions in the following manner within the "Research Notes" section of each article:
    - If article meets all 3 inclusion criteria, write "**Y**", to indicate **yes**
    - If article has 1 or more exclusion criteria, write "**N**" and "**-1, -2, or -3**", to indicate **no** and which criteria that it was excluded from

***Example*:** **Article 1** **Article 2**
Research Notes: **Research Notes:**
Y - LS N -1, 2 - LS

Screening Criteria:

4. This study is a review article
Include: Yes
Exclude: No
- If review article is not comprehensive in scope → **exclude**
- If review article is not systematic in its methods → **exclude**

5. This study matches our definition of e-learning, as follows:

E-learning *is an approach to engaging faculty of medicine learners in a form of education that applies technological approached to teaching, learning and scholarship and may include asynchronous and synchronous learning and interactions, which assist in the communication of knowledge and skills and their development and exchange.*
Include: Yes
Exclude: No

6. This study is about education
Include: Yes
- Include all forms of education (not just medical education)

Exclude: No

Appendix D. Article abstracting survey instrument

Demographic Information

1. Reviewer initials
2. Last name of first author
3. Year of publication

Eligibility

4. Does the article still meet the 3 eligibility criteria after reviewing the full text (1. review article, 2. about e-learning, 3. about education)

Location

5. Location of corresponding author
6. Number of articles reviewed in this paper
7. Databases searched

Learners

8. Who are the learners? (check all that apply)
    - Continuing Medical Education
    - Graduate Education (e.g. anatomists, physiologists)
    - Occupational Therapists
    - Other health professionals
    - Physiotherapists
    - Postgraduate Medical Education
    - Speech Language Pathologists
    - Undergraduate Medical Education
    - Non-specific
    - Not applicable
    - Other (please specify)
9. List the top 2-3 key messages in this article about learners, regarding e-learning. (If not applicable, please write N/A)

Teachers

10. Who are the teachers? (check all that apply)
    - Continuing Medical Education
    - Graduate Education (e.g. anatomists, physiologists)
    - Occupational Therapists
    - Other health professionals
    - Physiotherapists
    - Postgraduate Medical Education
    - Self-taught
    - Speech and Language Pathologists
    - Undergraduate Medical Education

- Non-specific
- Not applicable
- Other (please specify)

11. List the top 2-3 key messages in this article about teachers, regarding e-learning. (If not applicable, please write N/A)

Subject Matter

12. Which subject matter, content area(s) does this article discuss? (check all that apply)
    - Basic Sciences (e.g. anatomy, physiology)
    - Anesthesia
    - Clinician Investigator Program
    - Critical Care
    - Family Medicine
    - Lab Medicine & Pathobiology
    - Medical Imaging
    - Medicine
    - Obstetrics & Gynaecology
    - Ophthalmology and Vision Sciences
    - Otolaryngology - Head and Neck Surgery
    - Paediatrics
    - Psychiatry
    - Public Health Preventative Medicine
    - Radiation Oncology
    - Surgery
    - Physiotherapy
    - Occupational Therapy
    - Speech and language pathology
    - Intrinsic roles
    - Not applicable
    - Other
13. List the top 2-3 key messages in this article regarding subject matter and e-learning (If not applicable, please write N/A)

Strategies

14. Which e-learning strategies does this article include? (pick list – choose multiple)
    - Advanced distributed learning (ADL)
    - Asynchronous
    - Blended learning or blended instruction or hybrid learning or
    - hybrid instruction
    - Clip Media
    - Collaborative learning
    - Computer based learning (CBT)

- Flipped classroom or inverted classroom or
- Hypermedia
- Information architecture
- Information literacy
- Interactive media or
- Interactive multimedia or mixed media
- Just in time
- Multimedia
- Online learning
- Performance based instruction
- Social media
- Synchronous
- Technology assisted simulation
- Virtual classroom
- Virtual community
- Webinar
- Non-specific
- Not applicable
- Other

15. List the top 2-3 key messages in this article regarding the outcome/impacts/value of e-learning. (If not applicable, please write N/A)

Additional Comments

16. Any other comments

Appendix E. Abstracting protocol

E-Learning Literature Review Abstracting Criteria
Overview:

A primary screening of the titles and abstracts of 275 references was performed using the three criteria outlined below. The 78 articles that met the inclusion criteria will be abstracted and summarized by eight reviewers, with each article reviewed twice by two separate people. Thus, each reviewer will read the full text documents of approximately 20 randomly assigned articles and will complete a Survey Monkey survey for each (see URL below).

The full text articles are to be screened again using the following three criteria. If they do not meet all 3 criteria, they will be excluded and the survey will discontinue after answering "no" for question 4 of the survey.

The deadline to complete this exercise is **Monday August 25th 2014**.

Please see below for details on the primary screening criteria and for clarification on questions 8 to 15 of the survey.

Primary Screening Criteria:
Articles must meet all 3 criteria in order to be included

1. This study is a review article
Include: Yes
Exclude: No
- If review article is not comprehensive in scope → **exclude**
- If review article is not systematic in its methods → **exclude**

2. This study matches our definition of e-learning, as follows:

E-learning *is an approach to engaging faculty of medicine learners in a form of education that applies technological approached to teaching, learning and scholarship and may include asynchronous and synchronous learning and interactions, which assist in the communication of knowledge and skills and their development and exchange.*
Include: Yes
Exclude: No

7. This study is about education
Include: Yes
- Include all forms of education (not just medical education)

Exclude: No

Survey Questions
URL: https://www.surveymonkey.com/s/9JGRVFW

Question Clarifications:

- Questions 8 & 10: Gather demographic information on the learners and teachers, respectively
- Questions 9 & 11: Refer more to conclusions (such as capacities, best practices, familiarity, likes/dislikes) about e-learning for the learners and the teachers, respectively
- Questions 12 & 13: Pertain to subject matter as it refers to the article content
- Questions 14 & 15: Pertain more to the e-learning strategy itself – i.e. what types of strategies were used or considered and what were the outcomes of this?

Appendix F. List of reviewers

This scoping review benefitted greatly from a collaborative team of reviewers who assisted with the article review and analysis.

Additionally this team generously provided their insights to the data analysis and the summary of research findings.

1. Gordon Tait, PhD
   Staff Scientist, Department of Anesthesia
   Toronto General Hospital, University Health Network
   Assistant Professor, Departments of Surgery & Anesthesia
   University of Toronto

2. Heather MacNeill, MD, BSc(PT), MScCH (HPTE), FRCPC
   Assistant Professor, Department of Medicine, Division of Physiatry, University of Toronto
   Director of Medical Education and Physiatrist, Bridgepoint Hospital

3. Judith Hunter, BSc(PT), MSc, PhD
   Assistant Professor, Department of Physical Therapy

4. Marla Nayer, PT, PhD
   Education and Curriculum Consultant
   Assistant Professor
   Faculty of Medicine, University of Toronto
   Postgraduate Medical Education

5. Nathan Bugden, M.Ed
   Learning Resources Educator
   Department of Medical Education & Scholarship
   St. Joseph's Health Centre

6. Laura Leigh Murgaski , MScCH (HPTE) candidate
   Research Coordinator
   Faculty of Medicine, University of Toronto
   Postgraduate Medical Education

7. Lindsey Fechtig
   Project and Administrative Manager
   Office of the Vice Deans, Education
   Faculty of Medicine, University of Toronto

8. Lisa St. Amant
   Research and Project Assistant II
   PGME and the Department of Medicine, University of Toronto
   Mt. Sinai Hospital
   Wilson Centre for Research in Education

Appendix G. Article recommendations

G1. Articles recommended by reviewers

Article	Referred By	Reviewer 1	Reviewer 2	Arbiter(s)	Included? (Yes/No)
Hamilton, 2012	HM	Maybe (HM)	No (LLM)	LSA	Yes
Mehta, 2013	HM	Maybe (HM)	No (MN)	LSA	No*
Nicolaou, 2013	HM	Maybe (HM)	Yes (MN)	LSA	No**
Pearce, 2012	HM	Maybe (HM)	No (LF)	LSA	No***
Paton, 2011	NB	Maybe (MN)	No (NB)	LSA	No*
Satava, 2010	NB	No (LF)	No (NB)	LSA & LLM	Yes
Tan, 2010	MN	No (JH)	No (MN)	LSA & LLM	Yes
Jhaveri, 2012	MN	No (HM)	No (MN)	LSA	No*
Kurup, 2013	MN	Yes (GT)	No (MN)	LSA	Yes

Table Notes:
3 were opinion-based, non-comprehensive and not very useful—ex. case study analysis (*)
The full text could not be found for 1 article (**)
1 was not relevant in scope (***)

G2. Articles recommended by the eLearning Task Force

- Mainly used to inform the composition of the literature review in its final stages

Primary Author of Article	Year	Included? (Yes/No)
Conole	2004	No*
Cook	2014	Yes
Hratinski	2008	No*
MacNeill	2011	Yes
Means	2010	Yes
Seaman	2014	Yes
Trick	2013	Yes

Table Notes:
*Outside the 5-year cut-off period
**None were review articles, thus, they were primarily used to inform the composition of the eLearning Scoping Review

Appendix H. A closer look at the findings and analysis of specific eLearning tools and strategies

H1. Frequency of Articles Abstracted by Reviewers (Included Articles Only)

Reviewer	Frequency of Articles (included)
Gordon Tait	7
Heather MacNeill	10
Judith Hunter	6
Lindsey Fechtig	6
Laura Leigh Murgaski	11
Lisa St. Amant	16*
Marla Nayer	5
Nathan Bugden	11
Total	72 (36 articles; 2 reviewers for each)

H2. Frequency of Articles by Publication Year

Publication Year	Frequency of Articles (included)
2009	5
2010	7
2011	3
2012	13
2013	6
2014	2
Total	36

H3. Frequency of Articles by Location of Primary Author

Location of Primary Author		Frequency of Articles (included)
Europe	UK	5
	S. Europe	1
	N. Europe	1
	W. Europe	4
	Total	11
Asia	Taiwan	1
S. Africa	Durban	1
	Cape Town	1
	Total	2
N. America	USA	19
	Canada	3
	Total	22
Total		36

H4. Databases Searched by Included Review Articles

Database	Frequency of Use
Medline	18
EMBASE	8
CINAHL	15
PsychINFO	8
PubMed	19
ERIC	8
Scopus	4
Cochrane Collaboration Databases	9
Google Scholar	4
Web of Science	4
Other (includes internet searches, SABINET, EBSCOhost, NEXUS, RDRB and published conference proceedings)	9