Instructional technologies in medical education: An important need for Faculty Development

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**Abstract**

Background: Today’s educators are faced with both new challenges and new information technologies for teaching medical trainees; however, there is no consensus on the technology skills that faculty members need for teaching, and we found no information on faculty’s confidence in their use of technology in medical education.

Purpose: To evaluate what teaching technologies are considered important in medical education by teaching faculty members and to determine the degree of faculty’s confidence and interest in different available educational technologies.

Methods: A 10 question electronic survey was developed by the authors and distributed to 795 faculty members. The goals were to assess the degree of confidence and perceived relevance and interest in different teaching technologies among the faculty.

Results: Overall, respondents rated their knowledge and confidence on teaching technologies as below average. The technology rated as most important to teaching in medical education was PowerPoint, followed by advanced PowerPoint skills, proficiency in operating an LCD projector, and accessing and navigating the collegiate course management system. Response patterns were further analyzed by importance and learning interest, to identify those technologies faculty considered both important and interesting to learn more about. The survey also highlighted some technologies that were interesting to some faculty members, but were considered not important for teaching.

Conclusions: Most faculty members may not be confident in the use of new teaching technologies. This may be an important topic for continuing medical education and faculty development. Since our results may not be widely representative of faculty’s technology skills and interests, institutions may need to review and evaluate what instructional technologies can be of value to them based on their faculty’s confidence and interest in learning new technologies and/or based on available educational resources for faculty development.

**Keywords:** E-learning/computers and teaching and learning
BACKGROUND


Investment in technology is not sufficient to promote change in teaching. Professional development in technology-enhanced education is a priority and schools must invest time and resources to prepare their teachers. Blin and Munro report that the lack of transformation of teaching practices in universities can be attributed to the lack of competencies not being addressed by adequate training [Blin 2008]. On the other hand, resources to train may be available, but educators may not recognize or make it a priority to learn how to use the available technologies [Ajjan 2008].

Lessons learned in K-12 teacher professional development, where there has been great investment in teacher training, are likely to apply to professional development of medical educators. Ottenbreit-Leftwich et al. report that teachers and teacher educators tend to use technology to improve information presentation, personal productivity, and to access electronic resources to support teaching and learning [Ottenbreit-Leftwich 2012] rather than making changes to their teaching approaches. Gerard et al. discuss that teachers found “integrating the technology with their existing instruction challenging and problematic.” Teachers also lacked the expertise to use technology and mostly used it to enrich their existing practices (direct instruction, in most cases) [Gerard 2011]. and a national survey targeting teacher education programs found that only 1.3% of teacher education programs are addressing the need to prepare educators to teach online [Kennedy 2012]. Nevertheless, effective use of technology to enhance teaching requires identification of the critical needs of teachers and learners [Chu 2012, Robin 2011, Ottenbreit-Leftwich 2012].

We found no studies addressing these concerns in medical education, even though it has been estimated that medical schools spend considerable amount of money in information technology (In 2002, it was estimated that most medical schools spent about $5.5 million with a median of 50 full time employees to support the technology) [Kamin 2006]. In addition, the technology is already being used [Cook 2008, Moberg 1999, Chu 2012, Kamin 1998, George 2013, Bogoch 2012, Bahner 2008, Ruiz 2006, Sanders 2006, Boulos 2006], but we found no information regarding medical educators’ perceptions on the use of these technologies to enhance medical education.

Consequently, we set out to assess our faculty’s interest and needs for training in educational technology at the University Of Iowa Carver College Of Medicine. We reasoned that a needs assessment is important prior to allocating resources for new technologies, which may not be used efficiently without proper training. For this purpose, a short anonymous electronic survey was developed and distributed to faculty during the summer of 2012. The goals of the survey were to assess the level of confidence of faculty members in instructional technologies and to determine what technologies faculty members consider important to use for teaching in medical education. In addition, we sought to determine which technologies faculty members wanted to learn more about and their learning preferences for receiving such training. We think that the tool we developed may be of use to other institutions as they assess their faculty’s needs and interests. In addition, because our faculty body is similar to other medical schools, our results may be useful to those institutions considering the incorporation of new technologies into their medical curricula.
METHODS:

A review of the literature was performed to assess faculty needs for training in educational technology. The search did not produce an existing published instrument for our study purpose. Consequently, we generated an initial list of teaching technologies which was reviewed by a small sample of faculty to generate a complete list of technologies available at our institution. Two experts in classroom technologies and computer based education reviewed the list for comprehensiveness and accuracy of technical language. The list of technologies resulting from this process formed the basis of the questionnaire.

We reviewed types of response options for needs assessment surveys and chose to use a modification of a dual dimension need scale consisting of importance of the technology for faculty generally, and personal interest in learning the skill [Quirk 2002]. The questionnaire was reviewed by an expert in survey design. A pilot test of a paper version of the questionnaire was conducted with nine faculty members. This showed that the items were working as intended (there was sufficient variability in responses) and that a few items had ambiguous wording. The ambiguous items were then revised for the final survey. A web-based version of the questionnaire was developed in Qualtrics and tested by the research team prior to on-line distribution.

The questionnaire included a series of seven statements to gauge respondents’ own knowledge about teaching technology and their confidence in learning about and using teaching technologies. Responses were on a 5-point scale with end-points labeled (1= not knowledgeable, not confident, respectively; 5=very knowledgeable, very confident, respectively). We then provided a list of 22 teaching technologies available to faculty members on our campus and asked them to rate the importance of each technology, for most faculty members who teach, using a 5-point scale of importance. We also provided a sixth response option (“not sure what this is”) for those who were unfamiliar with any item on the list such that they felt they could not judge its importance. Respondents who chose this response did not rate the item. Subsequently we asked respondents to rate their interest in learning more about all technologies that they rated of high importance (a response of 4 or 5 on the previous question). Each individual was presented with a personalized list and checked any that they wished to learn about. The list did not include any items they had previously marked “not sure what this is.” Finally, respondents were asked to rate their preferred method to learn about new technology on a 5-point scale (1=do not prefer, 5=strongly prefer). Additional questions provided information to allow us to determine the representativeness of our sample for the entire faculty body as well as information about their teaching experience settings, for results interpretation. These questions included their sex, primary departmental affiliation, years of teaching as a faculty member and the typical teaching settings (e.g., lecture, small-group discussion).

The electronic survey was distributed to all 795 faculty members on the email distribution list maintained by the collegiate administration at the University of Iowa, Carver College of Medicine. This list is used for news, announcements and other broadcast communication and includes faculty from all tracks, ranks and tracks, including tenure, clinical and research tracks. A link to the electronic anonymous survey (Qualtrics, 2005, Provo UT) was included in the e-mail. Two follow-up invitations were sent at 2 and 4 weeks. The e-mail explained the research purpose and stated that by filling out the survey, subjects agreed to participate. Faculty members who had teaching responsibilities during the past 12 months were invited to complete the survey.

All statistical analyses were conducted with SPSS (version 20, 2011, IBM Corporation, Armonk, NY). To determine whether there were statistically significant differences in learning preferences (topics, methods) between groups of faculty (gender or length of time teaching) we conducted Chi-square tests, or in cases with small cell sizes, Fisher’s exact tests. If the probability of obtaining the test statistic under the null hypotheses was less than 5% (p < .05), we rejected the null hypothesis and concluded that the groups significantly differed in their preferences.

The confidence and knowledge items were scaled by taking the average score for the items (3 items for confidence and 4 items for knowledge). Cronbach’s alpha for the confidence scale was .794 and .934 for the knowledge scale. The correlation between them was .467, significant at the .01 level. The average of the each
set of scale item yielded a knowledge scale score of 2.72 (SD=.908) and a confidence scale score of 3.20 (SD=.921). Additionally, to enable identification of non-linear relationships, the two scales were coded into high, medium, and low values to assess their relationship with other variables. One-way ANOVA was used to examine whether perceptions of confidence and knowledge interacted with ratings of the importance of technology or interest to learn about them. The University of Iowa IRB approved exempt status prior to survey administration.

RESULTS:

A total of 106 survey responses were received, 43% from female participants (faculty body is 32% female) and 57% from male participants. Nine percent of respondents were from basic sciences departments and 80% from clinical departments; equivalent to our faculty body. Fifty-seven percent of respondents were appointed from departments considered involved in primary care medicine (internal medicine, family medicine, pediatrics) versus 43% from surgical and subspecialty departments. Our faculty body is 45% primary care and 55% subspecialties. The distribution of years of teaching were as follows: 31% of respondents had greater than 20 years of teaching experience; 6% had between 16 and 20 years; 14% had between 11 and 15 years; 19% had 6 to 10 years; 26% had between 1-5 years; and 4% had less than 1 year of teaching experience.

The majority of respondents taught in multiple formats: lecture (93%), small group discussions (89%), and in clinical rounds (67%). Twenty-seven percent taught in a laboratory and 38% taught in workshops, simulations or other hands-on training.

Table 1

<table>
<thead>
<tr>
<th>Faculty Knowledge of and Confidence in Educational Technology</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge about (N=103)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resources for staying abreast of new technologies for teaching</td>
<td>2.76</td>
<td>1.07</td>
</tr>
<tr>
<td>Campus resources to learn how to use teaching technology</td>
<td>2.60</td>
<td>1.03</td>
</tr>
<tr>
<td>Social, legal, ethical issues related to technology use</td>
<td>2.77</td>
<td>1.10</td>
</tr>
<tr>
<td>Common teaching technology terminology</td>
<td>2.76</td>
<td>1.07</td>
</tr>
<tr>
<td>Confidence in ability to (N=102)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose technologies that will enhance your teaching</td>
<td>2.89</td>
<td>1.06</td>
</tr>
<tr>
<td>Use technology that you want to use for teaching</td>
<td>3.16</td>
<td>1.11</td>
</tr>
<tr>
<td>Easily learn teaching technology</td>
<td>3.55</td>
<td>1.15</td>
</tr>
</tbody>
</table>

*Scale of 1 to 5 with 1=not knowledgeable, not confident, respectively; and 5=very knowledgeable, very confident, respectively.

Table 1 presents faculty’s ratings of their knowledge and confidence. Respondents rated their knowledge to find resources for new technologies, understand social, legal, ethical issues related to technology use, and use of teaching technology terminology below the mid-point of the scale (mean ratings between 2.60 and 2.77). Mean ratings of confidence to use technology for teaching, choose new technologies and learn about new technologies also hovered around the mid-point (2.89 to 3.55).

When examining whether different types of faculty had different levels of knowledge and confidence based on years of teaching and gender, respondents with different years of teaching did not differ in confidence or knowledge; however, men expressed higher confidence than women (mean of 3.37 versus 2.92 respectively).

Table 2

<table>
<thead>
<tr>
<th>Mean Ratings of Important Technology and Faculty Interest to Learn about Them</th>
<th>Mean*</th>
<th>Standard</th>
<th>N</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Importance</td>
<td>Deviation</td>
<td>Rating of the item</td>
<td>Interest†</td>
</tr>
<tr>
<td>---</td>
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<td>-----------</td>
<td>--------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>1.</td>
<td>4.84</td>
<td>0.42</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>4.61</td>
<td>0.65</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>4.41</td>
<td>0.72</td>
<td>103</td>
<td>†</td>
</tr>
<tr>
<td>4.</td>
<td>4.29</td>
<td>0.91</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>4.15</td>
<td>1.17</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>4.09</td>
<td>1.06</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>3.90</td>
<td>1.13</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>3.88</td>
<td>0.95</td>
<td>96</td>
<td>†</td>
</tr>
<tr>
<td>9.</td>
<td>3.75</td>
<td>1.18</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>3.82</td>
<td>1.08</td>
<td>94</td>
<td>†</td>
</tr>
<tr>
<td>11.</td>
<td>3.69</td>
<td>1.24</td>
<td>91</td>
<td>†</td>
</tr>
<tr>
<td>12.</td>
<td>3.66</td>
<td>1.19</td>
<td>101</td>
<td>†</td>
</tr>
<tr>
<td>13.</td>
<td>3.65</td>
<td>1.22</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>3.59</td>
<td>1.19</td>
<td>86</td>
<td>†</td>
</tr>
<tr>
<td>15.</td>
<td>3.57</td>
<td>1.12</td>
<td>74</td>
<td>†</td>
</tr>
<tr>
<td>16.</td>
<td>3.50</td>
<td>1.15</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>3.34</td>
<td>1.23</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>3.14</td>
<td>1.20</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>3.05</td>
<td>1.29</td>
<td>100</td>
<td>†</td>
</tr>
<tr>
<td>20.</td>
<td>2.85</td>
<td>1.25</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>2.53</td>
<td>1.25</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>2.41</td>
<td>1.24</td>
<td>97</td>
<td></td>
</tr>
</tbody>
</table>

*Scale 1 to 5 with 1=Not important and 5=Very important
†20 or more of all respondents who rated the skill high in importance (rating of 4 or 5) want to learn more about it.
§The original wording included the brand name for the product we use at our institution.
Table 2 presents the mean ratings of importance given by faculty members to 22 currently available teaching technologies. Technology skills considered important in teaching included the ability to make a basic PowerPoint presentation (mean importance rating of 4.84), to make a basic handout in Word or PowerPoint (4.61), to incorporate media into PowerPoint (4.41), to convert handouts and slides to PDF format (4.29), and to operate an LCD projector (4.15). Faculty also thought it was important to be able to access and navigate the course management system (4.09) but less important that faculty be able to create and manage a course on the system (3.65). Technology skills considered less important for most faculty who teach included developing a smart phone application (mean rating of importance was 2.41), create and use a social network to teach (2.53), create a podcast (2.85), develop a web page (3.05), and use Web 2.0 technologies (3.14). (See Table 2 for ranking of technologies).

A few faculty members chose the “not sure what this is” option for many of the 22 items, however, only a few items were very affected by this choice. These included the items: 1) author a questionnaire with web-based software (26% were unfamiliar); 2) access, navigate and search the curriculum database (15%); 3) use Web 2.0 technologies (15%); 4) operate a mannequin-based simulation (11%); and 5) operate lecture capture software (10%). Items 1, 2, and 5 above included the product name used at our institution for additional cueing.

Technologies that faculty wanted to learn about (considered as “high interest” technologies) are highlighted in Table 2. These items were those in which 20% or more of the respondents rated the item as of high interest (4 or 5) and indicated they wanted to learn more about it. Respondents were not always interested in learning more about technologies even though they were rated as highly important by most teaching faculty (mean score above 4 as rated by all respondents). Eight technologies received high interest but only one of them was also rated as highly important (across all respondents): incorporating media into PowerPoint.

There were no statistically significant findings between confidence and ratings of importance for any of the items. More knowledgeable respondents tended to give higher importance ratings to some technology items but only one item showed a statistically significant correlation: "creating and managing an ICON course” (r = 0.279, p < .01).

There were no correlations between knowledge and interest to learn about any topic. However, we found a negative correlation between level of confidence and interest to learn more about some topics:

**Significant at .01**

- Produce a basic presentation using PowerPoint or similar program that contains text slides, Clipart, or graphs, r = -.340
- Create a PDF hyper-linked document, r = -.256

**Significant at .05**

- Develop a basic handout in Word or PowerPoint that incorporates visuals (graphs or images) and tables, r = -.248
- Access and navigate ICON (the UI/CCOM course management system), r = -.231
- Operate a mannequin-based simulation, r = -.231
- Convert a Word or PowerPoint file to a PDF, r = -.228
- Use Web 2.0 technologies (wikis, blogs, social networking), r = -.215
- Operate an LCD projector, r = -.215

When asked about learning preferences, faculty indicated interest in learning about technologies with one-to-one training from an experienced person and/or via hands-on workshops. Grand rounds, online modules, guides, or self-study were less desirable to the faculty (Table 3). Learning preference was not related to confidence or knowledge with one exception: lower perceptions of confidence or knowledge were correlated with “explore the technology and figure it out myself.” The correlation with confidence was -.269 and with knowledge was -.208
Inspection of the probabilities for the Fisher's exact test value revealed only one instance where faculty groups differed significantly: Forty-two percent of highly experienced faculty (20+ years teaching) preferred to learn teaching technologies through grand rounds or department meetings compared to only 8% of their less experienced peers (1-5 years teaching).

Table 3

<table>
<thead>
<tr>
<th>Preferences on Methods to Learn New Technology</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands-On Workshop</td>
<td>4.18</td>
<td>0.98</td>
</tr>
<tr>
<td>One-to-one training from a knowledgeable person</td>
<td>4.03</td>
<td>1.12</td>
</tr>
<tr>
<td>Online module</td>
<td>3.39</td>
<td>1.32</td>
</tr>
<tr>
<td>Guide or manual</td>
<td>2.88</td>
<td>1.15</td>
</tr>
<tr>
<td>At a departmental grand rounds or faculty meeting</td>
<td>2.78</td>
<td>1.37</td>
</tr>
<tr>
<td>Explore the technology and figure it out myself</td>
<td>2.72</td>
<td>1.23</td>
</tr>
</tbody>
</table>

*Scale 1 to 5 with 1=Do not prefer and 5=strongly prefer

DISCUSSION:

The use of technology to enhance learning and to foster collaboration has created many possibilities in response to technological trends and challenges in medical education; however, to our knowledge, this is the first report on general faculty’s perception of the role of instructional technologies in medical education. In addition, we developed an easy to use, low cost, survey that can be used by other medical schools and residency programs.

Technologies considered important and that were in higher demand tended towards those used to enhance lecture formats and possibly, evaluation of students (PowerPoint techniques, “clicker” software, creating video clips, etc.). PowerPoint was ranked as fundamental for a medical educator (Table 2). These results are not surprising since a large majority of faculty respondents teach in lecture formats. Our results are consistent with other studies [Kennedy 2012], that have shown that even with training most teachers use technology for information presentation, personal productivity, and to access electronic resources.

Newer technologies such as wikis, social media, podcasts and mobile learning applications were rated to be much less important. In addition, some faculty indicated they were not familiar with these and other technologies. This may mean that faculty members are not prepared for more transformative uses of technology. Our results suggest that faculty may choose to use instructional technologies they are comfortable with, instead of newer technologies. We speculate that faculty’s perceptions are likely a result of their 1) lack of confidence in these technologies; 2) lack of knowledge on how to use these technologies to improve teaching and 3) lack of time to invest in learning about how to use these technologies.

We found that some faculty members were interested in newer technologies but they also ranked these technologies as less important for all faculty members. This interest was not related to their years of teaching experience. These educators may represent a group of “advanced learners” who have a particular interest in teaching technology and who have already mastered basic technologies. However, they do not consider them important for all faculty members.

Most faculty members still prefer to learn with one to one training or in workshops (Table 3). While these hands-on approaches are effective, they are also one of the most resource-intensive formats for institutions to
provide. Faculty with greater teaching experience had a stronger preference for Grand Rounds and Department meetings to learn about technology. These large-group formats can be efficient, but limited in the learning outcomes that can be achieved since they provide a more passive learning environment.

Limitations to our study include that only 106 faculty members responded to the survey (13%), however, although our invitation was worded to target those who did teach, the invitation was sent to all faculty on the listserv, which includes a substantial, yet unknown, number of non-teaching faculty. Consequently our response rate from teaching faculty was likely considerably higher than 13% or the lack of response may reflect lack of interest in teaching technologies.

Our sample composition was similar to the faculty body in percentage of faculty from basic science and clinical departments. It also appears to be representative of our faculty who teach in terms of the distribution of years of teaching and venues for teaching reported. However, our sample was slightly over-represented by respondents from primary care departments. Further, our sample had slightly more women than our faculty as a whole. This is consistent with other studies that found higher response rates for women [Sax 2003]. We speculate that those who took the survey represented faculty members who are interested and actively involved in the teaching of medical students and residents and likely to be concerned about teaching technology resources.

Other limitations include that results are from a single institution and the surveyed technologies were those available at our institution. Other medical schools may have other technologies we did not examine. Also, surveyed faculty may have had different interpretations of the “not sure what that is” response option. Although instructions directed them to select this option if they were unfamiliar with an item, such that they could not judge its importance, they may also have selected “not sure” even if they knew the technology but were uncertain about its importance or they chose not to rate its importance for some other reason.

Overall, results suggest that many faculty members seem to lack fundamental background knowledge and that they are unaware of resources available to learn and use new technologies to teach. These results could be consistent with concerns by others who have been trying to explain the lack of transformation technology use despite the availability of new technologies [30,31].

Conclusions:
We have ranked technologies relevant to medical educators at our institution and speculate that some technologies may be underrepresented due to lack of faculty awareness of some newer instructional technologies. Resources need to be appropriately allocated in faculty development and education if we want to use technology to support learning and to foster collaboration in medical education.
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