American Journal of Pharmaceutical Education **2011; 75 (5) Article 87.**

TECHNOLOGY IN PHARMACY EDUCATION

Educational Technology Use Among US Colleges and Schools of Pharmacy

Michael S. Monaghan, PharmD,[a] Jeff J. Cain, EdD, MS,[b] Patrick M. Malone, PharmD,[c] Tracy A. Chapman, Med,[a] Ryan W. Walters, MS,[d] David C. Thompson, PhD,[e] and Steven T. Riedl, MS[a]

[a]School of Pharmacy and Health Professions, Creighton University
[b]College of Pharmacy, University of Kentucky
[c]College of Pharmacy, University of Findlay
[d]Division of Clinical Research and Evaluative Sciences, Creighton University
[e]School of Pharmacy, University of Colorado Denver

Objective. To develop a searchable database of educational technologies used at schools and colleges of pharmacy.
Methods. A cross-sectional survey design was used to determine what educational technologies were being used and to identify an individual at each institution who could serve as an information resource for peer-to-peer questions.
Results. Eighty-nine survey instruments were returned for a response rate of 75.4%. The resulting data illustrated the almost ubiquitous presence of educational technology. The most frequently used technology was course management systems and the least frequently used technology was microblogging.
Conclusions. Educational technology use is trending toward fee-based products for enterprise-level applications and free, open-source products for collaboration and presentation. Educational technology is allowing educators to restructure classroom time for something other than simple transmission of factual information and to adopt an evidence-based approach to instructional innovation and reform.
Keywords: educational technology, instructional technology, online learning

INTRODUCTION

Efficient and effective use of technology is often a vital component for success in education. Although many criticize what they perceive as an overreliance on technology to improve teaching,[1] there have been substantial investments in the human and technical infrastructure necessary to implement these technologies on college campuses. More than a decade has passed since the last published study of technology use in pharmacy education.[2] Because technology changes at such a rapid pace, this study is no longer relevant and new information is needed. The 2000-2001 American Association of Colleges of Pharmacy (AACP) Academic Affairs Committee supported the development and use of computer-based technology for learning that is educationally sound and cost effective.[3] One of the goals of the AACP Technology in Pharmacy Education and Learning (TiPEL) Special Interest Group (SIG) is to help member institutions develop and integrate educational technologies that positively impact teaching, learning, and assessment. An important aspect of meeting this goal is to establish baseline information of the current technologies used by pharmacy programs so that further inquiry into the effectiveness of their use can be made. Although some may view incorporation of technology into teaching and learning as primarily a task for instructional design and technology specialists, pharmacy faculty members should ultimately drive the development and adoption of such technologies. Therefore, an overall awareness of the instructional technologies being used at other institutions is necessary for them to make informed decisions.

This study examined several different areas pertaining to technology use in colleges and schools of pharmacy. One new and evolving area of research pertains to the use of social media for educational purposes.[4] Described in this paper as social communications software, online tools such as blogs,[5] microblogs,[6] wikis,[7] virtual worlds,[8] and social networking[9] are newer technologies that were not included in the previous study. Likewise, new experiential education requirements necessitate the use of software to manage the experiential process and create and maintain portfolios.[10] There also have been advancements since the last study in technology used for lecture capture, audience response, and online learning

Corresponding Author: Michael S. Monaghan, PharmD, School of Pharmacy and Health Professions, Creighton University, 2500 California Plaza, Omaha, NE 68178. Tel: 402-280-1866. Fax: 402-280-1268. E-mail: msmonagh@creighton.edu

management.[11-13] The types of instructional hardware used in pharmacy education (eg, cameras, laptop computers) and the types of technology support provided were examined as well because these areas have evolved due to increased computing demands and mobile computing.[14-16]

This study was developed by members of the TiPEL SIG for 3 primary reasons: (1) to provide a resource for AACP members to identify the hardware and software products being employed, (2) to provide contact information so that faculty members can learn and possibly collaborate with others regarding technology use, and (3) to inform pharmacy faculty members of the various technologies that can be incorporated into teaching and learning and/or that can be studied within the context of education research. It was beyond the scope of this study to determine the effectiveness of the technologies. However, the results may familiarize faculty members with the various types of technologies available, which then may encourage further incorporation of technology into the teaching and learning process. Another tangible outcome of this study was the development of a searchable database of the educational technologies employed by colleges and schools of pharmacy, along with a contact person who could elaborate regarding their institution's experience with implementing and using various technologies.

METHODS

A cross-sectional survey was designed to identify the educational technologies used by colleges and schools of pharmacy and an individual at each institution who could serve as a resource for peer-to-peer questions regarding the technology employed and related experience. Using a survey instrument on technology use developed by the Council of Ohio Colleges of Pharmacy as a guideline, 38 survey items specific to this study were created. (The survey instrument is available from the author upon request.) A list of specifications (Table 1) was used to define the domains and the respective item sampling process. Educational technology domains included software used for instruction, hardware used for instruction, software used for communication, technology requirements for experiential education, and technology support. Where applicable, the respondent was asked to specify whether the software and/or hardware was the primary system used or only one of the technologies in use.

The survey was pilot tested by 1 psychometrician and 3 pharmacy educators from across the country with experience in survey development and educational technology, respectively. The purpose of this pilot phase was to test the adequacy of the instrument to meet the stated goals and to improve the internal validity of the survey. The pilot group identified ambiguities and difficult questions; determined the time required to complete the survey and whether this timeframe was reasonable; and assessed whether each question gave an adequate range of responses. Pilot data were used: to confirm that the survey items provided the information sought; to discard unnecessary, difficult, or ambiguous questions; and to reword questions that were not answered as expected. Changes made as a result of pilot testing included survey format (limiting the amount of scrolling required to complete the survey), question format (adding the terms "in use" and "primary"), and item content (clarifying whether items referred to student or faculty e-mail systems/software).

The survey was administered during the 2010 spring semester to a convenience sample of 118 TiPEL members representing programs deemed to be at a level of development sufficient to have employed educational technology (ie, fully accredited programs). Survey instruments were disseminated electronically and electronic reminders were sent periodically to nonresponders until the end of the 2010 spring semester. For programs with 2 distinct campuses, the survey request was sent to each campus. Responses were exported to an Excel spreadsheet before analysis via IBM SPSS Statistics, version 18.0.2 (IBM SPSS, Chicago, IL). Descriptive analyses were conducted on the data. The study was approved by Creighton University's Institutional Review Board.

RESULTS

Instructional Software

Eighty-nine survey instruments were returned for a response rate of 75.4%. The software used by the responding colleges and schools for course content management, classroom capture, and lecture capture on individual faculty computers is presented in Table 2. One hundred percent of respondents used a course management system for content delivery. Approximately 70% used software to capture the classroom environment for later viewing. Software used to capture lectures on the computers of individual faculty members was employed by 57.3% of respondents. Only a minority of programs used iTunes (Apple Inc., Cupertino, CA) to make lecture audio and/or video recordings available to students (10.1% provided audio only and 14.6% furnished both audio and video content). Other audio/video delivery modes were employed by 14.6% of respondents.

Web conferencing was used by a majority (74.2%) of colleges and schools (Table 3). Fifty-five (61.8%) indicated they also use interactive video conferencing. Only 7 programs (7.9%) had used Web conferencing to proctor an examination.

Audience response systems were used by 88.8% of programs (Table 4). Electronic testing was employed by

Table 1. Specifications for the Technology Survey

Technology Domain	Example(s)	Survey Item(s)
Contact information for technology questions at the institution	Name of institution, contact person's name, e-mail, etc.	1
Software use for instruction		
Course management	Blackboard, Angel	2
Classroom capture	Echo 360, Adobe	3
Lecture capture	Tegrity Campus 2.0	4
Aggregator for audio/video files	iTunes	5
Web conferencing	Adobe	6-8
Audience response systems	iClicker	9
Electronic testing	QuestionMark	10, 11
Blogging/micro-blogging tools	Blogger, Twitter	12, 13
Document collaboration	GoogleDocs	14
Virtual environment	SecondLife	15
Wiki tool	Wikispaces	16
Presentation tool(s)	Microsoft PowerPoint	17
Electronic portfolio tool(s)	RXportfolios	18
Electronic mail	Microsoft Exchange	20-22
Hardware use for instruction		
Presentation tool(s)	Sympodium	19
Required computer use	Computer requirement for enrollment, specific type of computer (laptop vs. tablet), PC vs. Mac, required software installed	23-27
Software use for communication		
Social media	Facebook	28
Social video/photo sharing	YouTube	29
Rotation requirements		
Self- and preceptor assessment	RXpreceptor	30
Personal digital assistant	iPod Touch	31-33
Technology support	Personnel separate from the University, source of financial support, etc.	34-38

79.8% of respondents, 29.2% of which required students to use a secured browser.

Table 5 lists responses regarding the use of blogging, microblogging, and document collaboration solutions by colleges and schools of pharmacy. Approximately 60% of programs reported that a blogging tool was used. Only 35.9% of respondents stated that their pharmacy program used a microblogging tool. Document collaboration applications were used by 66.3% of the programs. The survey instrument also asked whether the program used software to create simulation environments or ''virtual worlds.'' Eight (6.8%) responded that they employed simulation environments in the educational arena.

Sixty-six percent of participants reported their program uses wiki tools. Blackboard and Wikipedia comprised 42.7% of the systems used. Almost all programs (98.9%) incorporated classroom presentation software into their educational lectures. PowerPoint (Microsoft Corp., Redmond, WA) and Google Apps (Google Inc., Mountain View, CA), 85.4% and 15.7%, respectively, were the programs most frequently reported.

Software for managing electronic portfolios (e-portfolios) had been implemented in approximately 85% of programs. Most of the e-portfolio tools used were part of an educational software package or a course management system. For example, 31.5% used E*Value (Advanced Informatics, Minneapolis, MN), 14.6% used RXportfolio (RXinsider LTD, West Warwick, RI), and 10.1% used Blackboard (Blackboard Inc., Washington, DC).

Approximately 98% of respondents reported hosting and supporting program-wide electronic mail (e-mail) systems for students. Microsoft Exchange/Outlook (37.1%) and Google (24.7%) were the most common systems used. Eighty-eight percent of the programs required students to use the program-wide e-mail system. Approximately 98% of programs had e-mail systems for faculty members, with

Table 2. Software for Instructional Use, N=89

	Responses (%)
Course Management	
Is any system used? (yes)	89 (100)
Blackboard	54 (60.7)
Moodle	13 (14.6)
Angel	4 (4.5)
Other systems used (eg, Desire2Learn, Web CT)	18 (20.2)
Classroom Capture[a]	
Is any system used? (yes)	62 (69.6)
Camstasia Studio	
In use	13 (14.6)
Primary	4
Elluminate	
In use	12 (13.5)
Primary	2
Mediasite	
In use	10 (11.2)
Primary	7
Echo 360	
In use	9 (10.1)
Primary	6
Adobe Presenter	
In use	9 (10.1)
Primary	1
Panopto	
In use	6 (6.7)
Primary	6
Tegrity Campus 2.0	
In use	3 (3.4)
Primary	3
Other systems used (eg, mediaPOINTE, Profcast)	15 (16.9)
Lecture Capture Outside of the Classroom[a]	
Is any system used? (yes)	51 (57.3)
Camstasia Studio	
In use	23 (25.8)
Primary	7
Elluminate	
In use	12 (13.5)
Primary	3
Adobe Presenter	
In use	10 (11.2)
Primary	3
Panopto	
In use	6 (6.7)
Primary	4
Echo 360	
In use	4 (4.5)
Primary	2
Other systems used (eg, Tegrity Campus 2.0, Profcast)	9 (10.1)

[a] "In use" refers to the number of respondents that use the technology; "Primary" indicates the number of respondents that use the technology as their primary modality.

Table 3. Web Conferencing and Interactive Video Conferencing Software in Use, N= 89

	Responses (%)
Web conferencing[a]	
Is any system used? (yes)	66 (74.2)
Skype	
In use	29 (32.6)
Primary	5
Adobe Connect Pro	
In use	15 (16.9)
Primary	8
Elluminate	
In use	13 (14.6)
Primary	8
WebEx	
In use	10 (11.2)
Primary	6
Horizon Wimba	
In use	8 (9.0)
Primary	7
Microsoft Live Meeting	
In use	8 (9.0)
Primary	4
iChat	
In use	8 (9.0)
Primary	0
Other systems used (eg, DimDim, GoToMeeting)	12 (13.5)
Interactive Video Conferencing[a]	
Is any system used? (yes)	55 (61.8)
Polycom	
In use	31 (34.8)
Primary	20
Tranberg	
In use	20 (22.5)
Primary	13
Elluminate	
In use	10 (11.2)
Primary	8
Other systems used (eg, WebEx, Office Communicator)	6 (6.7)

[a] "In use" refers to the number of respondents that use the technology; "Primary" indicates the number of respondents that use the technology as their primary modality.

Microsoft Exchange/Outlook (52.8%) and Google (18.0%) the most commonly employed. Subtle differences in system use were apparent between students and faculty members; faculty members were more likely to use Microsoft Exchange Server/Outlook than students, most likely due to the calendaring (meeting requests, etc.) capabilities.

Table 4. Current Use of Audience Response Systems and Electronic Testing, N=89

	Responses (%)
Audience Response[a]	
Is any system used? (yes)	79 (88.8)
TurningPoint	
In use	51 (57.3)
Primary	45
iClicker	
In use	13 (14.6)
Primary	7
eInstruction	
In use	5 (5.6)
Primary	5
Other systems used (eg, Qwizdom, Interwrite PRS™, "Not sure")	11 (12.4)
Electronic Testing[a]	
Is any system used? (yes)	71 (79.8)
Blackboard	
In use	34 (38.2)
Primary	32
Respondus	
In use	16 (18.0)
Primary	8
QuestionMark	
In use	4 (4.5)
Primary	3
ExamSoft	
In use	2 (2.2)
Primary	1
Other systems used (eg, Angel, Desire2Learn)	19 (21.3)

[a] "In use" refers to the number of respondents that use the technology; "Primary" indicates the number of respondents that use the technology as their primary modality

Table 5. Software Use for Blogging, Microblogging, and Document Collaboration, N=89

	Responses (%)
Blogging Tool[a]	
Is any system used? (yes)	53 (59.5)
Blackboard	
In use	28 (31.5)
Primary	18
Blogger	
In use	7 (7.9)
Primary	3
WordPress	
In use	7 (7.9)
Primary	3
Other systems used (eg, Sakai, Blogspot, Desire2Learn)	11 (12.4)
Microblogging Tool[a]	
Is any system used? (yes)	32 (35.9)
Twitter	
In use	21 (23.6)
Primary	12
Yammer	
In use	1 (1.0)
Primary	0
Other systems used (eg, Sakai, "Not sure")	4 (4.5)
Document Collaboration[a]	
Is any system used? (yes)	59 (66.3)
Google Docs	
In use	43 (48.3)
Primary	20
Microsoft SharePoint	
In use	14 (15.7)
Primary	7
Microsoft Live	
In use	5 (5.6)
Primary	3
Google Wave	
In use	2 (2.2)
Primary	0
Other systems used (eg, Moodle, Xythos)	9 (10.1)

[a] "In use" refers to the number of respondents that use the technology; "Primary" indicates the number of respondents that use the technology as their primary modality.

Instructional Hardware

Seventy-five percent of pharmacy programs used presentation hardware for course instruction. SMART Board (31.5%) (SMART Technologies, Calgary, Alberta, Canada), tablet personal computers (PCs) (29.2%), and Sympodium (23.6%) (SMART Technologies) were the major systems employed.

More than half (53.9%) of the pharmacy programs required students to have a computer (Table 6). Of those requiring a computer, approximately 56% specified the type of computer the students must have. The most frequently required computers were laptops (laptop PCs, tablet PCs, or MacBooks). Most of the programs that required computers did not provide them and 47% specified what software the students must have on the computer.

Social Media Communication Software

Approximately 53% of pharmacy programs used social media in some form (Table 7). At some institutions, course management system communication tools were used, when necessary, in place of social media software. Other institutions acknowledged that no official use of the

Table 6. Computer Requirements for Programmatic Instruction, N=89

	Responses (%)
Are students required to have a computer?	
Yes	48 (53.9)
No	41 (46.1)
Is a specific computer or laptop required?	
Yes	27 (30.3)
No	61 (68.5)
Don't know	1 (1.1)
Which type(s) of computer satisfies this requirement?	
Laptop PC	36 (40.4)
Tablet PC	30 (33.7)
MacBook	27 (30.3)
Netbook PC	19 (21.3)
Desktop PC	8 (9.0)
Desktop Mac	8 (9.0)
Not applicable	34 (38.2)
If a computer is required, does the program supply them?	
Yes, cost built into tuition	11 (12.4)
Yes, students lease them with own funds	1 (1.1)
Yes, students purchase with their own funds	5 (5.6)
No	29 (32.6)
I don't know	6 (6.7)
Not applicable	37 (41.6)
Do you require specific software on these computers?	
Yes	42 (47.2)
No	18 (20.2)
I don't know	2 (2.2)
Not applicable	27 (30.3)

Table 7. Social Media Use for Communication with Students, N=89

	Responses (%)
Social Media Used to Communicate with Students[b]	
Is any system used? (yes)	47 (52.8)
Facebook	
In use	33 (37.1)
Primary	16
Required	0
Twitter	
In use	21 (23.6)
Primary	2
Required	1[b]
MySpace	
In use	6 (6.7)
Primary	1
Required	0
Linkedin™	
In use	5 (5.6)
Primary	0
Required	0
Social Video/Photo Applications Used to Share These Media with Students[a]	
Is any system used? (yes)	39 (43.8)
YouTube (general version)	
In use	18 (20.2)
Primary	10
Required	0
Flickr	
In use	8 (9.0)
Primary	1
Required	0
YouTube (educational version)	
In use	7 (7.9)
Primary	3
Required	0
Picasa	
In use	4 (4.5)
Primary	1
Required	0
Other systems used (eg, In-house application, Media Mill, iTunes U)	5 (5.6)

[a] "In use" refers to the number of respondents that use the technology; "Primary" indicates the number of respondents that use the technology as their primary modality.
[b] Required in selected courses.

media existed, but use did occur inside and outside of courses, including by professional organizations. In addition, social media was used to share video and/or photos by 44% of the colleges and schools.

Experiential Software

Experiential education programs have software requirements in a majority (58.4%) of programs (Table 8) to administrate experiential education, at least from the student interface perspective. Nineteen programs (36.5%) used either E*Value (Advanced Informatics, Minneapolis, MN) or RXpreceptor applications (RXinsider LTD, West Warwick, RI), while 63.5% used other applications including "home grown" or in-house systems. Several respondents stated that changes in software vendors were occurring at the time of the study. Personal digital assistants (PDAs) or smart phones were required by only 11.2% of programs.

Instructional Technology Support

Approximately 60% of responding programs had their own instructional technology unit separate from

Table 8. Experiential Education Software Requirements, N=89

	Responses (%)
Do you require students to use specific software for experiential requirements?	
Yes	52 (58.4)
No	30 (33.7)
I don't know	7 (7.9)
If applicable, which software program do you use?	
E*Value	14 (26.9)
RXpreceptor	5 (9.6)
Other systems used (eg, in-house system)	33 (63.5)
Are PDAs[a] and/or smart phone devices required for students?	
Yes	10 (11.2)
No	76 (85.4)
I don't know	1 (1.1)
Not applicable	2 (2.2)
If PDA devices are required, are students mandated to obtain them from the program?	
Yes, cost is built into tuition	6 (96.7)
No	19 (21.3)
I don't know	11 (12.4)
Not applicable	53 (59.6)
What brand of device is used?	
iPod Touch	10 (11.2)
Smart Phone	2 (2.2)
Palm	1 (1.1)
Other (any of these devices meet the requirement)	1 (1.1)
I don't know	9 (10.1)
Not applicable	66 (74.2)

[a] Abbreviations: PDA = personal digital assistants.

Table 9. Survey Responses Regarding Instructional Technology Support, N=89

	Responses (%)
Do you have a separate IT unit/personnel from the institution's central unit?	
Yes	53 (59.6)
No	34 (38.2)
I don't know	2 (2.2)
If applicable, how many FTEs work in this pharmacy program-based IT unit?	
Range	1-13
Mean (SD), Median, and Mode Response	3.2 (2.7), 2.0, 1
If the program has its own IT unit, what functions are covered?	
Computer hardware/software support	54 (60.7)
Helping in classroom	46 (51.7)
Support for instructional technology	43 (48.3)
Technology training	41 (46.1)
Server support	39 (43.8)
Website creation and support	37 (41.6)
Application development	30 (33.7)
Audio/video support	27 (30.3)
Instructional design	18 (20.2)
Other (eg, Support for online testing)	4 (4.5)
How is new IT paid for in your school/college?	
School/department budgets	63 (70.8)
Student technology/laboratory fees	43 (48.3)
Institution budget line item(s)	41 (46.1)
Institution pays for all technologies	8 (9.0)
Faculty funded	6 (6.7)
Other (eg, grant funding, donations)	7 (7.9)
How is IT maintenance paid for in your school/college?	
School/department budgets	58 (65.2)
Institution budget line item(s)	38 (42.7)
Student technology/laboratory fees	37 (41.6)
Institution pays for all technologies	8 (9.0)
Other (eg, shared with other health science units)	3 (3.4)

Abbreviations: IT= instructional technology; FTEs = full-time equivalents.

the institution's central instructional technology unit, employing a median of 2 full-time employees (Table 9). In order of responsibility, these units supported computer hardware and software, aided in the classroom, supported educational technology, offered technology training, provided server support, and created and maintained Web sites. New technology endeavors within programs were generally supported via college/school or department budgets (70.8%), with maintenance costs funded the same way (65.2%).

DISCUSSION

In this report, we provide a baseline of educational technology use and related support structures that exist among US colleges and schools of pharmacy. The data illustrate an almost ubiquitous presence of at least some form of educational technology among the colleges and schools responding. The most frequently used technology was course management systems (100% of respondents) and the least frequently used technology was microblogging (36% of respondents). Almost all institutions were using some type of technology to present information to students (lecture capture, 69.6%; presentation software, 98.9%; presentation hardware, 75.3%). Furthermore, most programs were using technologies to actively engage students (Web conferencing, 74.2%; interactive

videoconferencing, 61.8%; audience response systems, 88.8%; blogging/microblogging, 59.5%; document collaboration, 66.3%; wiki tools, 66.3%). Although the use of these technologies may be assumed to promote active engagement of students, further investigation is needed to determine whether this is actually the case. A larger majority of pharmacy programs reported using technology to assess student learning (electronic testing, 79.8%; e-portfolios, 85.4%). If use of audience response systems is categorized as assessment of student learning, the rate of technology use for assessment purposes increases to 88.8%. The high percentage of programs requiring students to use the institution's e-mail system (87.6%) suggests technology is routinely used by faculty and staff members to communicate with students.

Educational technology use is trending toward fee-based products for enterprise-level applications (eg, learning management systems, lecture capture systems, Web and videoconferencing, e-portfolios, and e-mail) and free, cloud-based or open source products for collaboration and presentation (eg, blogging, wikis, document collaboration, and presentation software). Such information may be helpful as new and existing programs make decisions regarding the purchase of educational technology.

As technology is increasingly implemented in pharmacy education, appropriate infrastructure should be developed in parallel to promote its success. To this end, more than half of respondents reported having their own technology support personnel. The majority (70.8%) of these positions are funded by college/school or department budgets. Such decentralized instructional technology units often exist to serve the unique needs of an academic program—functions a centralized instructional technology unit may be unable or unwilling to do. The advantages of having instructional technology support personnel who are focused on programmatic needs and responsiveness to faculty and staff members and students require assessment and justification, particularly in the current economic environment that may favor a cheaper, more centralized instructional technology support structure.

Perhaps the greatest impact educational technology has on the classroom and learning, at least in primary and secondary education, is pedagogical. Even as early as the mid 1990s, technology's influence was obviously more on learning activities and outcomes than on routine fact-oriented learning.[17] Technology requires teachers to define what they want to accomplish and question how best to accomplish this outcome. Educational technology stimulates change in the learning environment that fosters student-centered learning. Students take more responsibility for their own learning and teachers work more as mentors and less as presenters of information.[18] Therefore, educational technology in itself has not directly caused improvements in education; rather technology has indirectly influenced positive changes in teaching practice. These changes in pedagogy have generated the success of technology in education.[17]

The academy has been challenged to restructure classroom time for something other than simple transmission of factual information and to adopt an evidence-based approach to instructional innovation and reform.[19] Educational technology can help with the former. Some programs have employed technology (specifically, lecture capture technology) to shift the time and space in which teaching and learning occur. Students' first exposure to new content then can take place outside of the classroom, thereby reserving classroom time for actively engaging students in applying the new concepts and information. Others are employing technologies to encourage collaboration among students. However, as noted by several respondents, little formal assessment has been conducted on the impact technology has on students' achievement of learning outcomes. Given the costs of implementing and maintaining educational technology, as well as the faculty time required to gain fluency with the use of such technologies, development of an evidence-based approach to the incorporation of technology is imperative. One respondent said it best: "Since lecture capture began this past fall with lectures placed on iTunesU, students have expressed that this has helped them learn and study; however, no formal assessment of this has taken place yet." The data presented herein may aid faculty members and administrators in making decisions about the adoption of educational technologies. However, a concerted effort is needed to assess the objective benefits on student learning, especially in postsecondary and professional education, as little data exist outside of primary and secondary education.

How can the information we present be useful to the average faculty member? The database used to generate this report is provided as a searchable database (http://edtech-pharmacy.creighton.edu). The database can be searched by technology category, state (region of the country), or product name. A personal contact from each pharmacy program is also provided to facilitate the sharing of experience. We hope that this database will foster the implementation of educational technology throughout the academy by providing contacts who can aid in choosing technologies and share their experiences in implementing them.

This study gathered information regarding the use of educational technologies in schools and colleges of pharmacy. Yet, information regarding the availability of

resources to assist faculty members in the selection of technologies and preparation of faculty members for using technologies was not specifically collected. AACP has noted preparation and support for teaching activities is imperative to help ensure the success of faculty academic career advancement.[20] Therefore, additional research is warranted to understand faculty support needs and effective support practices for the use of IT in pharmacy education.

This study had some limitations. The reliability of survey data may be limited by the accuracy and knowledge of the respondents. For example, 32 respondents stated that their institution employed a microblogging tool but only 26 could name the product (Table 5). Also, only 10 respondents stated that PDAs were required by their experiential programs, but 25 respondents provided funding data that included/reflected the cost of PDAs for their program (Table 8). Therefore, the data may not be a completely accurate reflection of current educational technology use at each institution. An additional limitation is that an answer of ''yes'' to a question regarding technology use did not necessarily mean widespread use of the technology across the entire curriculum. Moreover, Google Wave (Google Inc., Mountain View, CA) was included in one of the survey items, but is no longer being actively developed. This illustrates that some educational technologies are still emerging; thus, their use by pharmacy programs may fluctuate and be impossible to determine or to define accurately. Finally, without a 100% response rate, our data do not represent all baseline educational technology use in pharmacy programs.

CONCLUSIONS

Colleges and schools of pharmacy in the United States use a variety of education technology solutions. The information provided herein and in the searchable database is intended to serve as resources that foster collaboration and identification of optimal technology-based solutions for enhancing student learning in pharmacy programs.

REFERENCES

1. Young JR. College 2.0: teachers without technology strike back. *Chron Higher Educ.* http://chronicle.com/article/College-20-Teachers-Witho/123891 Accessed May 10, 2011.
2. Grapes ZT, Johnson D, Matthews HW. A survey of instructional technology assets and support services at US schools and colleges of pharmacy. *Am J Pharm Educ.* 1998;62(3):266-270.
3. McKay AB. e-Education: integrating technology to support pharmaceutical education. Chair report for the Academic Affairs Committee. *Am J Pharm Educ.* 2001;65(4 Suppl):8S-12S.
4. Cain J, Fox BI. Web 2.0 and pharmacy education. *Am J Pharm Educ.* 2009;73(7):Article 120.
5. Educause Learning Initiative. 7 things you should know about blogs. Available at: http://net.educause.edu/ir/library/pdf/ELI7006.pdf Accessed May 10, 2011.
6. Educause Learning Initiative. 7 things you should know about microblogging. http://net.educause.edu/ir/library/pdf/ELI7051.pdf Accessed May 10, 2011.
7. Educause Learning Initiative. 7 things you should know about wikis. http://net.educause.edu/ir/library/pdf/ELI7004.pdf Accessed May 10, 2011.
8. Educause Learning Initiative. 7 things you should know about virtual worlds. http://net.educause.edu/ir/library/pdf/ELI7015.pdf Accessed May 10, 2011.
9. Bryant T. Social software in academia. *Educause Quarterly.* 2006;29(2):61-64.
10. Briceland LL, Hamilton RA. Electronic reflective student portfolios to demonstrate achievement of ability-based outcomes during advanced pharmacy practice experiences. *Am J Pharm Educ.* 2010;74(5):Article 79.
11. Educause Learning Initiative. 7 things you should know about lecture capture. http://net.educause.edu/ir/library/pdf/ELI7044.pdf Accessed May 10, 2011.
12. Cain J, Robinson E. A primer on audience response systems: current applications and future considerations. *Am J Pharm Educ.* 2008;72(4):Article 77.
13. Educause Learning Initiative. 7 things you should know about LMS alternatives. http://net.educause.edu/ir/library/pdf/ELI7062.pdf Accessed May 10, 2011.
14. Cain J, Bird ER, Jones M. Mobile computing initiatives within pharmacy education. *Am J Pharm Educ.* 2008;72(4):Article 76.
15. Godwin-Jones R. Mobile-computing trends: lighter, faster, smarter. *Lang Learn Tech.* 2008;12(3):3-9.
16. Moser FZ. Faculty adoption of educational technology. *Educause Q.* 2007;30(1):66-69.
17. Glennan TK, Melmed A. The use and effectiveness of educational technology today. In: *Fostering the Use of Educational Technology. Elements of a National Strategy.* Santa Monica, CA: RAND; 1996:15-45. http://www.rand.org/content/dam/rand/pubs/monograph_reports/2007/MR682.pdf Accessed April 6, 2011.
18. U.S. Department of Education. Technology's impact on learning. From: *Department of Education Forum* 1995. Available at: http://www.nsba.org/sbot/toolkit/tiol.html Accessed May 10, 2011.
19. Blouin RA, Riffee WH, Robinson ET, Beck DE, Green C, Joyner PU, Persky AM, Pollack GM. Roles of innovation in education delivery. *Am J Pharm Educ.* 2009;73(8):Article 154.
20. Popovich NG, Davis PJ, Fuhrman LC, Haddad AM, Monk-Tutor MR, Romanelli F, Meyer SM. Ensuring individual success in an academic career report of the 2004-05 academic affairs committee; 2005. http://www.aacp.org/governance/COMMITTEES/academicaffairs/Documents/2004-05_AcadAffairs_FinalReport.pdf Accessed May 10, 2011.