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# Considerations When Incorporating Technology Into Classroom and Experiential Teaching

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Technology and education are merging in today's society. Students in primary and secondary education recognize technology incorporated into teaching as a standard practice, not a unique experience. Curriculum standards in professional health sciences education have changed to promote the increased use of technology, with the purpose of enhancing student skills and engagement. The classroom and experiential settings offer opportunities for technology to be incorporated in a variety of ways. Technology can be useful for the teacher and student; however, challenges do exist. This paper highlights the benefits and challenges of incorporating technology into the settings of classroom and experiential teaching. Specifically, the purpose and use of technology, equipment, accessibility, time, and costs are discussed and example software programs are described.

**KEYWORDS** education; educational technology; pharmacy student; teaching; technology

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## Introduction

Technology has changed the world in which we live. It has changed how we communicate with others, how we move between places, how medicine is practiced, and how children are taught in primary and secondary education. In fact, the millennial generation expects technology to impact almost every aspect of their lives, including how they are taught.[1] However, the pharmacy education system has been slow to change the teaching paradigm away from the classic lecture system. During the past 2 decades increasing evidence has accumulated showing the positive impact on technology in education provided at both the classroom and advanced practice experience levels.[2–10]

In response to the increasing positive evidence supporting the use of technology in pharmacy education, the college of pharmacy accrediting body, the American Council for Pharmacy Education, and the Center for Advancement of Pharmacy Education have promoted the increased use of technology to enhance the development of student skills and engagement.[1,2,4] Many schools have adapted their curriculum to incorporate technology. In a research paper from 2011, Monaghan et al[2] noted that of the responders to their national survey, 52.9% required their students to have a laptop computer. Additionally, it was found that 100% of the responding colleges used electronic course management systems, 88.8% used some form of an audience response system, and 80% incorporated some form of electronic quizzing or testing software.[2] In a different survey, 70% of students report their schools using technology for some sort of activity in most classes.[3] As these in-class activities have increased in number, it has triggered the need for students to complete additional coursework and review outside of the classroom setting, and new programs have been developed to assist with those tasks.[2,4] In 2 studies of pharmacy students, most respondents stated they were comfortable with using technology[5] and considered themselves "tech-savvy."[6]

The addition of technology has many potential benefits, but it also introduces challenges. Technology can assist with active learning sessions in the classroom to increase student engagement with a subject and provide immediate and meaningful feedback, and it can be used to either clarify new concepts or review previously taught material.[6] It can assist the faculty member or preceptor with organization of materials and assignments, timestamp submission of projects or assignments, be linked to course management systems, including gradebooks, and be used for reflection and metacognition activities.[1,2,6] Barriers include finding the time for both the presenter/preceptor and student to learn the systems employed, the financial impacts on both parties, computer and device hardware limitations, including battery life, and Internet connectivity issues.[6] This paper, rather than focusing on individual software programs, focuses on general concepts to be considered when incorporating technology into a classroom or an experiential setting and discusses both the benefits and challenges of the technology. Specifically, the purpose and use of technology, equipment, accessibility, time, and costs are discussed. Within the text, examples of software programs are incorporated, and the Table provides summary information.[11–18] However, numerous other products exist. The authors are not endorsing one product over another, only providing examples.

**Table.** Example Software Programs for Teaching and Collaboration[11–18]*

| Software Program | Capabilities | Incorporated With Other Technology | Number of Participants | Response Device | Login | Anonymous or User Name Responses | Cost |
|---|---|---|---|---|---|---|---|
| Poll Everywhere[11] (https://www.polleverywhere.com) | Polling, survey; various types of questions | PowerPoint, Keynote, Google Slides | Depends on level of account | Computer, tablet, or smartphone | Not required | Either | Free option with account or paid subscription |
| Turning Point[12] (https://www.turningtechnologies.com/turningpoint) | Polling | PowerPoint or webpages/documents | No limit | Clicker, computer, tablet, or smartphone | Required | Either | Paid subscription |
| Kahoot[13] (https://kahoot.com) | Game-based quizzes; keeps score | No | No limit; can be individual or teams | Computer, tablet, or smartphone | Not required | Username | Free with account |
| Quizlet[14] (https://quizlet.com) | Various games and activities; tracks student progress | No | No limit | Computer, tablet, or smartphone | Required | Username | Free option with account or paid subscription |
| Socrative[15] (https://www.socrative.com) | Game-based quizzes; keeps score | No | Depends on level of account | Computer, tablet, or smartphone | Required | Username | Free option with account or paid subscription |
| Padlet[16] (https://padlet.com) | Digital walls for posting, allowing for participant reactions | Has URL pasting capabilities | No limit | Use website | Not required | Anonymous | Free option with account or paid subscription |
| Trello[17] (https://trello.com) | Document sharing | No | No limit | Use website | Required | Username | Free with account |
| SharePoint[18] (https://products.office.com/en-us/sharepoint/collaboration) | Document Sharing | No | No limit | Use website | Required | Username | Paid subscription |

* Updated as of August 1, 2018.

## Purpose and Use

First, adding technology to an activity or course should have a clear purpose; it should not be added only to say that technology is being used. Second, it is vital to determine how the teacher and the students will use the technology. The use and manageability of the software program are one of the most important aspects to consider when selecting technology to incorporate into the classroom or experiential setting. The software program capabilities should match the needs for the learning outcome. Technology should allow for student participation, thus engaging them in the teaching session. Learning should be fun! Technology can assist with activities and assessments in the class or course or fully become your active learning activities in class. Students can be introduced to material through software programs, or programs may be used to reinforce or apply concepts students learned previously. Identifying the purpose of the technology for the learning activity is key to selecting the ideal software program.

Software programs differ in their capabilities. Audience response systems are commonly used in pharmacy programs.[2] Many audience response programs offer polling, quizzing, or gaming capabilities, such as Poll Everywhere[11] (San Francisco, CA), Kahoot![13] (Oslo, Norway), and Socrative[15] (Edmonton, Canada). Programs may offer a wide variety of types of questions to use in activities, such as Poll Everywhere, whereas other programs limit a quiz to one type of question, such as multiple choice, in Kahoot! Polling questions or gaming activities may have the option of being timed or keeping score in programs, such as Kahoot! and Socrative. If graded, programs may have the capabilities to send the grade to the gradebook of a course management system directly. Tracking the students' progress for the activity may be important to document, or the activity's purpose may be to only provide student self-assessment. A systematic review of 17 studies evaluating the use of audience response systems within health care education found that clickers improved student satisfaction and the learning environment.[7] Some programs are focused on the individual student, whereas others allow teams of students to play games and compete against each other. Most programs are based on the teacher designing activities through the software, with the students using the program in class. Quizzing and gaming activities can be used in the experiential setting when there is down time during the day, or they could be used as an informal or formal assessment tool. There also are several programs, such as Quizlet (San Francisco, CA), where the students can obtain an account to create study resources, such as flashcards, or practice test questions. They can use these materials themselves or share the materials they developed with other students or anyone on the Internet. These types of programs can be used in the experiential setting when needing independent student activities or to assist in the development of poorly performing students.

Software programs may also allow for posting onto websites, such as Padlet[16] (Wallwisher Inc, San Francisco, CA), or serve as a document sharing service, such as Trello[17] (Atlassian, New York, NY) and SharePoint[18] (Microsoft, Redmond, WA). The teacher could be sharing content to the students, or the students could be sharing materials with their peers. This may be beneficial when coupled with real-time teleconferencing programs to allow multisite journal clubs or similar presentations or even topic discussions during rotations. The focus of the software could be to organize materials for class or a rotation and serve as an easily accessible, single location for students to find materials, assignments, or the syllabus. Students and faculty can use this software to organize a research project and monitor timelines on an experiential rotation. Faculty may use document hosting software programs personally for gathering teaching reflections, building dossiers, or sharing promotion materials externally. Electronic portfolio development can occur with programs such as Padlet, Trello, or SharePoint.

Many software programs allow faculty to provide feedback directly to the students. This can be immediate or delayed feedback for assignments or even through quizzes. The timing of feedback may be adjustable and based on when the teacher decides to release the feedback. However, it is important for feedback on the activity to be meaningful to the student. Lastly, peer-to-peer feedback on activities or assignments may be conducted through some software programs.

## Equipment

Determination of required equipment to run the software program is essential. Programs require at least 1 physical device or piece of hardware, with that device most commonly being a computer, tablet, or phone. Generally, the presenter will need to use a device to access the software in order to develop or complete the activities. Physical clickers are used with some programs, but most newer technology relies on Internet-based response though a computer, tablet, or phone, such as Turning Point[12] (Turning Technologies, Youngstown, OH), Poll Everywhere, or Kahoot!. Physical devices can also break or become outdated, needing replacement. Who is responsible for providing the equipment is also a consideration. One study that introduced NearPod (Aventura, FL), an audience response system, into the classroom found almost all students were satisfied using their own devices for activities incorporating technology.[9] Morrell et al[8] also determined that students preferred using their own device to a physical clicker. Certain software programs, such as Poll Everywhere, allow the designer to select the method of response (website address and/or text)

from the student when creating the activity. In the experiential setting, students must be able to access the technology. For example, students rounding in a hospital setting may have their phones or tablet but not a laptop. It is important to consider Internet and cellular phone service capabilities for the presenter and participants when designing activities. Variations in the brand and type of student devices may have technology incompatibilities. Faculty need to remind students to keep all devices up to date. Even devices and software in the classrooms that the faculty use need to be consistently checked and updated, especially if you build the activity on one device and will teach from another device. The compatibility of one product with another product and the integration of one program within another may be deciding factors when selecting a product. Sufficient memory and capability on equipment to run software programs is also important to consider if programs are not cloud based. Additionally, it is important to consider a power source for the equipment in order to use the technology. Because battery life varies per device, students and faculty need to ensure the equipment is able to function to complete the activity. Students need to have easy access to electrical outlets in classrooms or have extra battery sources to use in class or on rotation. Many newer classroom designs have power sources built within tables for every few seats. Access to power sources should be in a safe environment where students and faculty are not in a position to trip over power cords. Portable chargers are commonly available for phones and tablets. Morrell et al[8] found student concern with battery usage was a barrier to student participation. It is important to learn what equipment the program requires for the faculty and students to gain access, design, and fully participate in classroom or experiential activities.

## Accessibility

The different technologies that can be used in class or the experiential setting may be limited by student accessibility. Some of these limitations may be in hardware, whereas others are related to software, licensure agreements, or Internet connectivity and capabilities. For example, if clickers are required for participation, it has to be determined if the students will be expected to purchase the clickers or if they will be provided prior to each class session by the school. The distribution of school-owned clickers can take considerable time and can leave students arriving late for the session without the ability to participate. Integrating software that runs on student-owned laptop computers, tablets, or phones can limit the distribution issues, but this also introduces additional challenges. When requiring student use of their personal devices, there is a need to make sure that the program selected is readily available to students on multiple platforms (e.g., iOS, Android, etc). Additionally, prior to use students may need to register for the software. It is important to realize that this can take quite a bit of time, so it is beneficial to provide the registration information prior to the session so that student can be adequately prepared. A second issue related to accessibility can be limitations of licensure agreements. Many educational technology programs provide a tiered system in relationship to accessibility. This is especially important considering the increase in pharmacy class sizes seen in recent years. A simplified version or a limited number of participants may be provided for free or at a low cost, but unlimited participants and advanced tools may require payment by either the school or the participant. Students report inability to individually access a program as being a major constraint and a factor in decreased engagement.[6] A final consideration regarding accessibility is Internet connectivity and capabilities. Even when students have access to the program, they cannot participate if the location has poor Internet connectivity or speed, or if the server can become overwhelmed when a large number of students attempt to log in at the same time. Information Technology departments can often assist in determining if this may be an issue and suggest adaptions, such as layered logging in schemes or pairing of students. In the experiential setting, students may not be able to access the software or a website because of the institution's Internet security precautions or because they may be in a rural area with poor cellular service and no Internet connection. Accessibility should be evaluated before the activity whenever possible to ensure success.

## Time

As noted in the Accessibility section, time can be a constraint related to educational technology use. Initially, the time constraint falls primarily on the presenter or preceptor as he or she learns the new technology and determines how it can be used appropriately in his or her setting. Less obvious is the time that will be associated with making changes to current lectures, classroom activities, or rotation activities to allot for the technology. For example, if you are using Poll Everywhere or Kahoot! as active learning modalities, each student question along with a short discussion may take up to 2 minutes; thus, a 5-question mini quiz essentially will remove 10 minutes of classic lecture-based teaching. Having the students log in to a quiz or website at the beginning of class may take more than 5 minutes for a class of 150 students to be ready. Even 1 student on rotation who does not have his or her login information can result in a delay in starting activities. The time expenditure is valuable for learning but requires that the presenter adapt other modalities. Students will also need time to master the program. Some of the programs are relatively simple, and most of the polling software is easily learned, but more complex activities and rotation management programs, such as

Trello, may require the student complete a tutorial or spend a significant amount of time touring or testing the program. Most programs have instructional videos or handouts to help students learn the software for design and use purposes.

## Costs

Financial cost is a significant factor that must be considered prior to the introduction of technology in the classroom or experiential site, and it should be evaluated from both the school/site perspective and the student perspective. A primary cost to be considered is the cost for the hardware. If clickers are chosen, the cost can be covered by the college, or it could be passed on to the student individually or through student fees. The cost of future replacement of outdated equipment and software must also be considered. If instead of clickers the program uses the student's personal digital technology device, then most of the cost is transferred to the student. It is easy to initially consider the use of personal devices as cost neutral, but in reality it may be significant, because devices may need to be updated to allow the software to run correctly and to select devices with increased battery life to allow for increased time of use during the day. The software itself may also have a cost attributed to it. From the school of pharmacy perspective, the cost of the software could be negligible for a low number of students or for basic use, but costs can increase with larger class sizes or with advanced options within the software. If students are required to pay a software application fee, this could impact their willingness to use the tool. Additionally, software programs may change their cost structure over time. For example, Padlet was free to use, with unlimited development of pages, until spring 2018, when a maximum page limit was imposed and a cost structure was implemented for additional use. Evaluating all of the potential costs early on can help determine the feasibility of incorporating the technology from the college level and the level of student use along with associated engagement.

## Tips for Incorporating Technology

- Determine potential costs to both the institution and user before planning your session and determine if incorporating technology is viable.
- Seek technology support and education for the program you plan to use. Many program websites, universities, and schools/colleges have tutorials or classes on the software. Video tutorials may be freely available on the Internet. Colleagues may be able to provide one-on-one training or answer questions. Support contact information is also usually available from the software developer.
- Practice the activity multiple times, so you are familiar with how the program runs and how the students will participate in the activity.
- Practice the activity with the actual devices you and the students will use the day of the activity. Other devices may not be updated or have the supporting software programs needed to run the activity.
- Practice the activities in the actual setting to ensure connectivity and accessibility.
- Develop a backup plan if technology fails due to any reason. You want to be able to transition quickly to your backup plan and not lose class time.
- Solicit feedback from the students after using new software program. If there are issues, sometimes they are not brought forth from the student because the assignment did not include individual accountability. If a grade is associated with the activity, issues are typically voiced.
- Analyze and reflect on the results of incorporating technology. What went well? What did not go well? Were the intended outcomes met? What changes need to occur in the future? Use these data to grow as a presenter and improve teaching activities.

## Conclusions

Incorporating technology into teaching can be fun, appealing, and interactive for the presenter and student. Faculty can demonstrate innovation by using technology in the classroom and experiential settings. Students today are very comfortable with the use of technology, especially in a learning environment. Technology added to the learning environment enhances student learning, engagement, and learning outcomes. Once a purpose for the technology is established, evaluation of the use, equipment, accessibility, time, and costs merits consideration before design and implementation occur. Challenges will occur, but planning ahead and developing backup plans can assist with unforeseen issues.

### ARTICLE INFORMATION

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