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Internet-Based Virtual Classroom and Educational Management Software Enhance Students' Didactic and Clinical Experiences in Perfusion Education Programs

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Abstract: A challenge faced by many university-based perfusion education (PE) programs is the need for student clinical rotations at hospital locations that are geographically disparate from the main educational campus. The problem has been addressed through the employment of distance-learning environments. The purpose of this educational study is to evaluate the effectiveness of this teaching model as it is applied to PE. Web-based virtual classroom (VC) environments and educational management system (EMS) software were implemented independently and as adjuncts to live, interactive Internet-based audio/video transmission from classroom to classroom in multiple university-based PE programs. These Internet environments have been used in a variety of ways including: 1) forum for communication between the university faculty, students, and preceptors at clinical sites, 2) didactic lectures from expert clinicians to students assigned to distant clinical sites, 3) small group problem-based-learning modules designed to enhance students analytical skills, and 4) conversion of traditional face-to-face lectures to asynchronous learning modules. Hypotheses and measures of student and faculty satisfaction, clinical experience, and learning outcomes are proposed, and some early student feedback was collected. For curricula that emphasize both didactic and clinical education, the use of Internet-based VC and EMS software provides significant advancements over traditional models. Recognized advantages include: 1) improved communications between the college faculty and the students and clinical preceptors, 2) enhanced access to a national network of clinical experts in specialized techniques, 3) expanded opportunity for student distant clinical rotations with continued didactic course work, and 4) improved continuity and consistency of clinical experiences between students through implementation of asynchronous learning modules. Students recognize the learning efficiency of on-line information presentation but still prefer the traditional face-to-face classroom environment. Traditional paradigms impose limitations that are rooted in dependence upon the students and instructors being physically located in the same place at the same time. These represents significant impediments for PE programs that use geographically separate clinical sites to provide clinical experience. Historically this has led to a disintegration of the presentation of theory, and a reduction in the quantity or quality of clinical experience opportunities. New PE models help to eliminate limitations and improve the quality of education especially in the face of economic challenges. Perfusion education students and faculty will have to work together to find computer-based offerings that are equivalent to traditional classroom methods. **Keywords:** Internet, perfusion education, virtual classroom. *JECT. 2004;36:235–239*

Traditional education models impose requirements that require students and instructors to be physically located in the same place at the same time. One challenge faced by many university-based perfusion education (PE) programs is the need for student clinical rotations at hospital locations that are geographically disparate from the main educational campus. Historically, these geographic challenges have led to a disintegration of the presentation of theory or a reduction in the quantity or quality of clinical experience opportunities. The problem has been addressed through the employment of new perfusion educa-

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Table 1. Internet-based educational tools.

- E-mail, links to instructors and students
- E-mail professional news groups and lists
- Course dates and milestones
- Shared documents (e.g., class syllabi, slide shows and documents)
- Case study presentations
- Forums, threaded discussions
- Chat rooms
- Video and audio streaming, conferencing
- Web links to national professional and certification organizations
- Gaming

Table 2. What students and faculty report about virtual classrooms for clerkships.

Computer-based educational tools:

- Facilitate a group, collaborative learning environment through communication and sharing
- Help to create goal oriented learning environments that support students working as teams to solve problems or case studies
- Are able to automate time consuming processes such as test grading and statistical analysis of case evaluations
- Reduce the cost in the development of accurate educational sources of information
- Evoke a sense of "connectedness" among students

tion models to help eliminate the limitations and improve the quality of education. The purpose of this work is to evaluate the effectiveness of this teaching model as it is applied to perfusion education.

Virtual classrooms (VCs[1]) leverage all of the educational tools of the Internet (Table 1) to build an online classroom environment. The goal to incorporate Internet-based tools into clinical rotation coursework is best summarized by a quote from Turoff (1):

"Our objective is not to merely duplicate the characteristics and effectiveness of the face-to-face class. Rather, we can use the powers of the computer to actually do better than what normally occurs in the face-to-face classroom."

In the last 10 years, private entrepreneurs, businesses, and universities have been developing VC and educational database software to support the management of educational courses at distance. Capella University (2) and the New Jersey Institute of Technology are two excellent examples of Web-based enterprises providing Internet tools for educators. The State University of New York, a sponsoring institution for one of the longest-standing PE programs, supports a model project that allows students to take classes from any place at any time. The project is called the "The State University of New York (SUNY) Learning Network" (http://sln.suny.edu/sln/public/original.nsf).

The most popular VC national providers to universities and businesses are Web-CT™ (http://www.webct.com/), Jones Knowledge™ (http://jonesknowledge.com/), Campus Crossing™ (http://webcrossing.com/), Blackboard™ (http://www.blackboard.com), and web-based virtual classrooms and educational clerkship management systems such as EMS™ (http://www.memsweb.com/) software. Several universities, colleges, and medical schools have established VC Web sites to expand their student connectedness and enrollment. The peer-reviewed educational literature and numerous educational Web sites from the last 5 years insist on favorable outcomes to the adoption of Web-based technologies to support clinical education and control of clerkships (3–18). Table 2 lists the testimony of nonperfusion students reported by faculty using the Web to support clinical education (3–6).

METHODS

Survey items were created to measure the perfusion program customer response to the use of Internet-based educational tools. This initiative described herein is based upon the hypothesis that the quality of the clinical clerkship experience and communication will be superior and that the students' clinical learning curves will be more consistent compared to traditional, non-Internet-based, clerkship management and communication methods. The

Table 3. Implementation of Internet-based educational tools by PE programs.

Perfusion Education Program	Internet-Based Activity
OSU	• Adopted WebCT™ to support didactic and laboratory coursework by posting syllabi, handouts and assignments
UNHSC	• Instituted Blackboard environment to supplement student coursework • Students connect with instructors at distance by video/audio Internet connection
SUNY	• All syllabi, assignments and handouts are available for every course in a password protected Web-based environment • Clinical evaluation objectives and forms are available on-line for preceptor reference and access • Blackboard environment adopted for seminar course on special patient populations allowing students to go to distant clinical sites one semester earlier and for the class to have access to professional experts in unusual techniques.
MWU	• Adopted Blackboard to complement several didactic and seminar courses, posting handout materials and on-line exams • Adopted Blackboard to complement the clinical clerkship courses • Adopted EMS™ to track student and preceptor performance during clinical clerkship courses • Employ e-mail for student—faculty communication • Adopted Blackboard to offer a course in acid-base physiology to students from multiple PE programs • Students take two VC courses from perfusioneducation.com during their second year clerkships for academic credit

[1]The New Jersey Institute of Technology (http://www.njit.edu/old/njIT/Department/CCCC/VC/) has trademarked the term "virtual classroom".

Table 4. Significant Internet-based PE education advances vs. traditional educational models.

- Instant access to course syllabi and documents
- Improved student, preceptor, and faculty communication
- Enhanced access to a national network of clinical experts in specialized techniques
- Expanded and continued didactic activities during clinical clerkship
- Increased continuity and consistency of clinical and didactic student experiences

significant Internet-based activities of four perfusion education programs are listed in Table 3. Table 4 summarizes how Internet tools have facilitated the student experience in these programs.

During this time of scarce educational resources and limited clinician time for teaching, how does an allied health education program facilitate the connection between the program faculty and their students and clinical preceptors? The answer today for these university-based programs is the Internet. At Midwestern University in the Cardiovascular Science Program, as with other large university-based programs, such as The Ohio State University Circulation Technology Division, The University of Nebraska Health Science Center Division of Clinical Perfusion Education, and SUNY's Upstate Medical University Department of Cardiovascular Perfusion, perfusion students are assigned to clinical preceptors at multiple geographic hospital locations from the main campus educational program. As is the case in many allied health profession clinical practicum courses, it is challenging to keep the students' clinical experience consistent between rotations and to assure students are exposed to uniform clinical caseloads and experiences (9,11,13). These programs have adopted the use Internet tools. Table 5 lists the survey items used to measure customer perception of the use of Web-based processes.

RESULTS

Table 6 summarizes the utility that perfusion programs have discovered from the use of VCs and Web-based ap-

Table 5. Hypotheses and survey items to measure customer (student) satisfaction.

Proposed Hypothesies (H)	Survey Items
H1: The quality of the clinical clerkship experience and communication will be superior and preferable to traditional distributed clerkship models	
Survey Questions for H1: A ten-week on-line acid-base course in Blackboard was offered to students from 4 perfusion education programs. Student responses to these items follow:	
1. What is/are the strength(s) of this on-line course?	Students agree that: • course was very organized • communication between students and with instructor was well documented • on-line material was always available to study and refer to
2. Blackboard is easy to understand and use. The course content is logically organized at Blackboard.com. The instructions for using Blackboard are easy to understand and to follow.	90% of the students agreed with this statement.
3. The virtual classroom environment in Blackboard is my preferred learning environment compared to the traditional classroom lecture.	93% of the students disagreed with this statement commenting that they would not want to have all course work offered only on-line.
4. What would you change about this on-line course to make it more effective than the traditional classroom experience?	The majority of students stated that they would not change the acid-base on-line course as presented.
H2: Student clinical learning curves will be more consistent compared to traditional, non-Internet-based, clerkship management, and communication methods	
5. I am learning and understanding clinical applications at a quicker pace now that we use the Internet education tools.	
6. I am able to communicate with fellow students more effectively and efficiently now that we have access to Blackboard.	
7. As a preceptor, I have many more communications with other preceptors and students now that we have access to Blackboard.	
8. As a preceptor, I believe that I have more effective communications with students and program faculty now that we use Blackboard.	
9. As a preceptor, I find the information that I receive from the computer reports by EMS merit my continued Web data entry for the student case evaluation.	
10. As a student, I believe that my clinical clerkship experience is enriched and facilitated with student and faculty use of Blackboard compared to not having Blackboard.	
Questions 5–9 have not been tested in support of hypothesis 2.	

Table 6. How PE programs use Internet-based tools.

• Forum for communication between the university faculty and the students and preceptors at clerkship sites
• Seminar classes facilitating didactic lectures by experts to students at distant sites
• Small group problem-based learning modules
• Conversion of face-to-face lectures to asynchronous learning modules

Table 7. Pros and cons of VCs and Internet-based tools.

Pro	Con
• Benefit from a goal oriented learning environment	• Need for additional computer-based resources
• Content may be easily updated and changed	• Faculty and student time to learn computer applications
• Equal distribution and unlimited access to course materials to all students	• Development time and dollars to develop applications
• Single, reliable source of information	• Finding reliable content experts and authors

plications. The feedback from students using the survey items in Table 5 divulge that students prefer face-to-face classroom experiences to the VC chat room environment. Like other health profession students, Internet applications that allow video and audio streaming are preferable to perfusion students compared to the typed dialogue in the chat room environment. Table 7 lists the pros and cons of Web-based education tools derived from the published literature.

DISCUSSION

Figure 1 depicts the traditional University-based perfusion education program model. Students enroll in the program and begin an intense year of academically challenging coursework. Upon successful completion of the first year of academic and laboratory work where basic clinical knowledge and competencies are mastered, the student begins their second year of clinical clerkships.[2] Traditionally, didactic coursework has come to a stop as students travel to the distributed clerkships. The use of Internet-based education tools by perfusion programs assures that didactic coursework may continue during the clinical clerkship calendar. Perfusion students and preceptors report similar observations when challenged with the open-ended survey items regarding how to improve the Internet experience. Perfusion students recognize the same strengths for online courses as nonperfusion students. Perfusion students and educators will have to work

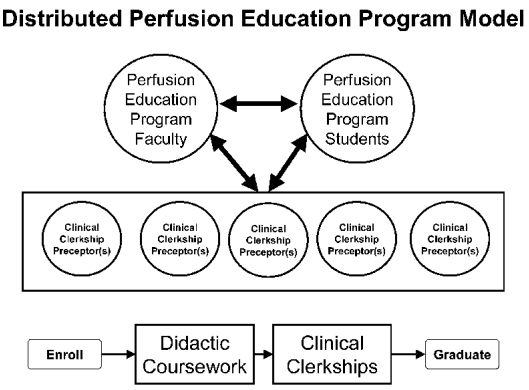

Figure 1. Distributed PE program model.

together to find online learning modes that are as well received by the students as face-to-face classroom interaction.

In recognition of the movement in the perfusion profession to adopt Internet-based education tools the American Board of Cardiovascular Perfusion (ABCP, http://www.ABCP.com/) has written guidelines that allow certified perfusionists to earn Category I continuing education units (CEUs) through computer-based Self-Directed Continuing Education. The ABCP insists that participants take and pass quizzes, and the CEU provider must collect participant feedback regarding the quality of the educational experience. The Accreditation Committee–Perfusion Education (http://www.acpe.org/) has moved PE program accreditation to an outcome measurement model. It is imperative for PE programs to measure both customer (students and employers) satisfaction and educational outcome data as educational processes evolve and hopefully are improved. These satisfaction survey items (Table 5) regarding computerization become even more important as an aspect to measuring indications of program educational en-route and outcome success.

Perfusion education program faculty and leadership must measure and respond to their student and preceptor feedback to continue to develop effective on-line educational activities. Perfusion profession continued education activities will evolve into a strong Web presence. PE programs, professional and private perfusion CEU providers, such as AmSECT (http://www.amsect.org/), the American Academy of Cardiovascular Perfusion (http://users.aol.com/OfficeAACP/home.html), and Perfusion-Education.Com (http://perfusioneducation.com/), with the approval of the ABCP, will develop more online content for perfusionists and perfusion students. Preceptors and health care facilities participating directly with PE programs employing Internet-based tools will benefit by the affiliation and professional networking.

[2]The traditional model is nearly the antithesis of the SUNY model. SUNY students start with integrated clinical and didactic responsibilities for the first four semesters and then only clinical responsibilities in the last semester.

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