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Review of Distance Learning Evaluation Models, Strategies, and Supporting Learning Theories

AETC
NATIONAL
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CENTER

DISTANCE LEARNING LITERATURE REVIEW:
Distance Learning Evaluation Models, Strategies, and Supporting Learning Theories

INTRODUCTION

Distance learning, the use of information technology to deliver instruction to learners in remote locations, is becoming a widely adopted teaching modality within the education and training industry. This teaching modality is used frequently in graduate medical education[1] and increasingly in the world of continuing medical education, which includes AETC trainings. Terms associated with and used to describe distance learning are extensive and include: computer-assisted instruction, internet-based learning, technology-assisted education, and web-based education.

According to the US Distance Learning Association, distance learning is defined as "the acquisition of knowledge and skills through mediated information and instruction. Distance learning encompasses all technologies and supports the pursuit of lifelong learning for all".[2] For the purposes of this review, we place the following terms under the broader umbrella of distance learning.

Table 1: Traditional and Distance Learning Taxonomy

Term	Definition
Traditional teaching	Delivering teaching face to face, typically in a classroom setting
Distance learning	Delivering teaching to learners who are not physically present. Also called eLearning, online learning, or Internet-based learning
Technology-assisted education	Computer-assisted instruction, web-based education simulation, and virtual reality technologies
Telemedicine	The use of telecommunication and information technologies to provide clinical health care at a distance, to eliminate distance barriers, and improve access to medical services that are not available in rural communities.
Telehealth	Health-related services and information delivered via telecommunications. Telehealth is an expansion of telemedicine, which also encompasses preventive, promotive, and curative aspects.
Blended learning	An approach that combines distance learning with traditional instructor-led training e.g., a lecture is supplemented by an online tutorial

METHODS

In October 2011, we entered the terms "evaluation, distance learning, continuing medical education" into PubMed and identified articles specifically reporting on outcomes of studies examining the effectiveness of distance learning techniques in the context of continuing medical education. We relied heavily on the authors David Cook and colleagues because of their comprehensive and extensive knowledge on the topic. In January 2013, we updated the literature review to reflect articles published through the end of 2012.

RESULTS

The documented benefits associated with distance learning include easy access, flexible timing, ability to meet different learning styles, interactivity, and learning and communication without consideration to geography or time zones. [3, 4] Easy access to learning opportunities refers to a learner's ability to find "what is needed, when it is needed." Thus, because learning tends to be an unplanned experience,[5] improving access is a central advantage over traditional training methods. Distance learning is also cost-effective and the evidence base supports that learners prefer distance learning over traditional educational venues.[6] Many of the aforementioned benefits are a subset of best practices in adult learning principles, particularly the flexible timing which allows for learners to tailor their learning experience to occur when they most likely need the information. Interactivity is another common practice in ensuring that trainings incorporate adult learning principles.

In terms of effectiveness, numerous studies have been conducted and summarized in review articles. For example, a review of 130 articles published between 1990 and 2007 reporting comparisons of internet-based instructional methods against no intervention and of 126 interventions evaluated using knowledge outcomes, all but two reported a benefit from e-learning. The review identified 76 studies comparing an internet-based instructional intervention to a traditional teaching intervention and discovered the difference between e-learning interventions and traditional methods is "minor, if it exists at all".[7] In a review conducted by Jwayyed et al, 67% of the studies that directly compared knowledge gains in traditional vs. technology-assisted methods found technology-assisted approaches to be equal or superior to traditional teaching methods.[1] Thus, there is general agreement that technology-assisted education methods can be a possible alternative to classroom or traditional lectures.[8, 9] However, the evidence thus far does not necessarily indicate that technology-based teaching and traditional teaching methods are "interchangeable".[1] There are several outstanding questions that warrant further research. Researchers highlight the need to investigate the questions of when, where, and how to best use technology-assisted education.[1, 10] These questions have not yet been adequately addressed by the existing literature. Evaluating the best use of distance learning is necessary to ensure that valuable resources are not wasted and to avoid implementing ineffective instructional methods, concerns raised by Jwayyed and colleagues in the 2011 review article.

There are multiple challenges associated with determining the efficacy of distance learning. The meta-analysis by Cook et al, which included studies with a wide variety of topics, settings, and assessments, found that confounding effects are unavoidable in media-comparative studies. Cook et al recommends "head-to-head comparisons of different e-learning instructional interventions" to determine when to use e-learning and how to use it effectively.[7] Cook also advises researchers doing head-to-head comparisons to sufficiently power their studies to show statistically significant differences because the expected effect size will be smaller than when comparing an active intervention with no intervention.[11] Below we outline an evaluation framework in which to attempt to answer these important questions.

The importance of instructional design: making the best use of technology

Because distance learning has been shown to be as effective as traditional classroom methods, it is increasingly important to recognize that "technology, no matter how advanced, cannot compensate for its misapplication".[12] Attending to instructional design is then "the key to unlocking the true potential of available learning technologies." **Instructional design is "the practice of maximizing the effectiveness, efficiency and appeal of instruction and other learning experiences. The process consists broadly of determining the current state and needs of the learner, defining the end goal of instruction, and creating some "intervention" to assist in the transition."**[13] Or put in simpler terms: instructional design focuses on the most effective way to present content. More importantly in the context of distance learning, instructional design plays a key role in bridging pedagogy and technology. Given one of the most pressing research questions associated with the evaluation of distance learning is that of determining when and how to use distance learning, turning to experts on instructional design can ensure that curricula are well organized and that strategies for teaching via a chosen medium have to be well-thought-out. Consideration of instructional design can help AETC trainers make the best use of technology. Many of the concerns of online learning such as learner resistance and poor learner performance can be addressed through careful development and a systematic design process. [12, 14, 15]

More research is needed on instructional design to ensure that distance learning activities are effective. For example, studies are inconclusive at this point on the topic of self assessment and feedback in the context of distance learning. These techniques are often effectively used in traditional learning environments; thus, theoretically authors believed these strategies would prove effective in distance learning environments as well. Yet research bears out that this is not necessarily the case. The same is true in the case of adapting the distance learning activities to suit the learning style of the learner. This was also thought to be promising, but results have been mixed. [16, 7, 17] While adult learning theory has had a significant influence on medical education in the last three decades, its influence may not be fully realized in distance learning educational strategies.[18]

Educational strategies shown to be effective in distance learning

Distance learning has been said to be "neither inherently superior nor inferior to traditional instruction; rather they are different and complementary".[19] The key question at this point in the literature is to determine when to use distance learning. Cook et al provides evidence on when and how to effectively use internet-based learning. Based on a meta-analyses of 50 studies, they determined that <u>interactivity, practice exercises, repetition and feedback</u> appeared to be associated with improved learning outcomes.[17] This ambitious systematic review of the literature concluded that further research was necessary to answer the questions on when and how to effectively use internet-based learning. This recommendation was supported in a 2011 publication by Jawayyed et al which concluded that questions of when, where and how to best use technology-assisted education have not been adequately addressed by the existing literature.[1] In a 2005 publication on the results of a randomized control trial, authors Allison, JJ et al reported on the effectiveness of "multicomponent CME or mCME" to change provider practice behavior on chlamydia screening rates. The trial demonstrated that an Internet CME program

"significantly blunted a decline in Chlamydia screening rates observed in comparison offices." The mCME was developed based on the theory of behavior change, case-based learning, and performance feedback whereas the control arm included traditional CME lectures, printed materials, and Internet programs relying only on flat text. The mCME modules were customized in real time as the physician interacted with the computer and respected the limited time of clinicians to engage in educational activities.[20] This study is promising in light of the similarity of training environments, targeted learners, and topical areas that the AETC's faculty is a part of.

Visualization has been shown to improve learning.[21] Thatcher 2006 suggested the multimedia teaching that was possible with computer-assisted instruction enriching learning.[22] Glittenberg & Binder 2006 noted that the complex material could be demonstrated in a richer fashion using computer-assisted instruction than was possible with traditional teaching methods.[23] Thatcher and Glittenberg & Binder are supported by Mayer 2009 which contends that multimedia learning made possible with technology-assisted education allows information to be presented to the student using multiple sensory pathways.[24] This aids the students' development in understanding the material.

The online format of distance learning offers learners two possibilities of engaging in discussion: **synchronous or asynchronous**. During synchronous discussions, participants of the discussion all meet at the same time whereas during asynchronous discussions, learners can take part in the discussion at any time. Each strategy has advantages. During synchronous discussions, learners are able to work collaboratively and receive instant feedback. During asynchronous discussions, learners have more time to think about the topic being studied and have a more meaningful analysis. Anecdotal reports of the integration of distance learning into traditional medical school curricula suggest that a combination of synchronous and asynchronous learning may sometimes be most appropriate (for example students watch a recorded video lecture ahead of a scheduled online group discussion section).[25]

Interface design considerations in developing distance learning curricula

Because the learning environment in which distance education takes place is very different from a face to face learning setting, it is important to understand how interface design variables, e.g, screen layout and organization, facilitate or impede learning. The software development field has taken seriously usability and usability testing, but these principles have only recently been applied in the context of distance or e-learning.[26, 27, 28, 29] Usability testing is a systematic process that evaluates the ease with which users can use the tool to achieve their goals. In an article by Sandars and Lafferty 2010, they present a compelling argument for conducting usability testing to develop effective e-learning curricula in medical education.[30] They point out that in the context of distance or elearning, the learner is affected by the technology used to deliver the curricula as well as the educational content. And yet the point at which evaluation of the technology is conducted takes place after training or when the technology has been developed and implemented, instead of during the development process when corrections and adjustments could be made to improve usability. In conducting usability studies there are five main areas to cover: navigation, learnability, accessibility, consistency, and visual design. It is also important to ensure that content is compatible across a wide variety of operating systems, different browsers, and versions of browsers. In an evaluation framework for distance learning, we

propose to advocate for and assess the acceptability and feasibility of conducting usability studies in the context of AETC distance learning. Fortunately, conducting usability studies demands input from a small number of people; Nielsen 1994 reported that 95% of usability problems can be discovered with 5-6 people.[31]

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