METHOD, MEDIA, AND MODE Clarifying the Discussion of Distance Education Effectiveness

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The increasing emphasis on distance learning across all segments of education has prompted questions about the quality of these offerings. Evaluation efforts of such distance courses or programs often focus on a single question, "Does this distance learning experience delivered through technology provide the same quality of education as a course on campus provides in a face-to-face delivery mode?" Even more problematic, distance education (DE) delivery technologies are often cited as providing learning experiences equivalent to those in a campus-based setting, or environments commonly labeled "traditional instruction." This exclusive focus on technological systems as the influencing factor of the effectiveness of the learning experience is misleading. As empirical research has proven, technology itself does not produce instructional outcomes; it is merely one variable among many that contribute to effective learning experiences. Ross (1994) uses a cooking metaphor to exemplify the idea that a variety of "ingredients" contribute to the success of an instructional event, as well as the context of the collective recipe, the chosen cooking method, etc. Unless we clarify the real "ingredients" (and their interactions) that affect distance education effectiveness, we are doomed to repeat the extensive research on technology in instruction that historically has yielded no significant difference (Lockee, Burton, & Cross, 1999; Lockee, Moore, & Burton, 2001).

This paper is meant to present a framework for understanding three of the primary variables that comprise the design and delivery of distance education, and to emphasize the importance of discriminating between them in the process of evaluating instruction. We will define these components as the "3 M's" of the distance education environment: the teaching **Method**, the **Media** attributes, and the delivery **Mode.** Although DE systems are truly comprised of many factors, it is important to place emphasis on these specific three, as they are all too often used interchangeably in the discussion of distance education effectiveness. While the 3M's are distinct variables within DE, they are also necessarily interdependent, and that may be where the confusion lies. The

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following analysis describes each of these system components, as well as identifies their inter-relationships. The purpose of this review is to clarify the discussion of distance education quality, as well as to focus faculty and instructional developers on the critical factors that influence success in such distributed environments.

INSTRUCTIONAL METHOD

Instructional methods are defined as those strategies or techniques used to facilitate intended learning outcomes. Sometimes called teaching methods or instructional strategies, selection of these methods is based on instructional design principles, after determining the learner needs. In order to choose the most effective strategy, instructional developers must consider the type of learning outcome to be targeted, as well as learner characteristics. Based upon these factors, developers can then select appropriate methods that will facilitate the stated course objectives.

Joyce & Weil (1996) detailed a variety of teaching methods organized according to intended instructional outcomes. For example, strategies such as mnemonics and advance organizers are effective for learning declarative knowledge, while methods like group investigation and inquiry training address both the acquisition of conceptual information, as well as the development of inductive problem-solving skills. Weston & Cranton (1986) offered a categorization of instructional strategies that group teaching methods based upon specific characteristics. Instructor-centered methods, in the form of lectures, questioning, and demonstrations, are perhaps the most commonly used strategies in face-to-face classrooms. Interactive methods, such as class discussions or collaborative activities, are based on communication either between instructor and student or between students. Programmed instruction and modularized instruction are examples of individualized learning methods—techniques that address individual learning styles by allowing students to engage in instruction at their own pace. Experiential methods, such as clinical experiences, role-playing, and simulations, offer learners realistic contexts in which to apply content-specific knowledge.

While the detailed explanation of instructional methods may seem to belabor the obvious, it is this term that has become commonly misused in the discussion of distance learning effectiveness. Often distance education is referred to as a teaching method when, in actuality, it is the tool that facilitates the implementation of a selected instructional strategy. The following description of the two remaining DE system variables, media attributes and delivery mode, will assist in the clarification of this concept.

MEDIA ATTRIBUTES

After selecting appropriate instructional methods to obtain the desired learning outcomes, instructional developers can then determine the media attributes necessary for implementing the chosen teaching methods. Developments in software design tools have provided the means to produce learning materials whose media attributes explicate complex theories and provide insights for novice learners. Media attributes are traditionally defined as "...the properties of stimulus materials which are manifest in the physical parameters of media" (Levie & Dickie, 1971, p. 860). provided a comprehensive taxonomy of physical media attributes, including sign types, sensory modalities, and level of realism. Contemporary views of technology as "tool" (Salomon, 1993) illustrate that media attributes are also manifested in the functional parameters of media. These functions are capable of actively involving the learner in pursuits recommended by the chosen teaching methods such as collecting, organizing, or discussing course material (Hannafin, Land, & Oliver, 1999).

Physical Attributes

Different media are capable of representing information in inherently specific ways. Levie & Dickie (1971) categorized possible representations, or *sign types*, as either iconic or digital—iconic being an image that somehow depicts its referent, and digital being an abstract portrayal such as words or numbers. Wileman (1993) offered a variation of this schema by identifying symbol groups as pictorial, graphic, or verbal. Pictorial images are meant to represent a given object with some degree of realism, usually through media such as photographs, drawings, etc. Graphics are more abstract visual depictions of such objects, while verbal symbols equate to the aforementioned digital sign type—complete abstractions typically in the form of language representations.

Another attribute is the ability of a medium to deliver information via specific *sensory modalities*, such as auditory or visual channels of communication. Instruction received through specific channels has additional relevant attributes. Visual representations have a sense of permanence, while auditory data are transient, "finite in duration" (Levie & Dickie, 1971, p. 867). This characteristic is referability, the capacity to review information. While asynchronously-delivered, stored audio has greater referability than live, synchronous delivery because learners can replay instructional material. Due to their sequential nature, auditory representations more strictly define the rate of information flow as compared to visual information. Visual stimuli can be simultaneous, and access to visual information is more rapid than auditory information, whether the representation is pictorial, graphic, or verbal. The fixed pace of auditory information is sometimes seen as an instructional limitation versus the flexible pace of engaging with visual material.

An instructional image's *level of realism* is another attribute of visual media. While much debate has occurred over the educational benefits of more realistic visuals such as photographs or video, the general conclusion is that realism is only necessary when relevant to the learning outcome (Dwyer & Lamberski, 1983). Levie and Dickie (1971) similarly supported this finding regarding three variables associated with realism: amount of detail, the presence of color, and the presence of motion.

Functional Attributes

In addition to physical attributes a medium can possess functional attributes such as the ability for learners to *assess their progress*. For example, textbooks often provide readers with content-related questions or problems as well as a key of correct answers to provide learners with feedback. Similarly, computer-based programs can be designed to not only identify when an answer is correct or incorrect, but also to provide extensive feedback regarding *why* a response is incorrect and to offer additional assistance in the search for the appropriate answer (Levie & Dickie, 1971).

Table 1 presents a taxonomy of functional media attributes adapted from Hannafin, et al. (1999).

As Table 1 illustrates, students may benefit most from functional media attributes when the chosen instructional method requires them to actively process information and construct original responses to novel situations. If students are only asked to repeat textbook- or lecture-delivered content on a test, fewer functional attributes will likely be required. By contrast, if an instructor selects a debate as a classroom method, students may benefit from functional media attributes that allow them to seek information about multiple perspectives of an issue, organize information in pro-con tables, generate information such as persuasive posters, and discuss or debate information with students in peer institutions. Likewise, if an instructor selects problem solving as a classroom method, students may benefit from functional media attributes that allow them to organize information collected during research into conceptual categories, and integrate their own thoughts or preliminary hypotheses

TABLE 1
Taxonomy of Functional Media Attributes

Media Features or Technological "Tools"	*Possess Functional Attributes that Enable Students to:*
Search engines, indices, site maps	Seek information
Bookmarking, cut & paste	Collect information
Software to construct tables, charts, diagrams, timelines, concept maps	Organize information
Note-taking, annotating resources	Integrate information
HTML text editors, web page generators, video editors, word processors	Generate information
Simulations, microworlds	Manipulate information
E-mail, listservs, bulletin boards, video conferencing	Discuss, debate information
Digital drop boxes, file sharing, collaborative web editing, "groupware"	"Collaborate on shared task
Quizzing, drill, and practice	Assess progress
Directions, instructions, strategic advice, action or goal manager	Ask for help or guidance, plan appropriate tactics
Color filtration, screen magnification, text-to-Braille scan converters, audio frequency modifiers, captions	Access information without regard to original format

alongside that information as notes. Students might also employ computer simulation or experimentation to manipulate information and modify hypotheses, eventually generating reports to share with peers.

DELIVERY MODE

The technological system used to convey instruction to the intended audience is referred to as the **delivery mode**. Examples of distance education delivery modes include interactive videoconferencing, Web-based course management systems, or hybrid approaches that incorporate a variety of technologies.

Ideally the delivery mode should be chosen based on it possessing the necessary media attributes required to implement the chosen teaching methods. However, the selection process does not always proceed in this manner. It may be pre-determined by logistical constraints and the resources available. These could include the provider's existing infrastructure or end-user constraints, such as access to a potential receive site or personal computing resources.

A commonly used matrix to describe the instructional environment is based on the variables of time and place. Although this presents an overly simplified view of a complex environment, it has proven to be a useful organizer, and provides a helpful graphical display for discussion. Each of the four quadrants is explained as follows (see Figure 1).

Same time/Same place

Instruction occurring in this quadrant is often referred to as the "traditional classroom"

		Place	
		Same	*Different*
Time	*Same*	Traditional Classroom	Conferencing Applications
	Different	Lab-based Instruction	Web-based Instruction

FIGURE 1
Instructional Environment

approach, although most would find such a generalization problematic. Generally speaking, this model of education occurs when instructor and student are face-to-face in a classroom-based setting. The teaching methods used in this environment may be constrained by class size and the physical arrangement of the space.

Same Time/Different Place

This quadrant describes "traditional" distance education and usually relies on video-based delivery systems. This could include one-way satellite systems, or two-way interactive video via room-based or desktop systems. The teaching methods used in this environment may be constrained by the delivery systems described above, with desktop conferencing providing many more options than satellite.

Different Time/Same Place

This quadrant describes the distributed learning environment in a campus setting that usually relies on computer-based delivery systems. These systems provide access to specialized instructional materials, such as curriculum-specific software. The teaching methods used in this environment could include a wide range of possibilities, such as self-paced, collaborative, problem based, or cooperative learning methods.

Different Time/Different Place

This quadrant describes a "virtual" learning environment, and could include a wide variety of delivery modes: paper-based content, audio- and videotapes, CD-ROM, and Web-based modes. Since, by definition, these courses are asynchronous, there are some constraints on the teaching methods available, such as live discussion methods, for example.

Hybrid Models

While the above description of the instructional environment has proven helpful in describing the possibilities available, in many cases a combination of these settings are used in so-called hybrid courses. For example, in the virtual learning environment, students may be periodically engaged in prearranged live chat sessions—even though the students are widely dispersed geographically.

APPLICATION OF THE THREE M'S

What years of research in instructional technology have revealed is that it is not the delivery mode that primarily impacts learning. Instead what matters most is the combination of many factors, including the appropriate choice of teaching method and the design of content with media attributes that support the instructional goals. Furthermore, to implement our understanding of these three primary components most effectively, it is critical to systematically rethink the instructional design process, applying the principles of analysis, design, development, and evaluation. The following examples are intended to further clarify the value of the "3 M" conceptual scheme in implementing and evaluating instructional technology.

Online Courses

Courses offered online use the Internet to deliver course content to students. This is an obvious statement that actually says nothing about the teaching method or the media attributes of the course content. "Online" is merely the delivery mode for the courses. Yet there is much discussion regarding the quality of online courses compared to courses delivered in the face-to-face mode. The important point is that, like any course, the quality of the online course depends primarily on the teaching method and use of media attributes—and much less so on the delivery mode. The more

relevant question, then, is whether the teaching method requires active learning by students and whether the content has media attributes that clearly assist students in learning complex concepts. For example, if students are expected to understand the three-dimensional relationships of chemical compounds and use these concepts to explain and predict chemical reactions, it is essential that the treatment of the instructional content provide the appropriate 3-D models to ensure the quality of learning. In addition, if students are expected to calculate solubility coefficients in aqueous chemistry, they must engage in active problem-solving of these problems. The teaching method must require that students actually solve problems that are challenging, yet within their capabilities, especially in the early stages of the course. Students also need timely feedback on their problem-solving activities. It is important to note that these concepts could be delivered in a variety of delivery modes depending on the needs and circumstances of the course. For example, the content could be delivered in a computer-based format, on videotape, or through a live lecture. While each of these delivery formats will have some impact on the quality of the learning environment, the teaching method and the media attributes are the more powerful variables.

Interactive Videoconferencing

Courses delivered through the interactive videoconferencing mode are often compared to traditional classes offered face-to-face. It is not surprising that these comparisons generally show no significant difference between the two cases. If the focus were simply on comparing the delivery mode of interactive videoconferencing and face-to-face instruction, differences in student achievement would not be predicted. A more important question would be to compare different teaching methods over interactive videoconferencing, or to compare a variety of media that incorporated powerful attributes, such as animation and feedback.

For example, in a public speaking class via interactive videoconferencing, does the instruction incorporate teaching methods that instill confidence in the students? Are there animated sequences showing appropriate breathing for enhancing voice projection? The instructor could use the system to present information via lecture and also to demonstrate appropriate and inappropriate techniques for public speaking. The videoconferencing system also supports the need for student practice and engagement in the instructional activity. Distance learners could easily give speeches to the distributed class using the videoconferencing technology and also receive immediate feedback from the instructor and their distance classmates. An appropriate question in this case would be to explore whether the instructor provided feedback to students in a positively reinforcing manner.

Case Study of Instructional Design

The following case study provides an example of a distance learning course that was developed using the principles of instructional design (ID).

The course in question is a graduate level course in Civil Engineering. The faculty member worked in a team environment that included an instructional designer, graphic artist, and a programmer. Early in the analysis phase of the instructional design process it was determined that the course needed to be offered as an online course in an asynchronous delivery mode. This decision was based on the prospective students' demographics—busy professional engineers who needed access to course content any time, any place. Typically, the instructional delivery mode is chosen later in the ID process, after the teaching method is selected. However, the essence of distance education is access, and so the delivery mode is usually selected based on the logistics of learner access.

Following an instructional analysis of the content the designer determined that job-related problem-solving skills were a critical outcome for the learners. Therefore, the appropriate instructional method presented students with many opportunities to work on authentic civil engineering problems with frequent feedback to guide their progress.

Further analysis showed that pictorial media attributes were required throughout much of the content to show students complex construction details. It was also necessary to use animation sequences to show the potential problems of poor design procedures that would occur as structures aged. An example of this type of realistic problem was a highway bridge that had fallen into a dangerous state of disrepair. A textual description of the problem accompanied pictorial representations of the structural problems given through photographs of the damaged bridge and graphic illustrations that highlighted its structural flaws. After the problem's context was established, mathematical representations of force were presented for students to calculate based on the preceding scenario. With immediate feedback important to prevent students from doing additional work under false assumptions, the website's HTML code generated instant responses to the students' calculations. If the students' responses were correct they could proceed to the next step in designing the repair of the bridge. If not, they had to attempt to solve the force computation problem again until they produced the correct response.

All of the preceding instructional method choices—presentation of information, problem-solving, and mastery learning—were made to ensure that the course attained its instructional objectives. The media attributes (text, pictorial elements, animation sequences, and interactivity) were designed to explain complex civil engineering problems. The delivery mode provided an effective and efficient means for working professionals to access this course without having to travel periodically to the main campus or to an educational center.

A SYSTEMATIC PERSPECTIVE

When assessing the effectiveness of a given distance education experience, perhaps evaluators will focus the questions on the many factors that influence learning, such as the selection of appropriate instructional methods or the leveraging of suitable media attributes, instead of simply concentrating on the delivery mode itself. Application of the principles of instructional design allows us to ask more relevant and fruitful questions, such as: Did the collaborative learning environment used in this distance-delivered course affect the quality of education when compared to a purely teacher-led direct instruction method? Did this full-color animation help students learn a complex concept when compared to a static display? In other words, did the teaching method or the media attributes enhance the learning environment, regardless of delivery mode? As Clark has long suggested (1994, 2001) effective mediated instruction will rely on effective instructional systems design, not on the delivery technologies as a single component of those systems. His theoretical perspective supports the idea that the discussion of distance education effectiveness be based on the careful identification of the system's components and their symbiotic relationships that combine to create productive learning environments.

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