Jl. of Educational Multimedia and Hypermedia (2000) **9**(3), 169-194

The Development and Evaluation of a Multimedia Course on Educational Collaboration

MARSHALL WELCH AND KERRILEE BROWNELL
University of Utah
Department of Special Education
1705 E. Campus Center Drive Room 221
Salt Lake City, Utah 84112-9253 USA
welch@gse.utah.edu

This article describes the development, implementation, and evaluation of a multimedia teacher education course on collaboration employing stand-alone video presentations, CD probes, support materials, and textbooks as part of a three-year, federally funded project. This includes a description of front-end evaluation used to identify salient features of specific media to be used in unique instructional activities. This article also provides an overview of the theoretical principles used in the instructional design of the program. Detailed descriptions of the production process and the multimedia program itself are presented. In addition, this article reports the results of quantitative and qualitative analyses conducted to assess the overall response to and impact of the program.

Technology is effective when developers thoughtfully consider the merit and limitations of a particular application while employing effective pedagogical practices to achieve a specific objective (Mecklenburger, 1990; Salomon, 1990). Instructional objectives should drive decisions as to what technology is to be used and how. Tessmer (1993) argued that developers should not simply use a specific form of technology because "we can." Instead, he urged researchers and developers to conduct "front-end" evaluation to carefully consider the suitability of a multimedia format in terms of the instructional objectives. This involves assessing the versatility and richness of

the medium and how it enhances the learning experience. Tessmer (1993) also suggested that developers employ formative evaluation procedures that include the use of testing prototypes to evaluate multimedia products. The formative evaluation process includes assessment of three distinct dimensions: (a) user interface, (b) multimedia integration, and (c) the learning experience.

User interface is the interaction between the technological tool and the user (Reisner, 1987). One aspect to consider is the transparency of the technology that refers to the intuitiveness of working with the product. The more transparent or "user-friendly" the technology, the more a learner can concentrate on the learning experience. Multimedia integration refers to the seamless organization and utilization of multimedia attributes to the program and content (Tessmer, 1993). It is an effort to bridge the content to the learner in various ways. Consequently, developers must carefully consider how to organize the information for the desired learning experience. Finally, evaluating the learning experience can be accomplished by a variety of ways. One is simply surveying consumer satisfaction. Another method is looking at learner performance to determine if new knowledge and skills were assimilated or applied.

Challenges

A major challenge related to using technology in education is the lack of theoretical frameworks used in the development and implementation of a particular tool or approach (Milheim & Martin, 1991). "Media research has generally not been theory based" (Wetzel, Radke, & Stern, 1994, p. 198). It is incumbent upon developers of technology-based instructional programs to base their work on sound theoretical principles. Likewise, it is helpful when these theoretical models are described in reports. Therefore, it is critical that researchers and developers articulate the theoretical foundations from which they develop educational technology applications

Finally, much of the information in the literature lacks adequate description of development and production procedures. In addition to describing methods, developers must also report the type of hardware and software used in creating their multimedia products. Detailed accounts of production procedures and use of equipment assist other developers as they attempt to replicate or explore alternative production methods.

PURPOSE

Each of the methods of front-end formative evaluation enumerated previously was employed in the development and evaluation of a multimedia program designed to prepare educators to use collaboration in serving students with special needs. This article describes the development, implementation, and evaluation of a multimedia teacher education course on collaboration employing stand-alone video presentations, CD probes, support materials, and textbooks as part of a three-year, federally funded project. This description includes an overview of the theoretical principles used in the instructional design of the program. Detailed descriptions of the production process and the multimedia program itself are presented. This article also reports the results of quantitative and qualitative analyses conducted to assess the overall response to and impact of the program.

APPLIED THEORETICAL PRINCIPLES OF INSTRUCTIONAL DESIGN

Principles from three theoretical models were incorporated in the development of the multimedia program. While each model is related, each serves specific functions in electronic-mediated learning. The theoretical constructs were considered in the decision making and development of specific components of the multimedia program.

Symbol Systems

Video-mediated instruction combines visual and auditory symbols that are processed by learners. Olsen's theory of instructional means (1976) and Salomon's media attributes theory (1979) have been developed to explain the effect of combined symbol systems. Olsen maintained that learning occurs when information is assimilated, processed, and stored. However, different learning activities and media used in the learning activities impact the way a learner processes the information. As such, the cognitive process requires the student to use various skills associated with the task, such as viewing verses, reading, listening, or a combination of presentation modes. Likewise, media are limited in the ways information can be presented. Information presented and obtained from printed materials is a different process than using video or audio. Salomon (1983) therefore argued that the amount of invested mental effort a student exerts in the learning process

could effect what is learned. He maintained that the closer the match between the instructional presentation and the cognitive process, the easier it is to process the instructional content. Consequently, specific types of symbols can facilitate the cognitive process of assimilating information. For example, the appearance of key words in the lower third of a video monitor coupled with a narrative presentation may prompt or cue a viewer to take notes. That tactile paraphrasing of the visual and auditory information facilitates the cognitive process of understanding. Learners essentially learn these symbols as they learn the content. Therefore, combining visual and verbal information in video presentations can be as effective or better than employing a sensory input source alone (Wetzel, et al., 1994).

Schema Theory

When learners begin to learn how to use symbols as tools, they are developing ways of managing new information and knowledge (Kozma & Croniger, 1992). This process represents the use of a mental model or schema (Kozma, 1991) that facilitates understanding. Learners use these models as tools to activate their prior knowledge as a reference point to help establish meaning with new information. Using schema enables a learner to organize large amounts of information into units of knowledge (Borich & Tombari, 1997). Video-mediated instruction is capable of delivering information in a manner that uses the learners' schema to facilitate understanding (Rumelhart, 1980). For example, a "virtual field trip" in a video presentation depicts information that evokes prior knowledge and experience of a similar setting known to the learner. Likewise, a computer-based tutorial is capable of using portions of previously viewed video presentations to reactivate information assimilated by the learner that can then be applied in a new task to facilitate understanding or generalize skills.

Instructional Events Model

The Instructional Events Model (Gange 1977; Gange, Briggs, &, Wagner, 1992) consists of nine key elements or instructional events. These components reflect the fundamental principles and procedures of effective instruction described by Rosenshine and Stevens (1986). The instructional events include: (a) gaining the learners' attention, (b) stating learning objectives, (c) guiding the learners through learning activities, (d) presenting

information with specific characteristics, (e) coaching through learning exercises, (f) facilitating interactions during activities, (g) providing constructive feedback, (h) assessing learners' performance, and (i) promoting transfer of assimilated skill and knowledge. Reeves (1989) incorporated these elements into seven activities to promote effective video-mediated instruction: (a) stating learning objectives, (b) providing previewing activities, (c) presenting specific, focused viewing topics, (d) breaking up viewing into segmented activities, (e) conducting postviewing activities, (f) providing follow-up activities, and (g) assessing student learning. The principles and steps of the instructional events model allows learners to acquire and transfer new knowledge and skills. The elements were infused throughout the multimedia program described in the next section.

THE MULTIMEDIA INSTRUCTIONAL PROGRAM

The multimedia instructional program is entitled, "Professionals Ready for Educational Partnerships" or PREP. The program was developed as part of a special projects grant awarded by the Department of Education, The program was conceptualized as multimedia because it incorporates the use of a textbook, video presentations, support materials, and CDs. This approach also reflects an effort to focus on multimedia integration as described by Tessmer (1993). The program was designed to be used in preservice teacher education programs at both the undergraduate and graduate levels.

Textbook

The content of the multimedia program was based on a textbook written by Welch and Sheridan (1995) and commercially published prior to producing the videos and CDs. The text serves as the foundation for the multimedia program's information. Participants are required to read specific chapters from the text prior to viewing the video presentations just as students would have reading assignments prior to a traditional lecture-based course.

As part of the front-end evaluation process, the principle investigator met with the production team consisting of a video producer, CD producer, and production assistant, to determine what content from the textbook would best be depicted visually. It was determined that fundamental information such as definitions and principles could be presented in traditional

textbook format. The production team was instrumental in identifying how to use video to illustrate examples or applications of concepts from the written text. This approach was essentially conceptualized as "virtual field trips" that allowed learners to see theoretical concepts and specific skills or strategies in action. A documentary format was used to "take" the viewer to authentic settings to see complex or abstract concepts described in the text in actual practice by educators in the field. Likewise, preproduction meetings determined that video was capable of bringing leading experts who were cited in the textbook and the professional literature to the viewer. Unlike traditional written textbooks, video allowed students to see and hear some of the experts they were reading about. A total of 11 of nationally recognized guest experts were interviewed. Passages of their interview were interspersed throughout the video presentations. Their comments were often placed "over" documentary footage. Interviews also included practitioners from the field to describe specific concepts or skills being applied in authentic situations.

Video Presentations

The instructional program consists of 10 video presentations that reinforce information from the textbook. The video presentations were professionally produced by Media Solutions of KUED, a PBS affiliate station at the University of Utah. The videos employed a documentary format rather than a video taped lecture of an instructor speaking from a podium. A professional narrator provided an aural presentation of information. Documentary footage or graphical text supported the narrative. As previously described, interviews with nationally recognized experts are included in each video presentation to present a rationale and theoretical principles associated with a given topic. The interviews are then complimented with documentary footage of practitioners applying skills or techniques related to the theoretical concepts described by the experts. The video presentations serve as a virtual field trip by "bringing" other educators and settings to the viewing site.

The video presentations, coupled with breakout activities described below, employ an instructional events model described above which depict critical events that occur during learning (Gange, 1977; Gange, Wagner, & Rojas, 1992). Each video presentation begins with a "preflection" activity and discussion to activate participants' prior knowledge and experience. The preflection discussion targets topical areas that are revisited following

the video presentation during a postviewing discussion to ascertain if participants' understanding was improved. Likewise, participants review instructional objectives enumerated in their support materials. The video presentations have what can be thought of as "bookend" discussions to initiate and review key concepts.

The actual running time of each video is less than one hour, with an average duration of 52 minutes. However, the videos are not viewed in a continuous manner. Instead, each presentation is interspersed with guided and directed breakout activities approximately every 15 minutes to reflect some of the components of effective video-mediated instruction suggested by Reeves (1989).

Breakout activities. Each video presentation includes a visual cue to instruct the instructor or facilitator to pause the video and lead participants through a variety of discussions, exercises, or role playing scenarios. This represents one of the salient features of effective video-mediated instruction described by Reeves (1989). Breakout activities are presented in the accompanying support materials that are described below. The activities range from 5 to 15 minutes in duration. Depending on the nature of the task, breakout activities can be conducted with an entire group, smaller groups, student dyads, or individuals. This approach promotes active, rather than passive, viewing and interaction on the part of the participant. Breakout activities have been used extensively in a distance education program for preparing prospective special education teachers in rural areas (Sebastian, Egan, Welch, & Page, 1996) and during a video-based staff development program (Welch & Sheridan, 1997). Formative and summative evaluation results of both programs revealed that the breakout activities were perceived as being a critically important element of video-based training.

Support Materials

Participants are provided with hard copy notes for each video presentation. These notes represent an acquisition outline in which key concepts, definitions, and procedures are included on the printed page to minimize the necessity of copying information as in the case of traditional note taking. The presentation format used various approaches described by Cyrs and Smith (1990). The printed information is presented on the left side of the page allowing the remaining space to be used for supplementary note taking. The support materials facilitate active interaction and engagement on

the part of the viewer. The degree to which participants write notes varies from individual to individual. The instructor or facilitator has a master hard copy of the support materials plus an electronic version on the facilitator's CD that can be printed and then copied and obtained by participants and placed into a three-ring binder. As in the case of college and university courses, students bought a copy of their support materials at the bookstore at the same time they purchased their textbook.

CD Probes

Ten cross-platform CDs are used for each module. As the project was developed, the CDs were originally conceptualized as "cyber quizzes" to replace traditional paper/pencil quizzes. It was felt during front-end evaluation that this medium could be exploited in a way that went beyond the limitations of the traditional pencil/paper medium of quizzes. Participants were assigned to a designated computer lab to check out the CD for a specific module. The CDs consist of 10 multiple-choice probes that incorporate text, full motion video, and audio. Participants read a question and then select a response. An initial correct response is awarded 10 points with additional text and sometimes, video or audio information explaining why the response was correct. If, however, the initial response is incorrect, a score of zero is awarded with an explanation why the response was incorrect. The participant is also encouraged to try again. A score of five points is awarded when the correct response is finally identified. The CD program automatically tabulates the participants' scores as well as the number of "hits" or attempts to respond to a probe question and the amount of time spent on the item. This information is downloaded and reported in a table format as an electronic grade sheet by the facilitator.

PRODUCTION PROCESS

Approximately $90,000 was allocated for production costs for each of the first two years of the three-year project. This included all travel of the video crew to remote field sites for video acquisition.

Content

Each chapter contains instructional objectives, vocabulary terms, and instructional activities such as case studies. Specific topics, terms, and skills presented in each module of the multimedia program were derived from the textbook's chapters. The modules from the multimedia program parallel the chapters from text for the most part. However, the content from two chapters on the topic of school-home partnerships was combined into one module. The content provides the learner with theoretically based information and skills to use collaboration in the school, home, and community to serve students at-risk of academic failure due to disabling, ethnic, economic, or cultural factors. The program begins by presenting a rationale for collaboration and then defining collaboration. Specific strategies for problem solving, interpersonal communication skills, adapting instruction and materials, and assessing students are presented. Models of educational collaborative partnerships within the school such as team teaching as well as in the home and community are also introduced.

Scripting

The instructional objectives from the textbook chapters were used to develop the scripts. A detailed script format (Wurtzel, 1983) was used in which the page is divided into two columns. The left half of the page describes the visual elements of the video presentation while the narrative is presented in the right half of the page. Drafts of scripts were sent to two faculty members for review at another public university in a neighboring state subcontracted with the grant who serve as development and research partners. These faculty members were asked to: (a) read each script for clarity of content presentation, (b) cross reference content from each script with the content from respective text chapters, and (c) critique the breakout activities. The principle investigator, who wrote the script, and the graduate research assistant met for a full day debriefing with these faculty members at their institution. Important information was gleaned from these discussions resulting in significant script revisions. A professional narrator read the narration. The entire narrative text for all ten modules was recorded prior to video acquisition and field production.

Video Acquisition

Expert interviews. The video presentations use a documentary format incorporating interviews with nationally recognized experts and footage of practicing educators engaged in various forms of educational partnerships. The majority of the interviews with national experts were conducted at the University of Utah. A brief overview of the interview process was produced as a short video presentation to be sent to each interviewee. The principle investigator/executive producer briefly explained the interview process on camera. This explanation was accompanied with a visual depiction of the interview set, complete with lights, microphone, and camera to illustrate the process. A sample of a finished video product was also shown. After consenting to be interviewed, guest experts were sent an outline of the questions and topics prior to the actual interview. Interviews took, on average, an hour to conduct following approximately 15 minutes to set lights and audio levels. As an aside, all interviewees indicated that the visual depiction of the interview process was very helpful.

Field production. Field production was conducted with a four-person crew (audio technician, videographer, production assistant, director) in Salt Lake City, Utah; Seattle, Washington; Boston, Massachusetts; Milwaukee, Wisconsin; Raleigh, North Carolina; and Rockford, Illinois. Each site was "scouted" by the principle investigator/executive producer and the video director/producer prior to sending the entire crew. An orientation meeting was conducted with the faculty and administration at each school to explain the purpose of the PREP project and the video production process itself. Sample video presentations from previous projects were also shown to give an idea of how the finished product would look. Release forms were gathered for all students.

Field production was typically completed during three days using a proven technique incorporate in the production of a nationally distributed educational series known as "Snapshots" which accompanies introductory textbooks to the field of special education published by Allyn and Bacon. The principle investigator and developer of this multimedia program is also a coproducer of the Snapshots video series and therefore has first hand experience with the production approach. The first day of production consisted of interviews with key individuals at each field site in the documentary segments. An isolated, quiet setting apart from much of the student movement and noise was identified during the scouting process to serve as an interview set. The same room could be used for each interview by varying the

background, props, and lighting to create the impression that the interview was being conducted in a different location. This approach allowed for much greater technical control on the part of the crew. The interviews provided a context for the type of footage to be obtained during the remaining two days of shooting. Interviews were scheduled in 45-minute blocks to allow for a 15-minute transition for the crew to make set adjustments.

An outline of the shooting schedule for the remaining days was developed and distributed to each individual so they could plan their instructional activities for the day. When shooting in classroom settings, students were given a brief overview of what was about to take place. Students were allowed to look at the camera and boom microphone and to ask questions. Following the orientation, the video acquisition process utilized a documentary approach in which teachers and students acted in a typical fashion with no coaching or staging of activities. The production assistant was in constant contact with a school secretary by "walkie talkie" to appraise them of the status of the shooting schedule. This communication also allowed the crew to call for individuals to come to the interview set or to forewarn a teacher when the crew was about to come to the classroom. An Ikegami HL43 camera with docking Beta SP camera was used for the video production. A total of 192 hours were spent acquiring video from the field. A production assistant logged and coded events being video recorded using a software program on a portable laptop computer. The log of codes was later used in the editing and assembly process to identify specific types of scenes, settings, and content.

Video Editing

Video segments were logged and catalogued by module and topic. Video modules were initially assembled and edited on an AVID digital editor and then transferred to videotape. A total of 232 hours were spent in post-production logging of video. An additional 1,511 hours were spent in actual editing. The principle investigator sat with the editor to select footage to be used.

CD Development

The CD was produced by Media Solutions at the University of Utah using Macromedia *Authorware* as its programming software. Questions and answers for all 10 modules were stored in a FileMaker Pro database before

the data was exported to *Authorware*. The CDs are cross-platform and can be used on either Macintosh or IBM compatible computers. For video and audio included on the CD, the VideoVision Telecast system was employed to achieve professional digital quality. Video clips were digitized using Adobe Premiere, compressed in the form of Cinepak at 15 frames per second and 24 bit colors, and saved as QuickTime movies at 280x180 resolution. Audio clips from the videotapes were digitized using Macromedia *Sound Edit16* and compressed at 16 bit and 22.05 KHz for CD quality. Still images from the videos were captured using an Adobe *Photoshop* plug-in before they were batch processed using *Equilibrium DeBabelizer*. The graphic design of the CDs is consistent in style with the video and the rest of the production, in terms of general look, the logo, fonts, colors, and background texture. Torn paper was scanned and then manipulated using Adobe *Photoshop* for graphic elements throughout the CDs, including background images, navigation bars, and buttons.

IMPLEMENTATION

The multimedia program was incorporated into five existing courses at three institutions during the 15-week fall semester of the 1998/99 academic year. Student participants included undergraduates in traditional on-campus programs at a public semi-rural university, graduate-level students at a public urban university, graduate-level students in a rural distance education program of a large urban university, and practicing teachers completing masters-level course work at a private, urban college (Table 1). The post-bachelors program at the public university had two different sections of the same course. One course section utilized all of the components of the multimedia program except for the CDs (Site 1). Another section of the same course incorporated all components, including the CD (Site 2). This was done to determine if there were significant differences in outcome measures for the group using the CDs and the group using traditional paper/pencil quizzes. Another test site was comprised of a distance education program affiliated with the same public university (Site 3). A group of undergraduate students comprised another test site at a different public university in a nearby state (Site 4). The last test site was with a group of post-bachelor students at an urban private college (Site 5).

Instructors serving as facilitators completed an extensive three-day workshop conducted by the principle investigator to learn how to use the text, videos, support materials, and CDs. The principle investigator modeled

each component of the multimedia product in simulated lessons. Later, each site facilitator selected a portion of a module of their choice to review, practice, and then deliver to the group as a form of guided practice. Trainees debriefed after each practice presentation and discussed various techniques to incorporate in their own setting and with their own students.

Table 1
Demographic Information of Field Test Participants.

Demographic Characteristic	Groups Site 1&2	Site 3	Site 4	Site 5
N	56	9	14	9
Major				
Elementary Education	21	2	8	6
Secondary Education	0	1	0	2
Special Education	23	6	6	0
Other	12	0	0	1
Taken Special Education Class(es)				
Yes	16	9	14	2
No	40	0	0	7
Teaching Expense				
Yes	22	8	1	7
No	34	1	13	2
Worked w/Special Education Children				
Yes	38	9	11	9
No	18	0	3	0
Age				
18-21	10	0	3	1
22-28	30	2	9	4
29-35	6	2	0	1
36-39	3	1	0	0
40+	7	3	2	3

EVALUATION

The evaluation of the multimedia program consisted of four procedures reflecting Tessmer's (1993) recommendations described previously. These methods enabled us to assess user interface, multimedia integration, and

students' learning experience and outcomes. One procedure employed a beta-test of a video, CD, and support materials prototype. Second, a formative consumer satisfaction evaluation was conducted to assess participants' overall satisfaction with the key features of the multimedia program. A third approach incorporated qualitative procedures in the form of focus groups to assess consumer satisfaction and perceptions. A fourth procedure used quantitative methods to assess student outcomes

Beta-test

One of the video presentations with accompanying support materials and a CD of one of the modules was field tested in four settings with four different audiences that were also used later in the pilot phase of the entire multimedia program. These sites and audiences include undergraduate students in traditional on-campus courses at a rural public university, post baccalaureate students in a traditional on campus course at an urban public university, post-baccalaureate students in a rural distance education site for a public university, and post baccalaureate students in a private urban college. Site facilitators attended a full day training workshop to learn how to use the multimedia products before returning to their respective sites to conduct the beta test. The workshop also prepared site facilitators to conduct and tape record focus group interviews to obtain feedback from participants. The beta test at each site took approximately three hours to conduct. Tape-recorded focus group interviews were returned, transcribed, and reviewed. Site facilitators were reconvened approximately two months later for a debriefing with a contracted evaluation specialist. This feedback provided critical information to assess user interface and multimedia integration. Revisions in the videos, support materials, and CDs were made based on this feedback and are reported later in the article**.** Following revisions, the entire multimedia program was implemented in four of the same field test sites during the following fall semester plus the private college, which did not participate in the beta test.

Formative Evaluation of Consumer Satisfaction

Participants in each site were asked to complete a 45-item survey to assess their overall satisfaction with the three major components of the multimedia product: (a) video presentations, (b) breakout activities, and (c)

CDs. These surveys were completed approximately 10 weeks into the 15-week semester. There were three dimensions for each of the three components. One dimension asked participants to rate the aesthetic production quality. The second dimension asked participants to rate the clarity and achievement of instructional goals. The third dimension queried learners' assessment of the instructional organization. Participants were asked to rate the content of the course as part of the fourth dimension. Three questions were posed for each of the three dimensions. A fourth category assessing participants' overall judgment consisted of three items, one for each of the multimedia components. The first question asked participants to rate the aesthetic value and production quality. Participants were asked in the second question to rate to what extent each of the components achieved their instructional goals. The third question assessed participants' perception of the overall instructional quality. Finally, participants were asked to rate the quality of content in each of the three multimedia components. The survey instrument employed a 4-point Likert-type response format (4 = very good, 3 = good, 2= poor, 1= very poor). This survey was inadvertently omitted at Sites 1 and 2 and only administered at Sites 3, 4, and 5.

Quantitative Evaluation of Learners' Experience

Quantitative methodology was used to assess learners' experience with this multimedia product to measure student outcomes. The dependent variable used the *t* pretest/posttest measures on participants' cognitive knowledge related to collaboration. The cognitive assessment consisting of 33 multiple-choice questions was administered via paper and pencil. These questions directly reflected the participants' understanding and knowledge about vocabulary terms and concepts pertaining to the course content in which participants were enrolled. Each question was directly tied to learning objectives from the textbook used in the course. The instrument was developed by the one of the authors and a graduate research assistant. The instrument was sent out to a panel of six content experts (one being the other co-author of the textbook) to assess content validity. Revisions based on the experts' comments were made. A test/retest was conducted spring quarter, 1998.

Thirty-five undergraduates enrolled in two sections of an introductory course for special education participated in the test/retest. The same form of the test was administered and then two weeks later readministered by the graduate/research assistant. A *t*-test for paired samples was conducted and

no significant difference was found between the two measures $t(1,34)=-.95$, $p=.347$, and a test/retest correlation measure of $r=.775$ suggesting a minimum degree of stability/reliability in test scores.

Qualitative Evaluation

Qualitative methodology was incorporated as a form of social validation to gather consumer satisfaction information as a means of assessing multimedia integration and learners' experience. Social validation has traditionally been conducted to assess the acceptability or viability of an intervention or treatment (Schwartz & Baer, 1991). However, within the last decade, the concept and practice of social validation has been broadened. Schwartz and Baer (1991) suggested social validity is two-part process: (a) collect an accurate and representative sample of opinions and, (b) use the information to sustain or change a program to support its feasibility. Likewise, Winett, Moore, and Anderson (1991) conceptualized social validity as a method for formative research that would allow researchers to refine program features.

Focus group interviewing has been used to gain consumer opinions on product and services (Denzin & Lincoln, 1994). Morgan (1997) stated that social scientists have found focus groups to be useful as a supplement to both quantitative and qualitative methods. "Focus groups are useful when it comes to investigating what participants think, but they excel at uncovering why participants think as they do" (Morgan, 1997, p.25). The focus group interview was semi-structured and administered by a contracted evaluation specialist or the graduate research assistant of this project. The interview consisted of open-ended questions. Each focus group interview was taped recorded and conducted approximately during the 10^{th} week of the 15 week semester in three sites and immediately following the last class session in two sites. To ensure integrity, the same focus group questions were read aloud with pauses between questions for the participants to answer. The focus group portion of this study addressed three questions: (a) what are your impressions of the video presentation provided in this course? And why do you feel this way? (b) What do you think of the breakout activities provided in this course? And why do you think this way?, and (c) What are your impressions of the CD provided in this course? And why do you feel this way? These questions reflected the basic content of the formative evaluation survey described previously.

DATA ANALYSIS

Quantitative Analysis

Statistical analysis was performed on the pretest and posttest measure of cognitive knowledge. A parametric statistical analysis is appropriate when the cognitive knowledge measure collects interval type data with a sample size greater than 15. Therefore, an analysis of variance (ANOVA) was employed with two groups of more than 15 participants. The ANOVA was performed to compare differences between the pre and post measures of the cognitive survey. A paired *t*-test was implemented with three groups consisting of less than 15 participants. This analysis was conducted to assess differences between pre and post measures on the cognitive measure.

Qualitative Analysis

A review team consisting of graduate students with experience in qualitative methodology independently analyzed the focus group transcripts. To enhance the validity of this analysis, the technique of triangulation (Patton, 1990) was used. Individually, each member of the graduate research group analyzed the transcripts for emerging thematic units and then they discussed and compared their finding as a group.

RESULTS

Beta-test

We were surprised to find that the majority of very useful comments and feedback from all beta test sites were related to the hard copy support materials. Participants had numerous suggestions regarding the graphical organization of the information on the printed page. For example, feedback included where and how to format the page to take notes while viewing the videos as well as what type of font and point size to use to differentiate narrative information from text presented on the screen. Most participants in each site reported that the support materials were useful in providing a benchmark as to where they were while following the video presentation. Likewise, most participants liked having the option of taking their own notes in the space provided in the margin. Very few participants found taking notes

while viewing the video as being difficult. These respondents were reminded that taking notes was optional. This suggests a positive and effective interface of the videos and hard copy support materials. In retrospect, the focus on the support materials in the beta test feedback should not be all that surprising as this is a familiar instructional medium to learners.

Conversely, feedback and suggestions regarding the video presentations and the CDs were somewhat limited. This may be due to the fact that these were less familiar media and formats to participants. Using principles from schema theory, this would seem to suggest that beta test participants' lack of experience with instructional video and CDs limited their ability to assess these particular forms of media. Overall, participants found the production quality of the videos aesthetically pleasing and were able to concentrate. Nearly all participants reported they liked having breakout activities interspersed throughout the video presentation to maintain attention. Participants generally found manipulation of the CDs to be intuitive with very little confusion. Most reported they enjoyed the immediate feedback given by the CDs. Likewise, most were intrigued with the use of full motion and video embedded with the probe questions. As a result of this feedback, few modifications were made in the overall production and format of either the video presentations or CDs.

Formative Evaluation of Consumer Satisfaction

A total of 50 surveys from three test sites were usable to tabulate descriptive means (Table 2). The average mean response of the four questions in the video component was 3.25 (SD = .54) on a four point rating scale. 94% of the responses were either "good" or "very good." The average mean rating for the breakout activities was 3.24 (SD = .64) with 92% of the ratings being "good" or "very good." The average mean rating for the CDs was 3.19 (SD = .76). Of those responding, 86% of the ratings was either "good" or "very good." The mean rating of the four dimensions within the videos, breakout activities, and CDs was also calculated. The overall mean rating of the aesthetic production quality of all three multimedia components was 3.26 (SD = .60). Participants' overall mean rating of clarity and achievement of instructional goals was 3.22 (SD = .59). The mean rating of instructional organization of all three multimedia components was 3.21 (SD = .60). The overall content had a mean rating of 3.20 (SD = .58). These combined ratings suggest that respondents generally found the overall quality and effectiveness of the videos, breakout activities, and CDs as "good."

Table 2
Mean Ratings on Consumer Satisfaction Formative Evaluation Survey

	Aesthetics	Goals	Instruction	Content
Video Presentations				
Mean	3.25	3.22	3.27	3.25
SD	0.59	0.57	0.59	0.63
% good or very good	80%	80%	84%	82%
n	50	50	50	50
Breakout Materials				
Mean	3.22	3.27	3.19	3.24
SD	0.79	0.70	0.68	0.61
% good or very good	86%	82%	74%	78%
n	50	50	50	50
CD				
Mean	3.28	3.25	3.29	3.22
SD	0.72	0.86	0.89	0.82
% good or very good	88%	83%	83%	72%
n	49	49	49	49
Average Across 3 Components				
Mean	3.26	3.22	3.21	3.20
SD	0.60	0.59	0.60	0.58
% good or very good	86%	84%	86%	84%
n	50	50	50	50

Average of	**Video**	**Breakouts**	**CDs**
Mean	3.25	3.24	3.19
SD	0.54	0.64	0.76
% good or very good	94%	92%	86%
n	50	50	50

Quantitative Results

The ANOVA and paired *t*-test results revealed significant growth on the post measures scores for all five sites (Table 3). The on-campus post-bachelors group without the CD component at a public university (Site 1 - $n = 28$)

had a post mean score of 23.64 which was significantly higher than the pre mean score of 16.04 [$F(1,55) = 27.94$, $p < .001$]. The on-campus post-bachelors group using the CDs at the public university (Site 2 - $n = 28$) had a post mean score of 23.54, which was significantly higher than the pre mean score of 15.04 [F (1,55) = 83.52, $p < 0001$]. However, an analysis of covariance (ANCOVA) indicated there was no statistical significant between the group using the CD and group that did not [F (1,55) = .195, $p < 661$].

The post mean score of 24.0 in the distance education group affiliated with the post-bachelors program at a public university (Site 3 - n=10) was significantly higher than the pre mean score of 17.5 [$t(9) = -6.412$, p < .001]. The undergraduate group at the public university (Site 4 - $n = 14$) had a post mean score of 17.64 which was significantly higher than the pre mean score of 14.43 [$t(13) = -3.56$, $p < .005$]. The post-bachelor group at the private college (Site 5 - $n = 9$) had a post mean score of 19.44 which is significantly higher than the pre mean score of 16.11 [$t(8) = -2.774$, $p < . 05$].

Table 3
Pretest and Posttest Scores

Site	Test	Mean	SD	Sig. *p*
Site 1	pretest	16.04	3.53	.0001
	posttest	23.64	4.32	
Site 2	pretest	15.04	2.70	.0001
	posttest	23.54	4.11	
Site 3	pretest	17.5	2.92	.0001
	posttest	24.0	3.59	
Site 4	pretest	14.43	3.16	.003
	posttest	17.64	2.34	
Site 5	pretest	16.11	2.93	.024
	posttest	19.44	2.40	

Qualitative Focus Group Evaluation

Video presentations. The participants had a range of impressions on the video presentation from mildly negative to very positive. The major focus of responses was related to the positive way the video presentation enhanced the participants' learning. Respondents felt the opportunity to see and hear how other teachers and school apply concepts was a positive

aspect. One participant stated, “I like seeing and hearing from the teachers talking about things and not just listening to a professor speaking all the time.” Another participant mentioned, “I like seeing and hearing the teachers and knowing what was going on out in the schools.” Several considered seeing the application of a specific concept or skill in authentic situations as being very effective. One respondent said, “I really enjoyed the videos that showed you how things are out there in the classroom.” A few learners enjoyed the diversity in the 10 modules. One participant mentioned how she learned more and remembered more from the videos. “I really enjoyed the videos and wished like the others had said there was more of the in schools and family life. I learned more from that and that’s what I remembered.”

Other comments were made about the opportunities to hear from experts and guest speakers. “I like it because it gave us the opportunity to hear from guest speakers and experts.” One participant liked the videos and compared them to a visual field trip. A negative comment brought up by several participants was the inability to ask questions of the experts viewed in the video presentations. One respondent stated, “I appreciated hearing from the experts and teachers, but I would of like them in person so I could of asked questions to them and have a dialogue.” Only one participant she did not like the use of the narration with printed words. “The narration was a bit fast and hard to follow along while taking notes.”

Breakout activities. All participants had a positive or neutral opinion regarding the breakout activities. The participants liked being able to discuss and apply what had just been viewed. “I really enjoyed the breakout activities and enjoyed being able to discuss with others what was being talked about.” Similarly, several learners mentioned they liked being able to apply skills taught. “I like the breakout activities especially the ones that had to do with application of the skills.” A couple participants agreed that the breakout activities were beneficial in that they didn’t spend more than 15 minutes just watching the video. “I like how the breakouts were paced such that we didn’t spend more than 15 minutes just watching the videos.” One negative comment was made about being a part of the same group of all the breakout activities. “A limitation was being a part of the same group of people in the breakouts.” However, it was clear from respondents that the facilitator plays a critical role in effectively conducting the activities and discussions. As such, facilitators must be adequately prepared for each activity and carefully monitor the activities.

CDs. A range from positive to negative impressions were expressed. Most of the negative comments were related to the multiple-choice format of probe questions. Participants felt that the multiple-choice format did not adequately measure or demonstrate what they had learned. "Having multiple choice questions for me is a bad way of showing what I learned." Another echoed that statement by saying, "I didn't like the quizzes but I would have disliked them more if they were regular paper pencil quizzes." Still another participant mentioned, "I like the CD-ROM but didn't like the multiple choice test questions." Many participants also reported their dislike of being assigned to a specific lab on campus to complete the CDs. Participants wanted to check out the CDs to use at the leisure and a more convenient location. This, however, was not possible due to limited supplies of CDs and possible limitations of hardware at home.

Aside from the negative comments about the multiple-choice questions, most participants reported the CDs as being beneficial. "I loved the CD quizzes because a lot of time I would get frustrated and ask why and with the CD I could go back and find out why." Several participants enjoyed getting the immediate feedback. A couple of participants liked the option of listening to an aural presentation while reading the questions. One respondent said, "I really like being able to see and hear something and not just read it." It was also suggested that the CDs be reconceptualized as a learning tool where students earn participation points rather than a grade for their responses. This would allow greater dialogue as learners take an active role in constructing their own learning experience.

DISCUSSION

We were interested in gaining insight regarding user interface of the various components of this multimedia product. Overall, it appears that there was an effective user interface of video, support materials, textbook, and CDs. Learners used each medium effectively and efficiently. Likewise, it appears that the unique quality of each medium was effectively applied and integrated. Participants reported overall satisfaction with each medium, coupled with constructive suggestions based on a degree of dissatisfaction of certain applications of the CDs. Finally, it appears that the learning experience resulted in cognitive gains as measured by reliable and valid instruments. As such, an integrated approach of video presentations interspersed with instructional activities coupled with support materials, text, and CDs is effective and favorably perceived by learners. This project also revealed a number of other important findings.

We expected that learners would be impressed by the "bells and whistles" of the video and CD technology. This appears to be true to an extent. Many participants commented that these approaches were "the wave of the future." However, we were somewhat surprised to find that participants found the "low tech" breakout activities interspersed throughout the videos to be as meaningful, if not more so, than the "high-tech" tools such as the CDs. Learners consistently reported they enjoyed being able to stop and interact with each other and the facilitator conducting the breakout activities. We conclude that technology can provide important instructional tools but their efficacy appears to be enhanced when human dialogue and interaction is infused with its use. As such, instructional tools may be capable of disseminating information, but interaction between and among learners and teachers is critical to actual understanding, assimilation, and application. This finding merits serious consideration as more and more institutions of higher education explore developing and implementing various forms of distance education and web-based instruction.

The project began with front-end evaluation to identify salient features of specific forms of media that would could be uniquely exploited and applied to enhance learning. Additionally, we attempted to assess the integration of various media and the learners' experience through consumer satisfaction reports and student outcomes. During the front-end evaluation of this project, developers and production coordinators made the pedagogical assumption that the CDs would be an effective alternative to traditional assessment procedures such as pencil/paper quizzes. Multiple-choice formats lend themselves nicely to the assessment and feedback architecture of the CD authoring program. However, we were surprised that the evaluation results refuted this initial assumption to an extent. Participants consistently reported their dissatisfaction with the multiple-choice format in the CDs as a tool that assessed and graded their understanding and performance. As such, participants did not see any additional benefit of the CD over traditional pencil/paper instruments using multiple-choice formats. Conversely, participants overall appreciated and even enjoyed the use of full motion video, audio, and text in the CDs. Participants perceived the use of various media in the CDs as being effective in facilitating their learning and understanding. Specifically, learners appreciated the immediate feedback coupled with explanations and opportunities to try each probe item again until the correct response was identified. Results also suggest the user interface with CDs was effective overall. Despite some participants' disdain for coming to a computer lab to complete the CD probes, virtually no one reported technical difficulty in actually manipulating the CDs or moving through each

item. It was suggested that students form dyads to complete the probe questions on the CDs together as a learning tool rather than an assessment or grading tool. Since these initial field tests, the CDs have, in fact been reconceptualized as a learning activity for pairs of student "P.A.L.S." or participation and learning scores.

Likewise, it was assumed during front-end evaluation that the video presentations would effectively incorporate principles of schema theory, symbol theory, and instructional events model. It seems that the videos were, in fact, effective in depicting information and modeling skills or strategies. Similarly, the videos were able to convey information in a manner unique from other media such as textbooks. Participants clearly recognized the value and ability of video to "bring" experts or authentic settings to their classroom. As such, the pedagogical and production assumptions that video could provide a virtual field trip appears to be validated. Similarly, the videos appear to support Salomon's (1990) argument that certain media are more effective in terms of the amount of invested mental effort in learning. Finally, the instructional experience appeared to be enhanced when the viewing process of video presentations was constructed as an interactive activity interspersed with instructional exercises rather than passively watching a linear presentation in its entirety. Similarly, it appears that the various forms of media were effectively integrated. Support materials used as a supplementary viewing tool for the video presentations were favorably received by learners and appear to have been used effectively.

CONCLUSION

Results of this field test also suggest that a multimedia program such as the one described here can be effectively implemented with a variety of audiences and settings. However, the overall effectiveness seems contingent upon the site facilitator's ability to conduct the activities before, during, and after the video presentations.

Using front-end evaluation, coupled with formative and summative evaluation procedures appears to be critical steps to developing multimedia programs. Likewise, theoretical models play a critical role in the conceptualization and successful implementation of multimedia programs. Beyond assessing consumers' satisfaction, measuring cognitive outcomes of learners is another important component to assessing the overall impact of multimedia programs.

References

Borich, G.D., & Tombari, M.L. (1997). *Educational psychology: A contemporary approach* (2nd ed.). New York: Lognman.

Cyrs, T.E., & Smith, F.A. (1990). *Strategies for designing a teleclass training program*. Paper presented at the 6th Annual conference on Distance Teaching and Learning, Madison, WI. Denzin, N.K., & Lincoln, Y.S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Gagne, R.M. (1977). *The conditions of learning* (3rd ed.). New York: Holt, Reinhart, and Winston.

Gagne, R., Briggs, L., & Wagner, W. (1992). *Principles of instructional design* (4th ed.). Orlando, FL: Harcourt Brace.

Kozma, R.B. (1991). Learning with media. *Review of Educational Research, 61*, 179-211.

Kozma, R.B., & Croniger, R.G. (1992). Technology and the fate of at-risk students. *Education and Urban Society, 24*(4), 440-453.

Mechlenburger, J.A. (1990). Educational technology is not enough. *Phi Delta Kappan, 72*, 104-108.

Milheim, W.D., & Martin, B.L. (1991). Theoretical bases for the use of learning control: Three different perspectives. *Journal of Computer-Based Instruction, 18*(3), 1-13.

Morgan, D.L. (1997, 2nd ed.). *Focus groups as qualitative research*. Newbury Park, CA: Sage.

Olsen, D. (1976). Towards a theory of instructional means. *Educational Psychologist, 12*, 14-35.

Patton, M.Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.

Reeves, E. (1989). A seven step lesson plan for using instructional television. *Vision, 4*(2), 2.

Reisner, P. (1987). HCI, what is it and what research is needed? In J.Carroll (Ed.) *Interfacing Human Thought* (pp. 337-352). Cambridge, MA: MIT Press.

Rosenshine, B., & Stevens, R. (1986). Teacher functions. In M.C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.) (pp. 376-391). New York: Macmillan.

Rumelhart, D.E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B.C. Bruce, & W.F. Brewer (Eds). *Theoretical issues in reading comprehension* (pp. 33-58). Hillsdale, NJ: Lawerance Erlbaum.

Salomon, G. (1979). *Instrucion of media, cognition and learning*. San Francisco: Jossey-Bass.

Salomon, G. (1983). The differential investment of mental effort in learning from different sources. *Educational Psychologist, 18*, 42-50.

Salomon, G. (1990). Studying the flute and the orchestra: Controlled vs. classroom research on computers. *International Journal of Educational Research, 14*, 521-532.

Schwartz, I. S., & Baer, D.M. (1991). Social validity assessments: Is current practice state of the art? *Journal of Applied Behavior Analysis, 24*, 189-204.

Sebastian, J.P., Egan, M. W., Welch, M., & Page, B. (1996). Preparing special education teachers at a distance: Effective televised instruction. *Journal of Technology and Teacher Education, 4*(2), 145-160.

Tessmer, M. (1993). Front-end and formative multimedia evaluation: Sharpening "cutting edge" technology. Paper presentation at the annual convention of the America Educational Research Association, Atlanta, GA.

Welch,M., & Sheridan, S.M. (April, 1997). *The tele-educational consortium project.* Paper presentation and nationally transmitted video teleconference at the Annual conference of the Council for Exceptional Children, Salt Lake City, UT

Welch, M., & Sheridan, S.M. (1995). *Educational partnerships: Serving students at-risk*. Ft. Worth, TX: Harcourt Brace.

Wetzel, C.D., Radtke, P.H., & Stern, H.H. (1994). *Instructional effectiveness of video media.* Hillsdale, NJ: Lawerance Erlbaum.

Winett, R.A., Moore, J.F., & Anderson, E.S. (1991). Extending the concept of social validity: Behavior analaysis for disease prevention and health promotion. *Journal of Applied Behavior, 11,* 203-214.

Wurtzel, A. (1983). *Television production* (2nd ed.). New York: McGraw-Hill.

Acknowledgement

This project was supported by a grant from the U.S. Department of Education Award Number HO29K960149-98.