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Photovoltaic System Design Course for Savannah State College: Course Evaluation

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Course Evaluation

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Introduction

Purpose

The purpose of this report is to describe the evaluation of a course entitled *Photovoltaic System Design (PVSD)*, which was presented by the Florida Solar Energy Center (FSEC)[1] to faculty members of Savannah State University (SSU), Savannah, Georgia. This distance education (DE) course was delivered via a two-way audio/video delivery system from FSEC to SSU. This course evaluation report is included as one of the deliverables in a contract awarded to SSU and FSEC as part of the Advanced Communications Technologies Satellite research project sponsored by the NASA Lewis Research Center, Cleveland, Ohio.

Course Description

The PVSD course was a four-day session presented during the week of December 9 to 13, 1996. The course described the essential requirements for conducting a complete photovoltaic system design and included the following topics:

- Introduction to Photovoltaic System Design
- Solar Radiation
- Photovoltaic Cells
- Modules, Panels and Arrays
- Photovoltaic System Configurations
- Batteries
- Charge Controllers and Inverters
- Stand-Alone System Sizing Procedures
- Electrical Design
- Mechanical Design and Building Integration
- Economic Analysis.

The PVSD course was presented over three and one-half days. The first three days began at 9:00 a.m. and concluded at 4:00 p.m., with one hour scheduled for lunch. Sessions were presented in two three-hour blocks for a total of six hours per day. The fourth day began at 9:00 a.m. and concluded at 12 p.m. to complete the total 21 hours of instruction.

Thirteen interested faculty members from SSU participated in the course. At SSU's request, half of the participants viewed the course "live" at FSEC for the first two days, and the other half viewed the course from SSC. These groups switched for the last two days. Wednesday, December 11 was used as a travel day for the participants to drive between sites.

Delivery System

The PVSD course was delivered from FSEC to SSU using a PictureTel Concorde 4500 ZX two-way audio/video delivery system. The course was delivered over integrated services digital network (ISDN) lines operated by BellSouth. Six channels were used, each with a transmission rate of 56 kbps. Thus the course was delivered using a compressed video rate of 336 kbps.

At the FSEC origination site, the system consisted of an instructor (control) station, and two 32" monitors positioned at the front of the classroom. In addition, there was one camera, positioned on one of the monitors, that showed the students in the classroom. A second camera was located on a tripod at the back of the classroom, focused on the instructor. The instructor station allowed the presenter to control all course media presentations (text, graphics, videotape), the document camera, and the classroom cameras from an easy to use touchscreen display.

[1] The Florida Solar Energy Center is located in Cocoa, Florida. It is one of several insitutes that are part of the University of Central Florida, Orlando, Florida.

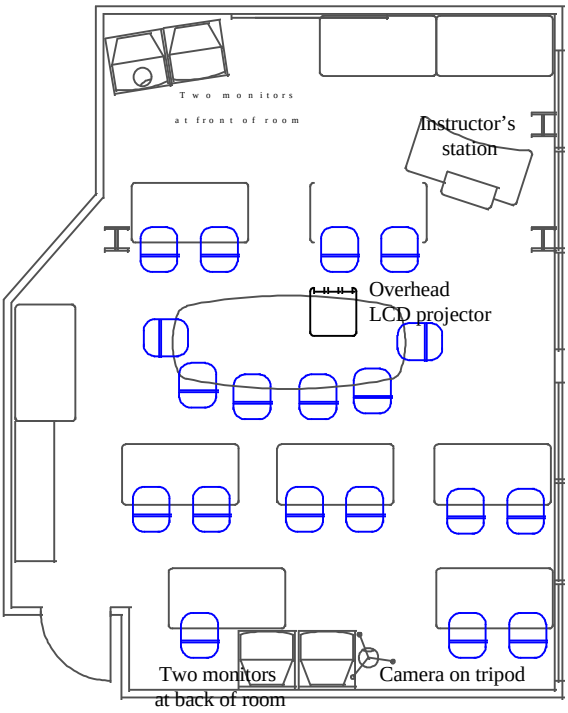

Figure 1. Layout of classroom at FSEC site

At the SSU site, the classroom was configured with two 32" monitors at the front of the room and two 32" monitors at the back. There was a small control console that allowed a technician (a student in this case) to operate the classroom camera, which was located on top of one of the front monitors. This camera could move and zoom in on any one student or object, but it was manually controlled by the technician.

At each site, the left monitor (from the students' perspective) displayed the instructional material (e.g., graphics, slideshow, or video), the instructor, or the students at either site, depending on the situation. The right monitor displayed the students at that site. For example, participants at SSU saw themselves on the right monitor. The two monitors in the back of the SSU classroom showed the same information as the two at the front. They were used by the site facilitator, who was positioned facing the students.

Course Evaluation

To evaluate the PVSD course, a course evaluator interviewed students and had students and instructors complete course evaluation questionnaires, and both the site facilitator and course evaluator took notes on their personal observations. No performance tests were utilized during this course, as there was no course credit being offered. The evaluation questionnaires are provided in Appendix A. Most evaluation questions utilized a five-point Likert-type rating scale, with one (1) anchored as "excellent" and five (5) anchored as "inadequate." The evaluation was broken down into the following sections: (a) delivery system (usability and reliability), (b) instructors, (c) site facilitator, and (d) instructional materials, which included the course presentation and course manuals. The author served as the course evaluator. The first two days were spent observing the course presentation from SSU, and the last two days were spent at FSEC. Observing the course from both sites proved very valuable, as there were subtle differences between them.

The instructors received one questionnaire, which they completed at the end of the course, although the site facilitator was asked to take notes each day. Students received the same questionnaire at the end of each of the first three sessions. Because their attitudes toward the course remained very consistent, their responses were collapsed across days.

Course Evaluation

Delivery System

The PictureTel delivery system was rated very high by the participants, instructors, and course evaluator. The compressed video was quite clear, although not quite as sharp as a direct, real-time television connection. Participants at SSU reported that they felt like they were part of a total classroom experience and did not feel that they were at a remote site. The presentation quality made the participants feel comfortable, as if the instructors were in the next room and not several hundred miles away.

The compressed video was somewhat choppy in appearance, as there was a short time lag between sending and receiving the communications signal. In addition, the clarity of the video transmission was not quite as high as it could be with a real-time system (their was some slight fuzziness), but it was still of excellent quality. This choppiness in video presentation was not a problem for basic standup instruction with still graphics. Both students and instructors adapted to the video by the conclusion of the morning session of day one.

As mentioned, one monitor presented the graphics and video segments or the instructor ("picture-in-picture" was also available on this monitor), the other monitor presented the classroom. At FSEC, the left monitor also showed the instructional material; the right monitor showed the FSEC classroom. It appears that this setup was a function of the number of channels that were available (or purchased), not a function of the PictureTel system. Thus, one important recommendation for a two-screen delivery approach is to have the graphics and/or video segments presented on one of the monitors, and the instructor on the other monitor, both at the origination and at the remote sites. This approach maintains continuity in the instruction, allows students to maintainpersonal contact with the instructor, and eliminates the need for the instructor to switch back and forth.

In this course, the FSEC instructors used a PowerPoint presentation to augment their instruction. To do this, a laptop computer that held the presentation was connected to the PictureTel system. Unfortunately, with this arrangement, the instructors could not see the PowerPoint slides when they were using the instructor station in annotate mode (see page 4 for a description of the "telestrator" annotate mode). One recommended improvement is to provide the PictureTel instructor station with an additional computer monitor so that the instructors can preview any material that they are going to present.

Figure 2. FSEC classroom

The monitor arrangement at SSU (two monitors at the front of the room and two monitors at the back) was preferable to the one at FSEC (two monitors at the front of the room only) since the instructors had to look at the monitors at the front of the FSEC classroom to verify what was displayed and to see the SSU students when the camera was switched to them, such as when an SSU student asked a question. This viewing angle was awkward for the instructors, who were positioned at the instructor station. They commented that they would have liked monitors in the back also. In addition, if one of the monitors had shown the SSU students, the instructors would have been able to see all of the students participating in the course at one time, which would have been beneficial from both an instructional and classroom management standpoint.

The quality of the graphics presented over the video system was high, but video readability could have been improved by increasing the font size and color contrast of some graphics. The quality of the instructional materials is addressed below.

The sound quality of the system was also excellent, and the instructor was heard very easily. However, during the first morning's session, audio communications were somewhat awkward, as people talked at the same time. The system took only the first signal, so some students' questions may have been cut off. If the instructor and a student or site facilitator talked at the same time, again, communications were incomplete or jumbled. This problem was minor, although somewhat annoying, and by the afternoon of the first day, communications ran very smoothly. To overcome this problem from the start, an introductory, training session could be held to familiarize the participants with the system. In the present case, the course began without students having any familiarization.

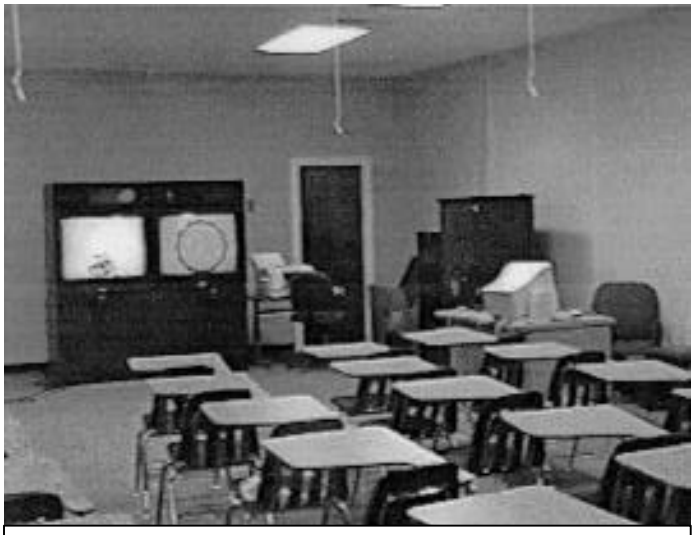

Figure 3. Savannah State University classroom

The classrooms at both sites used an open microphone arrangement, which sometimes led to too much equipment noise at one or both sites. The extraneous noise could have been filtered out by adjusting the equipment volume at one or both sites, but it took some time before people realized this solution would work. The instructors did have some difficulty hearing student questions over the open microphone system. Part of this problem was due to some of the students' pronounced foreign dialects. Student coughing also came through the audio very well, which was annoying at times if the volume was not adjusted very well, but the microphones should have been be heard clearly, while background noise (e.g., coughing, squeaking doors and chairs) was filtered as much as possible. A closed microphone system requiring students to press a button to speak might have been better for this course, although additional training would have been required.

Although the quality of the video was excellent, the camera work conducted by both the instructors and the student technician at SSU could have used some improvement. The system did not possess an automatic zoom-to-voice feature, so the instructor or technician had to move and zoom the camera in on the person asking questions. There was some awkwardness with camera control (positioning and focus), but it improved over the course of the session. This awkwardness did not adversely affect the course, however, it could have been minimized if camera operations had been practiced prior to the start of a course.

PictureTel's annotate or "telestrate" mode allows the instructor to use a light pen to circle key words, diagrams, or equations, and to write additional information on a slide. The instructors noted that the annotator was somewhat off target, which made highlighting key points more difficult. They were able to get the hang of it, so the students never realized that there was a problem. However, this problem should be corrected for future courses.

Student ratings of the quality of the equipment were very high each day. Table 1 provides the questions and associated composite ratings (collapsed across days) that related to the equipment used to present the PVSD course. Table 1 provides the percentage of students who responded with ratings of 1 (excellent) or 2 (very good) on a 5-point rating scale, the mean rating and standard deviation (SD), and the median rating.

Table 1. Student ratings of the audio and video aspects of the PVSD course

Question	Percentage rating 1 or 2	Mean rating (SD)	Median rating
Technical quality of the video	89.70	1.45 (0.78)	1.00
Clarity of the video	82.80	1.76 (1.18)	1.00
Readability of graphics/word pictures	80.00	1.90 (1.16)	1.00
Quality of the audio	96.60	1.48 (0.57)	1.00
Sound level of the audio	96.60	1.31 (0.54)	1.00

The delivery system was extremely reliable. There were only two incidents when the connection between the two sites was lost for unknown reasons. SSU lost connection to FSEC on the first day for seven minutes. The site facilitator had to restart the system to regain the link. On the third day, the connection was lost for 25 minutes due to an external problem at BellSouth. Thus, for the approximately 21 hours of on-line instruction, the system was down for 32 minutes, a reliability of 97.5 percent. Even though downtime was small, contingencies must be planned to respond to equipment failures.

In summary, the PictureTel delivery system was excellent. Both the picture and sound quality were rated very high, and the SSU students felt like they were in a traditional classroom, and not several hundred miles away. The reliability of the system was also extremely high, but contingency planning is always a necessity. The instructor station was also considered to be very easy to learn, although it does require some practice. Overall, with a few minor modifications, this system is an excellent choice as an educational communications technology.

Instructors

The two instructors who collaborated in the delivery of this course, Dr. Jerry Ventre and Mr. Jim Dunlop, were very professional, well prepared, and extremely knowledgeable about all aspects of photovoltaic system design. Dr. Ventre was better at bringing the complex PVSD concepts down to the students' level of understanding. Mr. Dunlop possessed a great knowledge of this topic, but he sometimes talked at too high a level for the audience. An important recommendation for any course, and especially for DE courses, is that the instructors be able to adapt their instruction to their students. The instructor cannot get as good a feel for how remote site students are doing as compared with the students at the origination site; thus the remote site students can more easily get lost. This points out an important role for the site facilitator —to monitor students' understanding so they do not become confused and lose motivation.

In addition, instructors need to practice their presentations and equipment use in order to make their talks more interesting, enthusiastic, and motivating. Both instructors, particularly during the first few sessions, used "um" and "ah" frequently enough to be distracting. If an instructor is comfortable with what he or she is discussing, the presentation is often more interesting because he or she is better at interjecting personal anecdotes, etc. With experience operating the equipment, the instruction can flow almost seamlessly, and few distractions impede students from attending to the content. Awkwardness using the equipment is magnified at remote sites in a DE course. Dr. Ventre seemed more comfortable presenting using the PictureTel system and it showed, both in his comfort level talking about the material and in his use of the equipment.

Another important recommendation is for the instructors to practice looking at the camera when answering remote site students' questions. The instructors tended to look at the monitor that showed the remote classroom, but at the remote site, this action made the instructor appear as if he was looking off to the side. This situation is partly due to the FSEC classroom arrangement, in which there were no monitors in the back of the classroom; hence, the instructors had to look at one of the front monitors. The ideal arrangement would be for a set of monitors to be positioned at the back of the classroom, with the camera on top. Then the instructors could look at the remote site students on one of these monitors, and would appear to be looking directly at them. The instructors also seemed to focus on the students at the origination site rather than on those at the remote site. For this reason some research suggests that there should be no students at the origination site during a multi-site DE course. However, this obstacle can be overcome with enough practice.

The instructors were very good at maintaining student attention and motivation. They interspersed the content of the presentation with slides, video presentations, breaks, and off-line activities, and made a conscious effort to ask students at both the origination and remote sites if they had any questions. Setting up formal question and answer sessions is important because it forces the instructor and students to interact, and is particularly important at the remote sites where students can come to feel isolated from the regular classroom.

The instructors also restated questions that were asked by the students, and answered those questions effectively and professionally. Restating questions turned out to be particularly important because students at one site could rarely hear questions asked by students at the other. This problem was compounded by the fact that many of the students had dialects that were hard to understand over the communications link.

A very good motivational technique was the use of a case study to set up the goal of the course, which was for the students to learn the requirements of PV system design. The example chosen was the PV system design for the Centennial Park lighting at the 1996 Atlanta Olympic Games. This example was very interesting, timely, and relevant to the real world, and probably particularly relevant to the SSU faculty, because Savannah is not too far from Atlanta.

The relevancy of content is particularly important for a highly technical course such as PV system design. It did appear that some students got bored or lost at times, perhaps because the course was not relevant to them. Although the instructors generally did a good job of maintaining motivation, some of the course content could have been cut for this audience. For example, the discussion on chemical reactions probably could have been deleted, with more details and examples added in other, more relevant areas.

The instructors kept the course on schedule pretty well, but did have to delete some material to finish some sessions on time. This may have caused the course to have less continuity than it could have. Research has shown that instructors cannot cover as much material in a real-time, one- or two-way video course as in a traditional stand-up instruction course. When rigid schedules must be adhered to, as in this course (on line at 9 a.m., off line at 4 p.m.), the instructors must pay close attention to the clock, since additional time is needed to get started with a presentation, switch between sites for question and answer sessions, perform off-line activities, and so forth. Extemporaneous discussions must be carefully limited or the instructors will have to cut back on lesson content.

The instructors also made good use of the PictureTel system's "telestrator" light pen, which allowed them to circle key words, diagrams, or equations, and to write additional text on a slide. The telestrator is an especially useful feature of this system.

Sometimes the instructors, while they were discussing some particular topic, mentioned concepts or terms that were not explained or defined until later. One example was the mention of the term *electrolytes* during the discussion of batteries. This term was not defined until later on, but its lack of definition made the discussion of batteries less clear in general and harder to follow. Some PVSD material should be reorganized to avoid these situations.

In addition, the instructors needed to make sure they knew where corresponding materials were in manuals that they discussed in the lecture. Several times the instructor had to locate items in the manuals for the students, but since cross-referencing wasn't provided, they often had a difficult time doing this.

At the end of each topic and each session, the instructors reviewed the material that was covered. In addition, at the beginning of each session, an open book review quiz was given to refresh the students' memories of the previous material. This was an excellent instructional strategy, which motivated the students and helped them consolidate the previously learned material.

The instructors believed that presenting instruction using the PictureTel system was much easier than they thought it would be, and in some cases easier than in a traditional classroom. All in all, the instructors felt that the quality of this course was as good as it would have been if taught traditionally.

Some additional recommendations are provided to help improve this instruction. First, it would be valuable if more real-life examples of situations, devices, etc. could be provided (e.g., different battery types and their uses). Employing the Olympic Lighting case study was excellent, however, and made the course relevant and interesting for the students. Second, the instructors should try to provide positive feedback of some sort to all student comments, rather than just acknowledging a comment and moving to another or continuing with the topic. Providing this feedback will enhance the students' perceptions of the instructor and promote more questions.

The students answered 16 questions in the course evaluation related to the instructors. The first question asked if the course goals and objectives were clear. All of the students (100 percent) answered that they were made clear. The remaining 15 questions and the corresponding student ratings are provided in Table 2. Students answered these questions using a 5-point Likert type scale. The table provides the percentage of students who provided ratings of 1 (excellent) or 2 (very good), the mean rating and standard deviation (SD), and the median rating.

Table 2. Student ratings of the instructors and related instructional aspects of the PVSD course

Question	Percentage rating 1 or 2	Mean rating (SD)	Median rating
Introduction to course and equipment	100.0	1.31	1.00
Video time allotted to cover topics	83.3	1.75	2.00
Ability to interact with instructor	94.4	1.28	1.00
Ability to interact with site facilitator	97.2	1.25	1.00
Ability to interact with other students	88.2	1.56	1.00
Instructors' poise, etc.	97.2	1.31	1.00
Instructors' delivery	100.0	1.26	1.00
Instructors' preparation	100.0	1.24	1.00
Instructors' organization	94.1	1.32	1.00
Instructors' use of available time	97.1	1.31	1.00
Instructors' communication skills	100.0	1.11	1.00
Instructors' encouragement of critical thinking	84.8	1.61	1.00
Instructors' ability to stimulate interest	91.2	1.35	1.00
Instructors' ability to use the equipment	94.3	1.34	1.00
Understandability/clarity of instructors	100.0	1.13	1.00

In summary, the instructors were rated very high on a number of attributes, including their knowledge of the topic, their presentation skills, their ability to maintain the course schedule, and their use of instructional techniques to maintain student motivation. The instructors need some practice using the delivery system to become more comfortable with it. They also need to gain some knowledge of their students before a course begins to make sure the course content is geared for the level of those students.

Site Facilitator

The site facilitator at SSU was excellent, as he had the requisite content knowledge to support the instruction, he was an expert with the off-line laboratory demonstrations, and he knew how to operate the delivery equipment. He was particularly good at restating answers provided by the instructors in a different context to make the content more clear, as well as providing additional information and answers to questions during off-line segments of the course. He was also good at clarifying student questions so that the instructors understood what was actually being asked, and he made sure that the SSU students had the right materials and were always on the right page.

The site facilitator commented that his biggest challenge was coordinating the presentation material with the pages in the various manuals provided to the students. Students mentioned this problem on several occasions: they had difficulty finding information in their manuals that instructors referred to in the presentation. However, in general, there were no major problems managing the interaction between the instructor and students and coordinating the use of the delivery equipment.

The hands-on demonstrations that were provided in this course could probably have been run by the instructors over the delivery system, but they would have been much more difficult to coordinate, and the students would have had more difficulty understanding them. Thus the site facilitator performed an important role here.

The students were very complimentary of the site facilitator and commented that he was a big help to them in understanding the material. Thus, it is very important to have a site facilitator with content knowledge for live distance education courses presented via one- and two-way video delivery systems.

Instructional Materials

Text Materials

Each student received three hardback notebooks consisting of a student manual (interactive study guide), a laboratory manual, and a course manual that served as the textbook for the course. These manuals were very professional, both in appearance and in content, and were highly rated by the students. There were only two things that need some improvement. First, the student manuals should contain all the important slides that will be presented on the monitors. Several times during the course presentation, a slide was shown that students wanted to view, but it was either in their course manual or lab manual. Similarly, as mentioned, several times references were made in the presentation to content in the manuals, but since the material was not cross-referenced, the students had a difficult time finding it quickly. Thus, all slides and other important information provided in the slide presentation should be cross-referenced to page numbers in the lesson manual and/or interactive study guides.

Slide Presentation

The quality of the PowerPoint slides was quite high, but it could have been improved with more planning. Some slides were difficult to read, due to small font sizes, too much text per slide, and poor text to background color contrast in general, and when a text block was highlighted. For example, in one case a red background was used that almost totally obscured the text.

A very effective slide was the one that covered the "Methods of Economic Comparison." This slide showed only the methods (one per bullet), and Dr. Ventre explained each one. This slide could be used as a model for many of the others. However, a concise bulleted text format requires the instructors to have their presentations highly prepared and well practiced.

In almost all cases chart slides were very difficult to read. These slides should be re-created so that they can be easily viewed over the monitors. In addition, the timing of bulleted text display and slide transitions may not have been checked prior to course delivery. In several cases, the bulleted text appeared faster than the instructor was ready for it. This problem can be corrected with more practice using this delivery system.

Some of the slide transitions also were distracting over the compressed video system. Transitions such as "slide up", "slide down", "slide left", or "slide right" looked choppy. Using a "fade in" or "fade out" might have been a better choice.

The video quality was the same at both sites since identical equipment was used. However, if sites use different monitors, the instructors and design staff must examine the slide/video presentation at each site to make sure the quality is the same for all. Different monitors will produce different colors, contrast ratios, etc., which will affect the presentation readability.

A short videotape was presented, which looked surprisingly good, considering it was filmed for a real-time video presentation using a VCR and monitor, and not over a compressed video system. The video was very clear and there were no noticeable choppy effects.

Class Demonstrations

The class demonstrations further enhanced learning and gave students a change of pace. The outside laboratory on the last day was very interesting and helpful, largely because it was a hands-on learning experience. It provided a different context for learning because it was outdoors and the students were actively involved. More hands-on activities would have been beneficial to the course.

Review Quizzes

The instructors employed review quizzes at the start of each day (after the first). These quizzes were excellent for helping the students recall and consolidate the previous day's material and for getting them geared up to begin the new session. The only complaint by the students was that there were no answer sheets for the quizzes. They would have liked to see answers to each problem and the associated problem-solving process.

Although the quizzes were scored in class (each student graded his or her own quiz), the students appeared to be highly motivated to perform this exercise. Maybe there was some subtle peer pressure to perform well, even though the students were not graded in the course. In any event, this method was highly effective.

Student Ratings of Instructional Materials

The students rated five items from the questionnaire concerning instructional materials. Table 3 provides the percentage of students who gave ratings of 1 (excellent) or 2 (very good) on the 5-point scale, the mean rating and standard deviation (SD), and the median rating.

Table 3. Student ratings of the instructional materials associated with the PVSD

Question	Percentage rating 1 or 2	Mean rating (SD)	Median rating
Quality of the lessons	97.2	1.31	1.00
Course organization	94.4	1.33	1.00
Overall quality of the printed materials	100.0	1.10	1.00
Value of practice activities	84.0	1.48	1.00
Value of remediation activities	91.3	1.52	1.00

Finally, students were asked if they had any problems with the lesson or study materials. The majority who responded to this item (83 percent) reported having no problems. The main complaints appeared to be related to locating pertinent information within the manuals (i.e., the cross-referencing problem between the slide presentation and the information in the manuals).

In summary, the instructional materials were rated very high. The interactive study guide, course manual, and laboratory manuals were comprehensive and professional. The slide presentation was also very effective, although the readability of some slides could be improved (e.g., increase font sizes, reduce the quantity of text per bullet, modify text to background color in both normal and highlighted modes, and increase the size of the charts). In addition, the review quizzes and class demonstrations very effectively enhanced both learning and motivation. The students would have liked more demonstrations, particularly those that provided hands-on experience.

Miscellaneous PVSD Course Recommendations

The following list provides miscellaneous recommendations for improving the PVSD course:

- There was an error on the slide “Effects of Temperature on PV Device Response.”
- The diagram of the hybrid system connections between the PV array, charge controller, and external power grid was confusing. Maybe it could be modified for novices.
- The charge controller demonstration was good, but the voltmeter was difficult to see over the monitors.
- Although the outside laboratory was effective and valuable, the lack of sunlight affected the results. Maybe an external light source could be added for cloudy days.
- Students expressed difficulty understanding the section on inverters. This section should be redesigned for a less experienced audience.
- The classroom should contain larger tables or desks rather than the small academic desk/chair combinations that were in place at SSU. FSEC used large tables, which easily accommodated the three manuals and note taking. In the future, all sites should have approximately the same classroom layout.
- The monitors at FSEC should be positioned higher so that students in the back of the class can see them easily.

Finally, if a live, two-way video course on PV system design is offered in the future for course credit, each session should be videotaped. The tapes could be used to provide remediation for students who miss particular sessions and for remote sites if there is a system failure.

Conclusion

As a whole, the students considered this course to be of very high quality. All of the students rated the course as (1) excellent or (2) very good on a 5-point rating scale. The mean response was 1.33 and the median was 1.00.

All students at the remote site felt like they were part of the class, and that this class was as enjoyable as a "live" class. They did not feel isolated due to being several hundred miles from the origination site, and they did not feel like they missed anything. They felt that everyone was all together and that the instructors were in the next room.

The students also were happy to be exposed to this delivery technology and really seemed to enjoy it. For many, this was their first exposure to a two-way video delivery system. They all agreed that it was nice to receive the same content information regardless of the distance away from the instructor. They also enjoyed interacting with their cohorts who were at the other site. However, they did not like the abrupt, scheduled cutoffs between sites (the telephone company rate plan required that the system go on line at 9 a.m. and off line at 4 p.m. exactly).

Approximately 85 percent of the students said that they were either very favorable (1) or favorable (2) (on a 5-point scale) to taking a future course by two-way video delivery. Only two people weren't sure if they would be interested in doing so.

All students commented that the course objectives were made clear and were followed, and that the course was well organized, although some of the logistics needed improvement. The students complimented the instructors and site facilitator for maintaining a friendly, collegial atmosphere. Fifty (50) percent of the students felt that this form of instruction was "superior" (1) or "a little better" (2) (on a 5-point scale) than traditional, live instruction. The other 50 percent rated this course as "about the same" (3) as traditional instruction. Only one person said that being at a distance impeded learning.

Hands-on practice was rated very high, and students wanted more opportunities to interact with the PV equipment. One suggested having the lecture in the morning and hands-on practice in the afternoon.

The students liked the simplicity of the instructional presentations. However, they did feel that too much material was covered for a four-day course. They did not like the long hours (approximately seven hours per day, including one hour for lunch), although it is not clear if that is because of the intensive nature of the material or because of cultural traditions of the mostly foreign-born faculty. They felt that four hours per day of this technical material was enough. One student suggested breaking the course into two courses, with the first one covering more basic information and the second covering the advanced topics. Another suggested making the course longer (more days).

Overall, the PVSD course was very successful. Given that this was the first time it was presented as a distance education course, it should significantly improve in future sessions, whether these are taught traditionally or at a distance.

Appendix A

Photovoltaic System Design
Savannah State College, December 1996

Student Course Evaluation Form
Day: ____

Directions: Now that you have completed this session of the Photovoltaics course, please provide information about your experience with this course. Please answer the following questions carefully and honestly. Your answers will provide important information to help us improve this course and to design other courses like it. We would like this survey to be anonymous; do not provide your name.

1. Were the goals and objectives of this course made clear to you? Yes____ No____
   Please explain:_____

2. Did you encounter any problems in completing the course? Yes____ No____
   If yes, please explain:_____

3. Did you encounter any problems completing the performance tests? Yes____ No____
   If yes, please explain:_____

4. Was this class as effective as a live, in-person class? Yes____ No____
   If no, why not?_____

5. Was this class as enjoyable as a live, in-person class? Yes____ No____
   If no, why not? _____

6. What did you like **most** about this form of instruction?_____

7. What did you like **least** about this form of instruction?_____

8. Did you feel like you are part of a course? Yes ____ No ____
If no, please explain_____

9. Did the physical distance that separated you from the instructor impede your learning of the course content?
Yes____ No____ If yes, please explain._____

10. Did the physical distance that separated you from the instructor affect your attitudes about the course?
Yes____ No____ If yes, please explain._____

11. What is your reaction to the method of evaluating your mastery of the course (i.e., testing, grading, out of class assignments (e.g., papers), instructor feedback, etc.)?_____

12. How would you rate this form of instruction (video teletraining) in comparison to traditional college courses you have experienced? Please circle one number that best applies to you..

1. Superior
2. A little better
3. About the same
4. Not as good
5. Much worse

13. If you could pick from the following educational options in the future, which would you prefer. Please rank them from 1=highest to 5=lowest.

    ____ Traditional classroom instruction at a community college or university.

    ____ Video telecourse (course taught by television or videotape) presented individually (at student's convenience) at a college site.

    ____ Video telecourse presented individually (at student's convenience) at a remote site (e.g., at home).

    ____ Video telecourse presented at a remote site with other students present.

    ____ Correspondence course.

14. On the following scale, circle the number that best reflects your attitude toward taking another video telecourse.

    1. Very favorable (I would take one if offered).
    2. Favorable (I probably would take one).
    3. Not sure (Whether I would take another one would depend on the topic and other considerations).
    4. Moderately unfavorable (I probably would not take one unless there was no other option).
    5. Unfavorable (I would not take another course like this one).

15. Additional comments and suggestions for improvement?_____

_____

_____

For questions 16-22, please rate the following aspects of the <u>course</u> using the scale below. Please circle the number that is most appropriate for you.

	1 Excellent	2 Very Good	3 Good	4 Fair	5 Inadequate
16.	Overall quality of the course	1	2	3	4	5
17.	Quality of lesson presentations	1	2	3	4	5
18.	General organization of the course	1	2	3	4	5
19.	Video time allotted to cover course topics	1	2	3	4	5
20.	Opportunities for interaction with the instructor	1	2	3	4	5
21.	Opportunities for interaction with the facilitator	1	2	3	4	5
22.	Opportunities for interaction with students at your site	1	2	3	4	5

23. Please rate the pacing of the course presentation. Please circle the number that is most appropriate for you.

    1. Very much faster than I would have liked.
    2. Faster than I would have liked.
    3. About right.
    4. Slower than I would have liked.
    5. Very much slower than I would have liked.

For questions 24-32, please rate the following aspects of the <u>instructor</u> using the scale below. Circle the letter that is most appropriate for you.

1	2	3	4	5
Excellent	Very Good	Good	Fair	Inadequate

24.	The video instructor's poise, personality, and enthusiasm	1	2	3	4	5
25.	The video instructor's delivery of information	1	2	3	4	5
26.	The video instructor's preparation to teach over videotape	1	2	3	4	5
27.	The video instructor's organization of class sessions	1	2	3	4	5
28.	The video instructor's ability to make good use of the available time	1	2	3	4	5
29.	The video instructor's communication skills	1	2	3	4	5
30.	The video instructor's encouragement of your critical thinking	1	2	3	4	5
31.	The video instructor's ability to stimulate your interest	1	2	3	4	5
32.	The video instructor's ability to use the equipment effectively	1	2	3	4	5

33. Did you have any discussions with the instructor or receive any assistance?
    Yes____ No____ If yes, please explain.

For questions 34-43, please rate the following aspects of the <u>course materials</u> using the scale below. Circle the letter that is most appropriate for you.

1	2	3	4	5
Excellent	Very Good	Good	Fair	Inadequate

34.	The overall technical quality of the video	1	2	3	4	5
35.	The readability of graphics and word pictures	1	2	3	4	5
36.	The clarity of the video	1	2	3	4	5
37.	The overall technical quality of the audio	1	2	3	4	5
38.	The sound level of the audio	1	2	3	4	5
39.	The understandability and clarity of the instructor	1	2	3	4	5
40.	The overall quality of the printed lesson and study materials	1	2	3	4	5
41.	The introduction of the video telecourse to you (e.g., preliminary information, course requirements)	1	2	3	4	5
42.	The value of the remediation activities.	1	2	3	4	5
43.	The value of practice exercises in helping you learn the needed skills.	1	2	3	4	5

44. Did you encounter any problems with the lessons or study materials?
Yes____ No____ If yes, please explain.

Photovoltaic System Design

Savannah State College
December 1996

VTT Instructor Evaluation Form

Name _____ Date: _____

Section(s) taught: _____

1. Did you have adequate time to prepare for this VTT teaching? If no, how much additional time would you have needed? What would have been the most effective use of your time?

2. Apart from the course development process, did the VTT course require more or less planning/ preparation for teaching than conventional classroom teaching?

   More _____ Less ____ If yes, please explain.

3. In comparison to classroom teaching, how difficult was it to present instruction and manage interaction in the teletraining classroom? Cite specific problems and solutions.

4. Given the capabilities of the teletraining system, how effective was the training in meeting the objectives established for the course?

5. Given the capabilities of the teletraining system and the particular learning strategies chosen for the training, how well were you able to encourage and maintain student motivation to learn the targeted skills and knowledge?

6. Considering the media available to you with the teletraining system (two-way video, audio, and graphics), how difficult was it to provide training of similar quality to that which you could provide in a normal class setting? Please comment on advantages and disadvantages of the media used.

7. Were some aspects of the course harder or easier to teach via teletraining? Please explain.

8. For what specific aspects of the course did you feel that teletraining was best suited? Least suited?

9. Was it difficult for you to handle the various components of the VTT equipment used in the instruction? If yes, please explain.

10. Of the specific teaching/instructional strategies selected for the teletraining course, which were successful? Why?

11. Which were not successful? Why?

12. Given your experience with the teletraining, which new strategies would you suggest to increase the effectiveness of a course such as the one you taught?

13. Explain how you promoted interactivity among the students during teletraining? Did you think the amount of interactivity in the course was sufficient?

14. How did student variables such as proficiency level, motivation, and aptitude affect students' abilities to benefit from the course?

15. Were there problems for some students in mastering the course objectives? Which objectives?

16. How do students taking this course compare to traditional college students (e.g. in motivation, learning, performances, etc.)?

17. How well was the site facilitator able to assist you in conducting the course? Cite specific strengths and weaknesses.

18. In terms of your own professional development, do you feel that the experience of providing this instruction via VTT has been beneficial? Why or why not?

19. Would you like to teach more classes by VTT? Why?

20. Please provide any additional comments which you feel may assist in improving the quality of this type of training in the future.

21. Please rate the following items using the scale below:

1 = Excellent
2 = Very good
3 = Adequate
4 = Below Average
5 = Poor

_____ 1. The technical quality of the audio.

_____ 2. The technical quality of the video.

_____ 3. The quality of the graphics/charts/etc.

_____ 4. Overall quality of course materials.

_____ 5. Your preparation to teach this class.

_____ 6. Opportunities for students to ask questions.

_____ 7. Students engagement (motivation) in learning throughout the class.

_____ 8. Technical support provided by the site facilitator.

_____ 9. Amount of time available to prepare for instruction.

_____10. Overall quality of the course.