

**Enhancing Teacher Problem Solving Skills in  
Behavioral Disorders through Multimedia Case Studies**

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**Abstract:** This session showcases new interactive multimedia materials which provide simulated case studies for training personnel to work with children with behavioral disorders. These materials are being developed, field tested, and nationally disseminated through a federally funded grant to preservice and inservice teacher education programs. The focus of the materials is to enhance problem solving skills of teachers to understand the real-world complexities of children's needs and adaptively select and apply knowledge from multiple perspectives. The presenters demonstrate the computer and videodisc components of the first program in this series, discuss its design from cognitive flexibility theory, and summarize results of field testing and comparison studies related to design issues.

### **Introduction**

Interactive multimedia technology offers exciting possibilities for teacher educators to bridge the gap between knowledge, skill development, and real-world applications. Multimedia materials, when connected to computer programs, link text, video, and audio in dynamic ways to provide an integrated and personalized learning experience for individuals. Video scenarios showing classroom situations anchor the learner's experience in real-world applications; the live interaction with the media-based material provides the learner the capability to structure his or her own knowledge base, view segments at will, seek information, explore alternative actions, and learn from response-based feedback. When designed appropriately, interactive multimedia technology offers a new way of instruction and a new way of learning (Falk and Carlson, 1988). Higher order thinking and problem solving skills can be learned through guided practice, much like clinical case supervision approaches used in medicine.

The constructivist view of learning asserts that knowledge is internal to the individual and constructed through the individual's interactions with the environment and negotiation of meaning with others. Learning occurs when new material is integrated within an individual's preexisting knowledge structure (Nelson and Palumbo, 1992). Knowledge comes from experiencing problems in diverse contexts, sharing multiple perspectives, scaffolding, and cognitive apprenticeships (Nelson, 1994). Important features of cognitive apprenticeship are modeling the thinking process used by experts, coaching the learner through hints and helps, scaffolding from the known to the unknown, exploring different strategies and hypotheses, and reflecting on the success of strategies and performance (Wilson and Cole, 1991).

Hypermedia-based instruction must go beyond simply representing associations (knowledge representation); it must stimulate cognitive processing so the learner constructs meaning from those associations (knowledge construction). Hypermedia systems can provide realistic problem solving "microworlds" within which learners explore and apply new knowledge

(Rieber, 1992). One challenge in designing hypermedia instructional systems is to avoid merely presenting information, but rather, to foster learning through effective strategies and problem solving approaches. Park and Hannafin (1993) have published a summary of empirically-based principles for the effective design of interactive multimedia materials. These principles provide a set of guidelines which are useful when creating interactive multimedia programs to facilitate cognitive flexibility in problem solving.

### **Theoretical Base: Cognitive Flexibility**

The design for the interactive videodisc program *Perspectives on Emotional and Behavioral Disorders* is based primarily on cognitive flexibility theory, one of the constructivist theories which emphasizes the real-world complexity and ill-structuredness of knowledge. Cognitive flexibility involves the *selective* use of knowledge to *adaptively fit* to decisionmaking in a particular situation; the potential for maximally adaptive *knowledge assembly* depends upon having as full a representation of complexity to draw upon as possible. In ill-structured problems, concepts which may apply to one case may not apply across cases of the same nominal type due to inconsistent combinations of factors. Ill-structured problems are more complex and require cognitive flexibility for understanding and decisionmaking (Spiro, Coulson, Feltovich, and Anderson, 1988).

The instructional approach for these materials strives to develop cognitive flexibility to enable the learner to construct knowledge based on complex and irregular situations. It focuses on both: 1) the construction of a knowledge structure, and 2) the use of that knowledge structure in problem solving. A major difference in cognitive flexibility theory from traditional constructivist theory is the change in emphasis **from** developing a knowledge structure based on intact preexisting knowledge **to** flexible adaption of preexisting knowledge to fit needs of a new situation. To accomplish this, the materials provide a flexible learning environment where information is accessed in a variety of ways based on multiple purposes.

Instruction in ill-structured domains is different from instruction in well-structured domains where knowledge may be taught in compartmentalized units and later integrated. In ill-structured domains, instruction must focus on general principles and interconnected knowledge across a wide scope of cases. Ill-structured knowledge domains are defined by two properties: 1) each case involves the interaction of complex multiple schemas or perspectives, and 2) considerable case irregularity exists across nominally similar situations due to complex interactions (Spiro et al., 1991a).

Such is the case in understanding children with emotional and behavioral disorders. While central concepts related to the child and situation must be considered, each case involves clinical and ecological differences which must be viewed, interpreted, and responded to from multiple perspectives. While the conceptual views of the problem may be well-structured—albeit different based on various theoretical perspectives—the use of those views in problem solving are substantially ill-structured, leading to diverse understandings and decisions (Spiro et al., 1991b).

The instructional medium itself should model the flexibility desired for the learner. Multimedia, because of its hypertext capabilities, is well-suited to modeling this flexibility due to its multidimensionality and non-linearity (Spiro et al., 1991a). Hypertext programs can be seen as "intellectual erector sets" that permit "open-ended exploration in the context of some flexible background structure" and "provides the tools for re-arranging knowledge for different purposes" (Spiro et al., 1991b, p. 24). As in other constructivist approaches, the learner must actively participate in constructing knowledge based on exploration and guidance. As learning proceeds, controls from within the program should be faded by removing scaffolds which support the user and allow adaptive use of knowledge in problem solving.

However, hypertext instruction in and of itself is not sufficient to develop cognitive flexibility. Hypertext systems must be designed so that knowledge is reorganized in different contexts to produce different understandings. To avoid confusions from out-of-sequence criss-crossings (nonlinearity) of information, a metacognitive framework can be provided which incorporates background information for each context and guides the user through case differences such as providing models or expert commentary. Case commentaries should provide information on conceptual themes, cross-reference applications to other case situations, and stress specialized aspects of the concept within the given context (Spiro et al., 1991b).

### **Objectives for the Training Program**

The purpose of *Perspectives on Emotional and Behavioral Disorders* is to enhance problem solving skills of teachers who work with children with behavioral disorders. Each of the three cases includes an opening challenge scenario and supportive information presented via software controlling a videodisc (level III application). The case materials allow users to explore and practice the processes involved in serving such children by (1) observing children in a variety of situations; (2) "interviewing" their teachers and parents; (3) seeking information; (4) comparing and contrasting multiple theoretical views. (5) hearing "experts" discuss the cases; and (6) engaging in problem solving and planning activities. The user has the option of exploring the case studies before, after or without hearing what the "experts" have to say about the main points of each theoretical perspective. The objectives for the program are to:

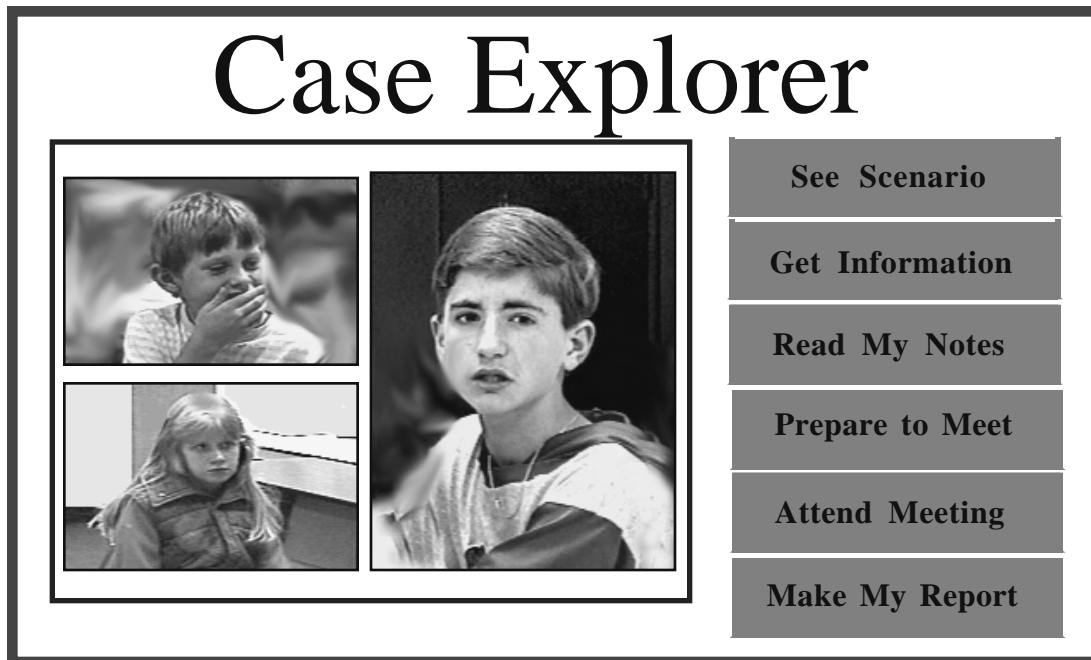
1. enhance problem solving skills of teachers preparing to serve students with emotional and behavioral disorders by developing an understanding of children and their problems from multiple perspectives;
2. assist teachers in appreciating the need and potential for collaborative, ecologically-based models in helping children;
3. provide flexible preservice and inservice training materials for general, special, and collaborative education programs; and
4. support the use of the materials as a teaching tool used by the instructor or as a learning tool used by individuals or collaborative learning groups.

### **Description of the Interactive Multimedia Program**

The program demonstrates the use of technology in many unique and innovative aspects. The design is non-linear with all activities and resources available from a main menu screen. Once the user enters his or her name, the *Case Explorer* screen appears on the monitor and the user starts exploring the case study materials through video, audio, and text-based activities.

- The opening *Scenario* depicts a school administrator addressing two teachers regarding a youngster who is having difficulties in school and home situations.
- The administrator asks the teachers to *Get Information* by observing the student, talking with others with knowledge in the field, reviewing background information on the child, and then meeting back with questions regarding the child's needs. This video-based scenario establishes the need to go through a problem solving process to consider a range of options and to synthesize information.

Figure 1. Main Menu Screen for *Perspectives on Emotional and Behavioral Disorders*



- The videodisc contains a database of information regarding the students in *Student Records* and substantial support material in *Fact Sheets and Theoretical Perspectives*.
- Users are able to view children in multiple classroom situations through *Observation* segments.
- Special terminology is hot-linked to a *Glossary*.
- The second audio track on the videodisc provides dialogue about the youngsters by *Experts* in the field of behavioral disorders. Photographs of the experts appear on the computer screen to provide a visual image of the speaker while the audio sound track is played.
- The program includes note-taking tools in *My Notes* for users to record observations, thoughts, and questions. These can be accessed by the user, either on screen in *Read My Notes* or through a printed hard copy; these notes provide an opportunity to document the user's progress through the program.
- Users check the accuracy of the information gained through the *Quiz* option.
- Users write their own question in *Prepare to Meet* to be discussed in a simulated case conference *Attend Meeting*.
- When finished exploring the case materials, the user enters answers to the challenge questions in *Make My Report*.
- The notes, the date and amount of time the program is used, quiz scores, questions prepared for the meeting, and report answers are recorded on a floppy disk. The instructor can use these files to monitor user's progress and make instructional adjustments.

Each component of the program *Perspectives on Emotional and Behavioral Disorders* is based on the empirical guidelines for interactive multimedia as described by Park and Hannafin (1993). Table 1 provides a listing of each principle and a description of the components and capabilities of the program which have been included to implement these guidelines. Program features which are hypothesized to stimulate the development of cognitive flexibility are placed in **bold** style.

Table 1. Empirically-Based Design of Program Components

Principle	Application to Program Design
1. Related prior knowledge is the single most powerful influence in mediating subsequent learning.	<ul style="list-style-type: none"> <li>• The program builds on areas of prior knowledge for teachers: the <b>case conference metaphor</b>, student files, <b>roles of resource personnel</b>, and knowledge of the field of behavioral disorders.</li> <li>• Instructors are encouraged to provide prerequisite <b>professional knowledge related to diversity</b> in classrooms and community service agencies.</li> </ul>
2. New knowledge becomes increasingly meaningful when integrated with existing knowledge.	<ul style="list-style-type: none"> <li>• Structural organizers are embedded in the program by providing a hierarchical category system in the information component and in the note-taking aids.</li> <li>• The <b>challenge questions</b> provide guidance in interpreting the information through a problem solving approach.</li> <li>• Resources are available within the program which can be integrated into courses, including fact sheets on behavior disorders, summaries of <b>theoretical models</b>, and support services in education.</li> </ul>
3. Learning is influenced by the supplied organization of concepts to be learned.	<ul style="list-style-type: none"> <li>• The information is accessible in semantically-meaningful units: users can pose questions to <b>characters who take roles within the case conference</b> and case records are organized by keywords on buttons. Videos and audios can be viewed for specific purposes. Thus, all content is segmented and accessed meaningfully.</li> </ul>
4. Knowledge to be learned needs to be organized in ways that reflect differences in learner familiarity with material, the nature of the task, and assumptions about the structure of knowledge.	<ul style="list-style-type: none"> <li>• The information is linked in a variety of ways through the database and on-line resources. Students can utilize <b>diverse search patterns and form multiple associations</b>, thereby supporting learner differences and pre-existing knowledge structures.</li> </ul>
5. Knowledge utility improves as processing and understanding deepen.	<ul style="list-style-type: none"> <li>• The <b>note-taking function</b> provides an embedded support for reflectivity; users can take notes on the cases in their personal files; these notes can serve to "think" through strategies and notate inferences.</li> </ul>

6. Knowledge is best integrated when unfamiliar concepts can be related to familiar concepts.
  - **Metaphors** assist users in generating their own mental models for content and procedures: metaphors include the opening scenario of the case conference, informational resources, and the participation of characters in the case conference.
7. Learning improves as the number of complementary stimuli used to represent learning content increases.
  - Information is presented through multiple images and media: video, sounds and narration, text, graphics and still frames, and animation.
8. Learning improves as the amount of invested mental effort increases.
  - The program requires mental effort by **seeking, synthesizing, and interpreting information**. Each case can be viewed from **different theoretical perspectives**.
  - **Feedback to quiz items re-directs the user to seek additional information** from the program; no answers are provided.
9. Learning improves as competition for similar cognitive resources decreases and declines as competition for the same resources increases.
  - The program is structured to reduce cognitive overload as information can be selected by meaningful words on buttons and icons. These referents allow the user to focus on the information rather than how to utilize the computer program.
10. Transfer improves when knowledge is situated in authentic contexts.
  - The problem solving approach is anchored in real **case scenarios which represent a range of children's disorders**. Each case is situated in a real-life context and focuses on authentic educational concerns.
  - The opening scenario establishes the situated context and issues the overall problem solving challenge.
  - The videos depict children in naturalistic **settings which must be interpreted and analyzed**.
  - The **experts provide commentary** on children as depicted in the video segments.
  - Case information is gathered from actual case files from **reports written by service providers and from interviews with teachers and parents**.
11. Knowledge flexibility increases as the number of perspectives on a given topic increases and the conditional nature of knowledge is understood.
  - The program encourages users to acquire knowledge from five theoretical perspectives and to **utilize information for multiple purposes**. Each expert provides a unique perspective on the case; background and descriptive information on the child is cross-referenced to source and time through a database; **each user must create his/her own organization of the material**.

12. Knowledge of details improves as instructional activities are more explicit, while understanding improves as the activities are more integrative.
- The purpose of the program is for the user to develop an understanding of children's behavioral problems in an educational context. The overall challenge issued to the user provides the **advance organizer for the user to integrate information**. The purpose is not on learning factual information but on synthesizing across the theories.
  - The **note-taking function** supports the user in integrating information into his/her personal knowledge structure as note files are developed.
13. Feedback increases the likelihood of learning response-relevant material, and decreases the likelihood of learning response-irrelevant materials.
- There is only one use of feedback in this program—to focus the user on relevant information which may have been overlooked. This is handled by:
    - a) having the administrator suggest the user look at other perspectives or search for additional information, and
    - b) providing feedback on the quiz to help the user determine whether background material has been mastered. Incorrect responses to quiz items offer suggestions to the user for securing additional information.
14. Shifts in attention improve the learning of related concepts.
- Specialized words are hot-linked to a glossary where their meanings are explained. This option helps users learn new terminology without leaving the program.
  - When information on the case is secured through query of a program character on the icon bar, that **character provides personal comments** related to the theoretical information which is delivered.
15. Learners become confused and disoriented when procedures are complex, insufficient, or inconsistent.
- The program is designed to be easy to navigate. All information is accessed in one of two ways:
    - a) clickable objects located on the case conference metaphor screens, and
    - b) keywords displayed on buttons.
  - Help information is available on the pull-down menu bar.
16. Visual representations of material and structure improve the learner's awareness of both the conceptual relationships and procedural requirements of a learning system.
- There is no graphical organizer or concept map in this program, as to do so would obliterate the purpose of the program for each user to develop a personalized schemata to understanding children's deviance.
  - One of the activities suggested in the instructor resource notebook, however, is for each user to **reorganize personal notes into a concept map**. This activity could provide a graphical organizer for each user as fits his/her perspective.

17. Individuals vary widely in their need for guidance.
- Procedural advice is incorporated through the pull-down "help" menu structure on how to use the program. Assistance in locating information is provided on the quiz component.
  - One way the program may be used is in **collaborative problem solving groups** so that users can compare and contrast information and strategies they used.
18. Learning systems are most efficient when they adapt to relevant individual differences.
- The program has no adjustments for differences in user learning variables since it offers nonlinear access to multimedia components. Personalization is provided in multiple ways in the program:
    - 1) The user's name is embedded in the quiz and the percent correct on quiz items is displayed and recorded.
    - 2) Data regarding usage is collected and stored in user records file on an individual floppy disk.
    - 3) The user keeps a **personalized notebook of information and reflections regarding each case through the note-taking component.**
19. Metacognitive demands are greater for loosely structured learning environments than for highly structured ones.
- Explicit directions are not provided for using the program. Rather, prompts are provided through the administrator who serves as the mimetic interface, and through **commentary from the characters interacting in the case conference.** The quiz serves as a self-checking device to monitor comprehension.
  - Another level of self-monitoring occurs through discussion. The user might be involved in a discussion group to supplement or further explore the learning options provided in the program.
20. Learning is facilitated when system features are functionally self-evident, logically organized, easily accessible, and readily deployed.
- The program is designed to be user-friendly through the use of metaphors and familiar objects used as clickable options to access information. The process of securing information has been made simple and familiar, not complex. It also **models procedures the users need to follow in real-life to access information**, thereby supporting transfer to the teaching situation.
  - Videos and audios have "break-out" buttons to provide user control.

## Study I: Field Testing

The program was field tested in a graduate course in behavioral disorders with nine students. To obtain course credit, all students were required to complete the case studies on all three children featured in the program. Users worked independently in the computer lab on the case studies. No direct instructor supervision was provided but computer lab assistants and the instructor were available if help was needed. Following case exploration, discussion groups were held during class time to simulate a planning conference for each child. Students submitted their floppy disks containing usage data and computer-generated reports to the instructor; the instructor provided feedback on submitted work.

### Keyword Search Strategy

In the earlier version of the software used in this portion of the program, users searched for information in the student records component using a keyword search strategy. To access information using the keyword search strategy, users were required to enter keywords in a text format. If the entered word was a "hit", a category of information was opened and records were displayed. If the entered word was not a "hit", users were prompted to consult the help option for hints and then try another word. The keyword index was flexibly designed so that multiple words in singular or plural form could "hit" to open the categories in the school records.

### Usage Time

The time of use equalled a mean of 5.04 hours (standard deviation = 1.80) for the first case study; a mean of 4.24 hours (standard deviation = 1.91) for the second case study; and a mean of 4.06 hours (standard deviation = 1.23) for the third case study.

### Qualitative Interviews

Two-and-one-half months following course completion, semi-structured interviews were completed with all students. The purpose of the interviews was to evaluate the students' perceptions of the software and its use in the course. A phenomenological approach was used to analyze the data (Glesne and Peshkin 1992). The interviews were transcribed and read multiple times in group sessions by the researchers and an ethnographer who then segmented the transcripts into idea units and categories. The idea units and categories were independently applied to three interview transcripts and discrepancies were resolved. The remaining interviews were subsequently segmented and sorted by the ethnographer. One of the themes which emerged dealt with problems users experienced with equipment and software. A frequently cited problem was the keyword search strategy to solicit information from student records as described by one user:

"The only problem that I did have was coming up with keywords to type in to get some information—some feedback—on each child, because they don't really give you keywords you should pay attention to; you kind of had to come up with some words on your own to try to get information."

From a constructivist learning theory orientation, the designers believed the information search process using keywords rather than clicking on buttons to access information would be superior, even though problematic, for the users. The act of generating keywords would seem to require users to reflect on the type of information needed for problem solving and to construct terminology typically found in student records. To test this hypothesis, an experimental study was designed to compare learning under two contrasting conditions: searching for information using the keyword strategy versus clicking on buttons with identified keyword labels.

## Study II: Design Study

The materials were integrated into a methods course in behavioral disorders for preservice teachers. Participants included 17 undergraduate students and 5 graduate students enrolled in the teacher certification program. The course was taught by the same instructor who conducted the field testing as reported above with similar course requirements, lab support, and data collection procedures. Users worked independently in the computer lab using their assigned disks.

### Comparison of Search Strategies

A second version of the program was created to provide a comparison to the keyword search strategy. A new version of the school records information component using "point-and-click" buttons was created for one of the program cases. In the button version, users simply clicked on buttons to open the information screens which were organized into categories. Half the users received the school records component in the button version and the other half received the keyword version.

### Protocol for Scoring User Reports

All reports were scored blind by two raters using a five-point holistic scoring rubric. Interrater reliability equalled 50%. Only 14% of scoring comparisons differed by more than one point. All differences were resolved prior to data analysis.

### Quiz Scores

Users were required to take the on-line quiz until achieving an 80%-score. The second-try quiz score was used in this analysis because the users frequently looked at the quiz for an overview of the questions and then returned to the program components to seek case-based information. Attempts on the quiz required a minimum lapse time of 15 minutes to indicate the user looked for additional information rather than immediately re-trying the quiz.

### Results

1. No significant differences were found between users in the two treatment conditions on the length of time spent completing requirements for the program using an unpaired t-test. Users in the keyword group spent a mean of 3.71 hours completing the case study; users in the button group spent a mean of 3.69 hours completing the program ( $p = .94$ ).
2. No significant differences were found on the second-try quiz scores between users in the two treatment conditions using an unpaired t-test. Users in the keyword condition achieved a mean score of 68.8% while users in the button condition achieved a mean score of 85.7% ( $p = .11$ ).
3. A "personal perspectives" score was given based on responses to the on-line question prompts: What is your perspective of this child's needs? and How do you support this position? On the "personal perspectives" analysis, no significant differences were found between scores for users in the two groups using an unpaired t-test. Users in the keyword condition received a mean score of 2.46 while users in the button condition received a mean score of 2.35 ( $p = .87$ ).
4. A "team synthesis" score was given for responses to the question prompts: Who would you like to be on the team for this child? and What views do your team members share? On the "team synthesis" analysis, no significant differences were found between scores for users in the two groups using an unpaired t-test. Users in the keyword condition received a mean score of 3.18 while users in the button condition received a mean score of 3.64 ( $p = .44$ ).

## Conclusion

No significant differences emerged to support the hypothesis that accessing information using a keyword search strategy was superior to allowing users to simply click on buttons to access information on any of the measured variables. The method of accessing information showed no relationship to the user's ability to develop a knowledge base or synthesize information from multiple perspectives. Although not a significant finding, the direction of the difference in quiz scores between the two groups suggests that users were more successful in locating information using a point-and-click search strategy with buttons. Based on comments gathered during field testing, users were frequently frustrated and unsuccessful using the keyword search strategy and left the information component prematurely. Fewer frustrations were observed in the second study by those using the button version as opposed to the keyword version of the program. Based on these findings, the designers decided to change all three case studies to a button search strategy in the school records information component.

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