Association for Educational Communications and Technology

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About this issue...

This issue contains four substantial articles on several aspects of the ID field. Coscarelli and White describe and unusual (and highly successful) application of ID to a class based on the Guided Design approach to teaching decision-making skills. Task analysis, self-instruction, and in-class problem solving played major roles in the design. This article reports on an unusual situation in which the client-professor was entirely, even enthusiastically, supportive of ID methods.

Dalgaard, Simpson, and Carrier discuss “coordinate status consultation”—a method of improving instruction in which the client-professor and the instructional developer work together as equals in the consultation process. This paper defines coordinate status consultation, summarizes its conceptual bases, describes the major phases in the consultation process, and provides an extended example to illustrate its use.

Jonassen offers a critique of Aptitude-Treatment Interactions—a major theoretical foundation for individualized instruction. After a detailed survey of ATI, Jonassen goes on to consider Content-Treatment Interactions. He concludes that CTI should be given a much greater role in instructional development. He includes a substantial list of references.

Schwier discusses the controversial subject of student evaluations and their role in instructional development. The article discusses the roles played by student evaluations and reviews issues related to their use. Accepting student evaluations as a given fact of life for instructional developers, Schwier focuses on ways to minimize contamination of the useful data contained in them.

In this issue you will also find JID’s regular book reviews. Due to the length of the articles, however, this issue does not contain the usual summary of recent ERIC reports.

The final pages of this issue contain the index to volumes 4 and 5 of JID.
Applying the ID Process to the Guided Design Teaching Strategy
A Case Study

Part I: The Development Process

Greg and I first met in the Fall of 1978 when he asked me to observe one of his lecture classes. He had been teaching classes of 30 or so students at another university but now found himself in a large lecture hall with over 250 students. While discussing my observations he mentioned that what he really wanted to do was use a technique that he had experienced success with when teaching at another university. The technique, developed by Wales and Stager (1977) at West Virginia University, is called Guided Design. Greg wasn't sure, however, that the technique could be adapted to a large lecture situation. As we began to examine its assumptions and the constraints in a large lecture situation we felt that, through a careful application of the ID process, we could overcome most of the problems of implementing the Guided Design process.

Guided Design

Guided Design emphasizes teaching students to learn decision-making skills through applying their knowledge about content material to the solution of a complex problem. Unlike case studies, students are not given all the background material and data at one time and asked to deal with the problem en masse. Instead, they are led through the problem step-by-step. For example, students might be told just to define the problem and then set their objectives before even considering possible solutions. In general, Guided Design projects proceed in the following sequence of steps:
1. Define the problem.
2. State the objective(s) of your work.
3. List any constraints which limit possible solutions, assumptions which you must make to solve this problem, and the facts which you know.
4. Develop a list of possible solutions and evaluate these possibilities using appropriate criteria.
5. After selecting one solution, synthesize this solution.
6. Present the results in the form of a report.
7. Evaluate the results. (Wales and Stager, 1977, p. 17)

Usually, each of the above steps corresponds to an instruction which is given to the students, who work in groups of three or four. After a group has performed the instruction, they receive written feedback describing how an experienced decision-maker might have performed the instruction. This feedback is intended only as a guideline and not as a correct answer. The feedback also provides the next instruction. In this way, students are led through an entire decision-making exercise.

Unlike a standard lecture class, time in a Guided Design class is used for work on projects. Students must learn the content material on their own outside of class and then apply this knowledge to the assigned problem in class.

Thus, two significant instructional problems must be solved to implement a Guided Design course: (a) the content must be taught at a mastery level outside of class; and (b) having learned the content, the problem-solving process must be taught. The content is typically taught by self-instructional materials. The problem-solving process is taught using group projects which are strategically designed to afford maximum utilization of the content in solving the problem presented by the group project.

Design of the Course

At Southern Illinois University at Carbondale, Administrative Sciences 318, Production-Operations Management is a three credit course serving approximately 500 students per year. Students learn basic concepts and pro-
cedures used to plan, schedule, and control the production of goods or services. It is, by nature, a very quantitative course requiring more individual interaction and explanation than can normally be accomplished in a lecture format. To implement the Guided Design system in this course, we needed to focus on four major aspects of the instructional system: self-instruction units, group projects, grading, and the course management system. However, before focusing on any of these components it was necessary to specify course goals and prerequisite tasks to these goals.

Specification of Goals and Prerequisite Skills

The American Production and Inventory Control Society has, as a professional group, specified the basic skills that a professional in Operations Management would have. Using this documentation as a starting point, we established the goals of the course to meet these standards. Following this, we performed a task analysis of these competencies with the intention of generating the map or instructional blueprint for organizing both the content and problem-solving components of the course.

The overall course goal is to have students formulate a production plan for a production-operations management problem. The analysis of this goal shows that the learner must be able to integrate three broad planning processes into a single whole. These processes include forecasting, aggregate planning, inventory control, and capacity planning strategies. Each of these techniques can be further broken down into its component parts. Figure 1 represents the task analysis for the course. The task analysis also points directly to the proper placement of problem-solving exercises in the classroom. These problem-solving exercises are best placed at the intersection of component parts for a given task, e.g., in a forecasting problem one would place the guided design exercise at the intersection established by joining the content of moving averages, exponential smoothing, and regression analysis. At this intersection the students have learned the content necessary for approaching the problem-solving exercise in the limited context of forecasting decisions.

Note that the task analysis is built in two directions. It proceeds from the most basic unit at the bottom of the task analysis to the most complex, comprehensive unit at the top. We have also placed the most basic components of the production plan on the left side and have proceeded to the more complex issues on the right. Using this procedure we find that forecasting techniques are crucial to understanding both aggregate planning and inventory control problems. Similarly the guided design exercises can come at the confluence of aggregate planning component parts and inventory control parts. Thus conditions are established wherein the student gains both content and problem-solving experience in each segment of the overall course structure. It also becomes logical to insert the final course problem-solving exercise at the confluence of the larger components. In Figure 1, A, B, C, and D represent the placement of guided design exercises within the content structure of the course and specifies the location of the final exercise. The analysis stage of the project was completed at the end of the Spring, 1979, semester.

Self Instruction

For the guided design strategy to be effective, students must learn the content outside of class using self-instruction materials. It is essential that these materials be developed following a systematic procedure which will guarantee that students possess the prerequisite skills prior to attempting to solve the problem. While several approaches are possible in designing self-instruction materials, Faust (1977) has proposed a model that is particularly useful in selecting appropriate instructional strategies based on specified objectives. Figure 2 illustrates Faust's model for teaching rules. In developing an instructional segment the expected learner outcome is stated, the rule defined, examples are presented to illustrate the expected behavior and opportunities for practice with feedback are presented. The "Help" steps are used by students as needed.

At the end of the instructional segment students complete a posttest. If a student does well on the posttest it is assumed that the material has been learned. Typically there is no formal check for determining student performance on the posttest. However, students who do poorly on the posttest are expected to review the area of difficulty within the self-instruction segment. If they continue to have difficulty assistance can be requested from the instructor.

Figure 1. Task analysis for a Production-Operations Management course.
Each of the units was developed to match the skills outlined in the task analysis. Greg wrote each of the units generally following Faust's procedures. Over 300 pages of text were written during the summer of 1979.

**Group Projects**

To teach problem solving skills, the Guided Design strategy relied on the use of group projects. Projects in a Guided Design course are intended to promote student learning of the problem-solving process through solving open-ended problems. Because of the size of the class, it was necessary to reduce the feedback from seven to four steps. (This reduction was necessary due to the logistical problems in dealing with a large class. If seven steps were used, the instructor would spend most of the time simply handing out feedback sheets rather than interacting with the groups, e.g., in a class with 12 groups the difference between seven steps and four is 84 feedback steps versus 48.) Thus, the groups of three to five members were guided through these four consolidated instruction-feedback steps: problem definition; constraints, assumptions, facts; possible solutions; analysis and synthesis.

*Problem definition.* Students were started in the right direction immediately by defining the problem. Once the problem was clearly defined, the students' knowledge of the material usually enabled them to determine what was expected. Students were directed to define the problem by considering the symptoms, causes, and objectives. Explaining the differences between causes and symptoms in the instruction statement will usually assist the students' success at this step.

*Constraints, assumptions, facts.* At this step students are given an explanation of the differences between constraints, assumptions, and facts. They then must determine the factors that will influence their possible solutions.

*Possible solutions.* This step allows only one check on the direction each group will take in solving the problem. It is also a time for creative thinking or brainstorming to determine as many solutions as possible. At this point the relationship between the project and the content should be clear to the students.

*Analysis and synthesis.* This step is usually the longest and should be closely coordinated with the content material. Students are required to break the selected solution down into meaningful elements and then seek in-

problems with real world referents. With the exception of the first project, which required only one day to complete, the other projects each required approximately three weeks to complete. These projects were written during the Summer session in conjunction with the self-instruction materials.

**Grading.** As we were concerned with both content skills as well as problem-solving skills, two grading systems were established. One was based on content, the other on group projects.

**Content.** To assess competence on the various content objectives three tests and a final examination were administered. Drawing primarily from objectives in the self-instruction materials.

**Group Projects.** Each unit of the course culminated in a group project that required the group to exercise the problem-solving skills taught in the course. The grades from these projects were weighed with the test grades to determine final course grades. An interesting problem that arose in dealing with the group projects was the varied level of participation of each group member in the project. In an attempt to manage the system somewhat more effectively than exhorting each to participate, three approaches were tried. Eventually we settled on a peer rating system that would motivate those less inclined to participate more fully.

The first approach was to check off the name of each student when feed-

“Guided Design emphasizes teaching students to learn decision-making skills through applying their knowledge about content material to the solution of a complex problem.”

*Developing and Implementing the Projects*

There were a total of five different projects for the groups. The first project, developed by Wales, was an introduction to the Guided Design process. In this project, the group is asked to deal with a situation in which they are stranded on a desert island and must develop a survival plan. The focus here is on the steps in the Guided Design process. The remaining four projects were operations management back was provided. The time when an instructor or assistant has direct contact with each group is when written feedback is provided. At this time, each student's performance was evaluated by checking off the names of those people who worked on the instruction. Unfortunately, this system proved time consuming and unreliable, e.g., students tended to "cover" for each other.

The second approach was to evaluate oral reports. Rather than using individual written reports, each group's work on a project was evaluated through an oral presentation of 3-5 minutes. Each group was
given an overhead transparency on which it was to specify the details of its solution. The transparency required completion of specified items so that groups could be compared. We had hoped the oral presentation would provide sufficient peer pressure to motivate the group members as well as show the diversity of solutions possible in solving each problem. The presentations did spark discussion but consumed large amounts of time without changing non-participant behaviors.

When these failed to work as well as we wanted, we turned to the third strategy—peer evaluation.

For the peer evaluation, anonymous rating of each group member is made by all other members. Adjustments to a final grade on a project are made on the basis of those ratings. Members who are rated as contributing nothing can receive a zero grade for the project.

Course Management

Our first problem in executing the course was finding a place for individual groups to work on their projects. After talking with the university scheduling division, we arranged to have one large room in addition to the large lecture hall. The class was divided into three groups, and each group met on a different day of the week in the large room. In this way, one instructor was able to handle 180 students, dealing with only 60 at a time. During the time they were not scheduled into the large room, each group was free to meet outside of class. The large lecture hall was used only to administer tests or periodically bring the class together to discuss problems, e.g., an extra lecture on forecasting strategies.

To insure that students wouldn’t fall far behind, a detailed schedule was distributed which specified exactly what they should be working on each day of the week. Thus students knew they had to begin a self-instruction unit, when it had to be completed, and what progress they should be making on a given project.

Finally, we established a computerized grading system to handle the peer ratings on each project. Since each student was rating each of the members of the group, the mass of data justified the time to create the system. Printouts indicating each student’s individual test and peer grades, as well as their average, were continuously posted outside the instructor’s office. At any time, a student knew how he or she was doing.

Evaluation

After development, the course was first introduced into the Fall of 1979. Considerable time was spent during the term in fine tuning the materials and procedures. During the Spring of 1980 a series of studies was begun that focused on the cognitive gains made by the students. Using test items designed to assess 11 specific goals, we compared performance of the Guided Design class to another section in personal, some professional, that may be worth sharing.

From the Developer

(A) Reaction to the problem. When Greg first mentioned that he really wanted to use Guided Design, I thought “Oh no, he has a solution in search of a problem.” As a general rule clients often confuse the symptoms and the problems and seek solutions to their symptoms rather than their pro-

“His willingness to accept the ID process also brought about a sense of abject horror on my part...My one constant fear was, ‘What if we do everything we are supposed to and it all fails?’”

which material was presented through lectures. (Students self selected sections of the class. As we were concerned about possible sample bias due to self selection, we distributed a short questionnaire asking the students to list their reason for choosing a particular section. Over 95% indicated convenience of schedule as the primary reason, rather than familiarity with the instructor, instructional technique, or other reasons.) On these eleven items, the 180 Guided Design students averaged 94.9% compared to an average of 88.8% for 86 students in the control group. In the Spring of 1981 on a similar test 141 Guided Design students averaged 93.4% compared to 71.8% for 142 students in the control group.

Other more qualitative data is now being collected focusing primarily on the dynamics of the group process. It is interesting to note that many of the students have complained that the course is “too easy.” It seems that they feel learning ought to be more difficult in a college course. Given the performance of the students on test items referenced to professional competencies, one finds this complaint more damming of current educational practice than an indictment of the course design. It appears the ID process did work for the course.

Part II: Reflections on the Process

This project was particularly satisfying to both the instrucional developer and the instructor. Along the way we dealt with a variety of issues, some problems. As it turned out, the Guided Design process was a reasonable strategy to use in this situation. What made the project different from other Guided Design projects was its use of the ID process. None of the Guided Design projects currently reported have combined the elements of task analysis, praxiological theory, and large group lecture settings.

(B) Abject horror. When I explained the ID process to Greg, it made great sense to him. I immediately knew I was dealing with a “non-normal” client. His willingness to accept the ID process also brought about a sense of abject horror on my part. With one exception I have never worked with a client who would buy the whole ID process. Most have to be cajoled into accepting bits and pieces. When Greg just asked for guidance on what to do throughout the project, my one constant fear was, "What if we do everything we are supposed to do and it all fails?" I haven’t shared this with him until today.

(C) Presence, or lack thereof, of an ID model. There was no single ID model used in this project. What we relied on was a general sense of the systems approach to creating and managing the instructional system. To the extent we did use a model, it consisted of determining our goals in light of the entry level of the students (a professional judgment made by Greg without any formal analysis of entry skills), the task analysis, development of materials, implementation, and ongoing evaluation of the system. Given the informal nature of our relationship there didn’t appear to be a need to
to understand that after experiencing the excitement of working on an individual basis with small groups, I was ready to try anything in order to avoid a mass lecture. (Obviously, I do not get my kicks from playing Johnny Carson to a group of bored students).

(D) Task analysis. Basically, the task analysis is what made everything work. I had previously thought about the structure of my course and how it all fit, or didn’t fit, together, but had never formally analyzed it. Using a text, I followed the author’s organization, only occasionally rearranging chapters. This often led to a vague feeling of dissatisfaction, but no real idea about how to reorganize the material.

The task analysis really forced me to look at what I wanted the students to learn, and how it all fit together. Today, because of the way we analyzed it, the course material forms one unified whole. Students progress in a logical sequence from one topic to the next. The material flows smoothly and builds upon itself. Students can quickly see that one unit is important because the next unit builds on it. At the conclusion of the course, students complete a project which ties all the material together, reinforcing the importance of understanding the linkages between separate com-

port of my course. They are surprised when I show them the depth of material my students learn, and become incredulous when they see how well students perform on tests. For me, the ID process has produced very positive results. Even though Bill might have had doubts, I always felt that what we were doing would work out. If it didn’t, we could always go back to making up transparencies!

Some Implications for the Developer

If there is an organizing principle to the success of the project, it must be flexibility in application. Many of our clients feel there is a best way for them to teach. While, in this case, Guided Design was presented as a preferred teaching strategy, other clients in other disciplines often have equally strong preferences for a particular strategy, e.g., the inquiry approach. While most of us would prefer to begin a project without the constraints of a given strategy, it is possible to apply the principles of ID to the strategy and create an effective instructional system. This tactic not only enhances the strategy, but saves a great deal of time and effort on the developer-client relationship.

Flexibility in accepting the client’s assumptions about the teaching process needs to be carried over to other aspects of the ID process. Specific models and PERT charts are useful only if they fit into the client’s style. In this case, they didn’t fit and no attempt was made to find a fit. What was there, however, was a general systems approach that underlies most ID models. However, there was no room for flexibility in this project when it came to the task analysis. The whole project turned on the successful completion of this process. In this case, the client grasped and enjoyed the process. Had he balked, we would have tried other strategies to gather the task information, but flexibility here would focus on alternative ways of gathering this information, not going on without it.

Thus students knew when they had to begin a self-instruction unit, when it had to be completed, and what progress they should be making on a given project.”

about 30. It seemed to work pretty well. However, when I tried to use it in a limited way with my large classes, the results were disastrous. I was overwhelmed by the sheer volume of students. The text I was using did not relate well to my projects which confused the students. Also, I had insufficient time to work closely with each group. I ad pretty well decided to give up Guided Design and just lecture when I asked Bill to observe my class. I thought he could help me make up some good transparencies (a job which, I’ve since learned, Bill hates).

Bill is probably right that I was a non-normal client. However, it is im-

ponents.

(C) Value of the ID process. The entire ID process was extremely useful for me. I was able to develop a course the way I wanted it, rather than following someone else’s text. It forced me to state explicitly what my objectives were and examine ways of getting there. I had to specifically identify how one concept or idea related to others in the course. While this did take some time, it was well invested. Besides, sitting around in the afternoon with a six-pack doing task analyses can be great fun.

Today, colleagues are very impressed with the organization and structure

References


Abstract. College and university instructional development programs frequently rely on seminars and workshops as methods for assisting faculty. Group formats alone are unlikely to provide the individual assistance faculty need to explore problems in their unique teaching environments. An alternative approach is coordinate status consultation in which a faculty member and teaching improvement consultant collaborate to address the faculty member's concerns. The faculty member brings his knowledge of his content area and his teaching environment to the relationship. The consultant provides his expertise in examining teaching concerns and facilitating change. This paper defines coordinate status consultation, summarizes its conceptual bases, describes the major phases in the consultation process, and provides an example to illustrate its use.

Many instructional development programs are limited in approach and scope. Some concentrate on teaching methods, preparation of instructional materials, or evaluation of teaching. Group seminars or generation of evaluation instruments may be the approach. At times faculty members' problems are redefined to fit into the service offered by the program. More often, faculty who perceive their problems as matching the available service receive help, but others do not. The difficulties with this instructional development approach are that a faculty member may not understand how the service could be useful and thus not use it, or that even those who receive help may not have their major problems solved if those problems are not addressed by the faculty development program.

Some programs rely primarily on seminars and workshops as the delivery systems for their services. While group seminars are useful for providing information, group support, and a format for sharing problems, they are not optimal for giving faculty the opportunity to use new teaching approaches and to receive individual feedback and suggestions for improvement. The changes we seek to encourage in faculty are conceptual and behavioral ones which are individualistic; the methods for encouraging such changes must be flexible enough to meet the variety of needs which a diverse faculty will have.

Recognizing the need for individual assistance, some programs have used individual consultation (or supervision) as their primary method for assisting faculty. Three views of the consultant (supervisor) are common in such programs: consultant as counselor, consultant as expert, and consultant as problem solver. Each role definition has different implications for the faculty member and the consultant.

The "consultant as counselor" role definition assumes that if the consultant can help a faculty member address his personal problems, then teaching development will follow. The counselor-consultant may focus on the faculty member's feelings of stagnation in his personal and professional lives. She would not necessarily address any specific teaching concerns.

The "consultant as expert" viewpoint assumes that the instructional development consultant has knowledge and insights about teaching and her primary role is to convey that expertise selectively to individual faculty. The expert-consultant decides which of her insights are relevant to her faculty member consultee and offers those insights.

The "consultant as problem solver" definition suggests that the consultant assumes responsibility for solving an instructional problem. A consultant using this approach might design and test microcomputer materials for the faculty member. In this model the consultant is usually responsible for identifying the problem and implementing solutions.

While we accept the notion that instructional development will best be accomplished through individual consultation, our assumptions about adult change lead us to a fourth model: "consultant as collaborator." This paper will describe those assumptions, outline the model which results from them, define the roles for consultant and faculty implied by the model, and illustrate its use through an extended example.

Assumptions Leading to the Model

Literature on adult learning gives a number of important suggestions for structuring an effective environment for change. Knox (1977) summarizes these findings. He states that:
Usually, when an adult sets out to learn about something it is related to a large amount of experience and information that the adult already possesses. The person’s current understanding of the topic or problem is typically organized around his or her previous encounters with it. (Knox, 1977, p. 428)

David Hunt (1976) concludes that faculty members have a set of theories about students and the teaching-learning process. As would be implied from Knox’s comment, these theories are based on the faculty members’ experiences and previous learning. Thus, any individual consultation approach should focus on knowledge and experiences the faculty member has accumulated during his teaching and on his theories of teaching.

Knox also states that adults are more likely to be motivated to learn when they help to identify objectives, select learning tasks, and understand the general procedures to be used in the change process. The models of expert-consultant and problem-solving consultant leave little room for the faculty member’s influence on the theories he wishes to change his behavior, alter his theories, or both.

The role of the consultant, then, is to help the faculty member explore his espoused theories, understand his theories-in-use (behaviors), perceive the discrepancies, and alter his theories and behaviors in appropriate ways.

Growing from these and a number of other theories is coordinate status consultation for instructional development. Coordinate status consultation is a collaborative process. The faculty consultant enters into consultation as a content expert and primary provider of teaching to his students. The faculty member is recognized for his expertise and his experiences as an instructor are acknowledged to be legitimate. He retains responsibility for his students.

The teaching improvement consultant serves as the catalyst for the faculty member who wishes to examine and perhaps change aspects of his teaching. Kurpius and Robinson (1978) summarize the outcomes of such a process: “This collaborative approach results in an efficient and effective process through which members learn to analyze and change their own behaviors…” (p. 5).

Coordinate status consultation is similar to process consultation (Schein, 1969) which is commonly used for organizational development. The similarities are the basic assumptions about change and creating environments conducive to change. But coordinate status consultation and process consultation are different in three important respects:

1. The individual teacher is the focus of change efforts. Changes may have effects on the organization, but those effects may not be significant and they are not the focus of consultation.

2. The focus is on individual problem solving rather than group processes.

3. The teaching improvement consultant is usually part of the same organization as the teacher. Thus, maintaining a coordinate status relationship is paramount to the success of the consultation.

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In coordinate status consultation the consultant’s focus is the faculty member. The faculty member’s concern is his students. Their joint focus is the teacher’s instructional improvement goals.”

Direction of consultation. An alternative model is one in which the faculty member has responsibility for his own change with the consultant assisting in that process.

As vris and Schoen (1974) contend that people have inconsistencies between their espoused beliefs and their behaviors. The authors say that if a dilemma demands behavior or theory change is to occur, “events must emphasize the conflict between espoused theory and theory-in-use in ways that overcome normal attempts to avoid noticing the conflict” (p. 31).

Merely presenting the faculty member with information from an expert or helping him to resolve personal problems is not likely to produce lasting changes in teaching behaviors. The consultant must collect data and information about the way the faculty member actually teaches, the way he would like to teach, and the way he thinks he teaches. The contrast between the data and the instructor’s theoretical process through which members learn to analyze and change their own behaviors…” (p. 5).

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<th>Phase</th>
<th>Sample Consultation Strategies</th>
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<td>1. Explore the teacher's theories and concerns about teaching.</td>
<td>Elicit information through questions&lt;br&gt;Active listening&lt;br&gt;Summarize problem statement&lt;br&gt;Probe for addition through questions&lt;br&gt;Active listening&lt;br&gt;Summarize problem statement&lt;br&gt;Probe for additional information&lt;br&gt;Reach agreement on problem statement&lt;br&gt;Ask for examples of teaching situations which illustrate the problem&lt;br&gt;Ask for hypothetical ideal teaching situations</td>
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<td>2. Gather data about teaching and student learning.</td>
<td>Examine course materials&lt;br&gt;Observe classroom teaching&lt;br&gt;Interview students, examine written evaluation&lt;br&gt;Elicit information through questions&lt;br&gt;Use a framework to focus data gathering activities&lt;br&gt;Examine student written work</td>
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<tr>
<td>3. Examine teacher's theories, select, design, and implement more effective teaching strategies build teacher's skills as needed.</td>
<td>Summarize pertinent information&lt;br&gt;Use a framework to organize feedback&lt;br&gt;Contrast espoused theories with theories in use (data)&lt;br&gt;Oral feedback&lt;br&gt;Written feedback&lt;br&gt;Task analysis&lt;br&gt;Brainstorming&lt;br&gt;Use a framework to analyze interactions&lt;br&gt;Present alternatives and evaluate them&lt;br&gt;Examine feedback: student interviews&lt;br&gt;Prepare materials&lt;br&gt;Change materials, strategies as needed during implementation&lt;br&gt;Provide individual tutoring of students&lt;br&gt;Provide methods for teaching skill acquisition&lt;br&gt;Provide references for reading&lt;br&gt;Model new strategies&lt;br&gt;Conduct group seminars&lt;br&gt;Consultant acts as student&lt;br&gt;Pilot-test in seminar group</td>
</tr>
<tr>
<td>4. Evaluate outcomes of new strategies</td>
<td>Pilot-test in classroom&lt;br&gt;Collect data&lt;br&gt;Compare to first set of data&lt;br&gt;Adjust strategies, reevaluate</td>
</tr>
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Figure 1.  Coordinate status consultation model and strategies.

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Consultant-Faculty Relationship

By definition, in coordinate status consultation the relationship between consultant and faculty member is a collegial co-equal one. Consultant and teacher are mutually dependent on one another (Caplan, 1970). The teacher depends on the consultant for the support and the stimulus to change which a second party provides (Peck and Tucker, 1973). In turn, the consultant depends on the faculty member for information about his teaching environment and his conceptualization of the teaching-learning process. The consultant also depends on the faculty member for indications of her own success in encouraging instructional improvement through consultation.

Such a relationship means that the consultant and faculty member must develop a mutual respect. Each learns to trust the expertise of the other while retaining the right to make his own decisions. The teacher and consultant learn to make use of one another’s expertise during the consultation process. The consultant might use a faculty member’s ability to perform a task as the basis for a task analysis and subsequent teaching strategies. The faculty member might notice the consultant’s adept use of questions and ask her to explain the questioning process she uses.

"Coordinate status consultation is less likely to be successful when one participant has formal authority over the other."

Both consultant and teacher must be assured that the content of consultations will be confidential unless agreement is reached to use the information publicly. This confidentiality is the basis for trust; trust is an essential element in any consultation relationship.

No decisions which affect the direction of consultation can be made unilaterally in a collaborative relationship. Crucial decisions about goals and solutions are considered and negotiated. Areas of disagreement are openly discussed. While the faculty member ultimately makes decisions, he makes them in light of the consultant’s comments. Because of their mutual dependence, every decision affects the consulting relationship and, therefore, both consultant and teacher. The example which follows provides an illustration of how the collaborative relationship is established, maintained, and concluded.

An Extended Example

Professor Solomon is a Political Science faculty member at a large university. He teaches two courses each semester, one on the undergraduate level and the other on the graduate level. Solomon called the instructional improvement consultant for his college and requested help in improving his teaching. Solomon explained that his undergraduate course was not going as well as he would like. The consultant and Solomon agreed to meet to discuss his concerns, to determine if the consultant would be able to provide assistance which addresses these concerns, and to outline their responsibilities for consultation.

At this point in the consultation process, the consultant has responsibility for clearly explaining her role and her ability to address the needs of the client before agreeing to collaborate. The teacher has the right to know that the consultant will be serving as an expert or a problem solver. If Professor Solomon is seeking something other than the assistance she is willing to provide, the consultant may wish to suggest other resources to meet those needs.

Initial Interview (Phase I)

During the initial interview the consultant seeks to understand the instructor’s assumptions about teaching and learning and his perceived strengths and weaknesses. The consultant seeks information about the professor’s instructional goals and objectives, students, course content, and teaching strategies. The teacher usually identifies a primary area of concern and the consultant pursues that area by listening to the faculty member’s description of his assumptions about teaching and about what occurs in the classroom.

Example. After some general conversation about Solomon’s courses, the consultant and Solomon began to explore his perceptions about teaching. Initially the consultant asked for information about Solomon’s perceptions of his strengths and weaknesses as a teacher. As a strength, Solomon identified his ability to explain complex concepts by using simple language and concrete examples. As the discussion continued Solomon began to talk about the factors which he considered to be important for good teaching. The one factor he stressed was his concern for students and whether they are learning what he teaches. Solomon attributed his use of class discussions to that factor. He expressed his concern, however, that those discussions were not going as well as he would like. As necessary, the consultant used questions to elicit Solomon’s perceptions of crucial issues in his teaching.

Faculty and consultant responsibilities. During phase one of consultation the consultant’s role is to ask questions and the faculty member’s role is to provide information. Both are equally important to the collaborative process. The consultant has responsibility to listen carefully and to check her understanding of the faculty member’s conceptualization. The faculty member is responsible for providing relevant information as truthfully as he can and for honestly correcting consultant misperceptions.

The consultant seeks to understand the faculty member’s concerns for preliminary examination. During this initial phase they usually identify broad concerns such as Solomon’s desire to improve classroom discussion. Within this broad area, and usually in the context of a specific course, the consultant asks the faculty member to help her understand salient features of his teaching situation. Without this understanding the consultant cannot collaborate with the faculty member on an equal basis.

New information—the faculty member’s espoused theories. In all phases of consultation the faculty member and the consultant will collect and categorize new information about the faculty member’s teaching situation. During the initial interview of phase one the consultant is categorizing information about the faculty member’s espoused theories and perceptions of his teaching.

Example: The consultant’s summary of Solomon’s theories and perceptions was as follows:
Goals: Wants his students to analyze and evaluate world political events by using knowledge and processes from the course. He seeks active participation by students. He wants them to look at issues from a variety of perspectives.

Students: They are intelligent but not very well informed on current events. They usually complete assigned textbook readings before coming to class. Students are probably motivated to do well in the course. They seem to have difficulty analyzing issues from anything but their own perspectives. They don’t interact with one another. Class size is about 30 students.

Content: Theories about power, balance of power, countervailing forces. The possibility of reaching different conclusions based on level of analysis—individual, group (national), societal (world).

Methods: Assigned readings are rarely supplemented by lectures. Short explanations are given to clarify confusing points. Main focus in class is policy analysis. He uses discussion questions for the class.

Instructor’s major concerns: Lack of desired type of student participation in course. Inability of students to analyze issues from a variety of perspectives.

By talking about his teaching, Solomon helped the consultant understand his beliefs about teaching and learning in general, as well as his perceptions of his specific teaching situation. Based on this new information and understanding, the consultant and Solomon agreed to collect additional information which would either support or contradict Solomon’s theories.

Collecting Other Data

Once the consultant develops a basic understanding of the faculty member’s instructional theories, the focus of consultation shifts. Consultant and teacher explore and discuss the teacher’s classroom performance. In order to base their discussion on as much information as possible, the collaborators seek information from a variety of sources. The consultant might suggest a rationale for each type of information, but the instructor ultimately decides which sources seem best suited for his purposes.

Example: In working with Solomon, the consultant offered suggestions and rationale for various types of data which could be collected. She mentioned classroom observation, videotape of the class, a list of the questions the teacher planned to use, and student interviews. In addition, she inquired about examining student performance on relevant quiz or examination questions.

Solomon thought they should begin with the consultant observing his class. At the consultant’s suggestion, he decided that his contribution to data gathering would be a list of the questions he planned for classes which the consultant would observe. The consultant suggested that Solomon could provide additional insights into the observations by making notes after each class concerning his perceptions of student responses, his role in the discussion, areas of satisfaction and dissatisfaction, and an assessment of student performance.

“Solomon was able to identify three areas in which students might be unprepared and thus unable to give the ideal answer.”

Faculty and consultant responsibilities. By the end of the discussion, the consultant and Solomon agreed on an area for preliminary analysis and the methods they would use for examining Solomon’s current teaching practices. They specified the consultant’s and Solomon’s responsibilities for bringing data to future discussions. The ability of both collaborators to contribute needed information is a major factor in maintaining the coordinate status relationship.

New information—the faculty member’s teaching practices. Each of the three types of information collected contributed to the understanding of how the faulty member actually teaches. The consultant noted the following during her observations of Solomon’s class:

Students: The students try to answer when a question is posed. They seem to be ignorant of current events, especially those related to international news which does not involve the United States. Students perceive “multiple perspectives” as meaning all perspectives are (only) opinions. It is questionable whether students have a framework or process they consciously apply when analyzing an issue. Instead, they focus on bits of content for their analysis.

When leading a discussion about the realignment of British political parties, the teacher had very little success or student participation.

Methods: The first part of each class was devoted to answering student questions about the readings. Students listen to one another’s questions and ask further questions if they don’t understand a response. The pattern for most questioning (90%) was instructor question-student response or student question-instructor response.

When conducting the issue analysis discussion the instructor begins with a comprehensive question based on an issue in current events. Primarily he expects students to work from their own current events knowledge. Solomon functions as discussion organizer. He recognizes various stu-
did not respond to the last one. He was not satisfied with their performance.

The data gathered reflect the difference in perspectives between the faculty member and the consultant. Data from each of these perspectives are vital if the faculty member's teaching practices are to be clearly understood.

Using Data (Phase III)

The purpose in collecting data is to enable the faculty member to examine his beliefs and assumptions about teaching in light of information about his teaching practices. By comparing and contrasting the instructor's perceptions of the class with the information gathered by the consultant, the faculty member's understanding of what occurs in the classroom is enriched. The enriched understanding frequently enables the faculty member to redefine his assumptions about teaching and subsequently leads to changes in his teaching.

Example. During the first meeting following data collection Solomon expressed his concern about the problems he had in promoting analytical discussions. The consultant began by asking Solomon to identify specific frustrations he felt during the discussion. He focused immediately on the last question from his list, Solomon could not understand the students' lack of response. Based on the first part of the class Solomon concluded that they understood the theories. He had wanted students to apply various theories and to see how they would reach a different conclusion depending on the theory they applied. The consultant suggested that she play the role of the instructor and that Solomon, playing a student, answer the question as he would have liked his students to respond.

Faculty and consultant responsibilities. Both the consultant and Solomon followed through on their responsibilities in the coordinate status consultation model. The consultant did not begin by outlining a laundry list of problems to be cleaned up for the next observation. Instead she asked Solomon to describe his intentions when using a strategy. She encouraged him to evaluate the outcome of the approach and to produce alternative explanations for the outcome. Solomon provided his responses and engaged in the thought processes suggested by the consultant. He brought data to the discussion as did the consultant. While the data are of different types, both are necessary to the consultation process.

New information — sources of learning problems. The consultant led Solomon through an examination of the sample ideal answer. Together they listed the knowledge and skill which students would need to give the ideal answer. By comparing that list to the available data Solomon was able to identify three areas in which students might be unprepared and thus unable to give the ideal answer:

1. knowledge of relevant current events
2. skill in performing a logical, organized, comprehensive analysis
3. ability to take multiple perspectives, especially ones which differ from their own beliefs

Important pieces of data led Solomon to these potential sources of learning problems. The consultant had provided Solomon with a summary of his assumptions about teaching and learning. One of those assumptions concerned the students' unfamiliarity with current events. A second important piece of data was student performance on the questions about Iran and Solomon's reaction to it. This led him to observe that even when students know the current event they do not analyze it effectively. Finally, Solomon used his recollection of student responses and those quoted by the consultant to test this conclusion; these data corroborated his suspicions that students have difficulty viewing the same event from a number of points of view.

Planning New Teaching Strategies

During this part of phase III the consultant works with the faculty member to understand implications of the data gathered on teaching processes. Typically a hypothesis about the factors affecting the particular concern of the instructor is generated. This hypothesis leads to selection of teaching strategies which address these important factors.

Example. Solomon and the consultant determined that their first concern should be the three areas which inhibit students' ability to contribute to discussions. Solomon hypothesized that there was a direct connection between students' ignorance of current events and their inability to answer certain questions. The consultant helped Solomon explore this connection by asking questions to clarify the hypothesis and to specify the data which he used to support that hypothesis.

Solomon concluded that most students are ignorant of current events because they do not read newspapers or hear news broadcasts. He concluded that this severely constrained their ability to answer his questions. Current events knowledge was the material students had to use to demonstrate their ability to use the theories in analysis of issues. The consultant and Solomon decided that their

"The consultant led Solomon through an examination of the sample ideal answer."

Solomon's focus on classroom discussion was only one of many teaching issues that he could have addressed. That focus might have been different than the one the consultant would have selected. But obviously the issue is important to Solomon. He mentioned it during the initial interview, commented on it in his notes about the class, and selected it as his first issue for discussion. All of these provided signals to the consultant that the issue should be explored. Again, the instructor's information and the consultant's skill in interpreting that information were both needed for a successful consultation.

Faculty and consultant responsibilities. In this part of phase III, the faculty member becomes a "scientist." He examines the data, generates hypotheses about possible new teaching approaches, and examines the viability of various approaches to testing hypotheses by using data already collected. The consultant offers possible teaching strategies and approaches to testing those strategies, monitors the congruence of the
hypotheses given the available data, and calls attention to any inconsistencies. It is the consultant’s responsibility to monitor this congruence and it is the instructor’s responsibility to determine the level of congruence needed before trying a new approach in the classroom.

While it is the instructor’s responsibility to use the most viable teaching approaches for his circumstances, it is the consultant’s responsibility to insure that the faculty member is knowledgeable and skilled in the use of that approach. The consultant may assume the role of model, of student, or of tutor to assist the instructor in learning and practicing the new teaching approach before its actual implementation in the classroom setting.

New information—Instructional implications. The teacher’s hypothesis reads, “Students’ inability to participate in discussion is due in part to a lack of knowledge of current events. In order to get better discussions I must increase students’ knowledge of current events.” While the test of this hypothesis ultimately occurred in the classroom, the consultant and instructor assessed the viability of several instructional approaches to test the hypothesis. Solomon and the consultant began by examining these approaches in light of the information they had collected. Solomon and the consultant compiled a list of six possible instructional approaches:

1. Weekly quizzes on current events
2. Assignments to read specific newspaper articles before coming to class
3. Short articles to read during class before beginning discussions
4. Lectures by Solomon which summarize current events
5. Distribute special student discount coupons to Newsweek and Time magazines and require students to subscribe
6. Break class into groups of six or seven students with one student in each group responsible for summarizing the critical events in a major geographical region of the world each week

Solomon rejected the first idea (one of his own suggestions); he felt that students needed more direction in their reading if they were going to be quizzed. Since his students were acting responsibly and preparing assigned readings, Solomon felt the quiz would be unnecessary. Solutions 4 and 6 required too much class time. The consultant commented that lecturing also would not encourage students to study current events independently. Merely requiring purchase of a magazine would not assure that students would read it; Solomon rejected option 5.

The consultant and Solomon decided to use approaches 2 and 3 and to evaluate which of the two produced the most desirable results.

When searching for these new teaching strategies Solomon frequently called upon the consultant’s knowledge of teaching and learning. Their coordinate status relationship was maintained because Solomon had responsibility for using the consultant’s information and for providing critical information about his own students, goals, content, and preferred teaching style. Collaboration was necessary to solve the problem through consultation.

Evaluating New Teaching Strategies (Phase IV)

Evaluation takes place as the instructor experiments with new approaches and also when the consultant and instructor are ready to terminate consultation or focus on a new problem. The first evaluation helps the instructor adjust new teaching strategies and determine whether he is implementing them as intended. The faculty member and consultant may also collect data concerning the effects new strategies are having on student learning.

Example. Solomon began building discussions around particular current events reading assignments. On the basis of new observation data, he concluded that both homework assignments to read current event articles and short articles to be read in class increased student participation in discussions. Solomon preferred the outside assignments since they did not require class time, and students could read at their own pace.

But Solomon was not entirely satisfied with the specific article assignments either. He felt that students were doing analyses based on limited data—the one or two articles he provided on the topic. Interviews with students supported his theory. As a result, Solomon modified his approach. Instead of assigning a specific article, he identified current event topics and some general issues students should explore using periodicals. Later when students seemed ready to take additional responsibility, Solomon simply assigned a topic and asked students to seek appropriate information and to identify the critical issues.

Faculty and consultant roles. The faculty member in this phase is responsible for implementing new teaching strategies consistent with his new understanding of students. On this basis, the faculty member can gather information relevant to evaluating the strategy. For example, he can assess students’ knowledge through questioning or students’ interest in the topic through an assessment of their level of involvement in the discussion. During implementation, the consultant’s role shifts to that of an observer of the instructional process in order to gather data to evaluate the success of the new teaching strategy.

As in earlier phases of collaboration, the faculty member and consultant pool their information to arrive at a decision regarding the success of the strategy. Coordinate status remains intact as long as each participant contributes to the effort.

New information—revised theories. Based on the information obtained during the evaluation, Solomon had three new theories to use in understanding his class:

1. Students will keep up with current events when that is part of the course assignments.
2. Students need a significant amount of information about current events if they are going to do meaningful analyses of them.
3. When gradually given less structure, students can learn to explore cur-
rent events on their own.
Solomon's refinement of his new teaching strategy and articulation of the third theory occurred as a result of the evaluation information contributed by both participants. Continuous assessment of consistency between what the faculty member would like to occur in the class and what does occur is essential to effective teaching. Information gathered in these assessments is used to revise and refine a faculty member's theories and consequently his teaching strategies.

Some Cautions
As much as we find coordinate
status consultation to be a useful model for helping faculty members address teaching concerns and make significant changes, we believe it is not ideal for all settings. Coordinate status consultation is less likely to be successful when one participant has formal authority over the other. This usually happens when the consultant (say a department chairman) is in a position of power over the faculty member. This unequal power relationship violates a basic assumption of coordinate status consultation. Even if the consultant does not see himself acting as an authority over the faculty member, the faculty member is unlikely to forget the power of the consultant. This feeling may constrain the faculty member's ability to openly explore his problems, discuss hypotheses, and critically evaluate his own teaching.

Coordinate status consultation may not be effective when faculty expect the consultant to be acting as an expert or a problem solver. With such expectations come demands for the consultant to implement solutions or give definite answers. At time such expectations can be changed, but if they are not the faculty member will view the consultant as failing to deliver the implied services.

Coordinate status consultation probably will not be successful with faculty who are required to participate, because they may be reluctant to participate fully. Without that commitment the faculty member and consultant are not contributing on an equal basis. In coordinate status consultation the consultant cannot solve a teaching problem without active participation by the faculty member. This same difficulty occurs with faculty who seek a low-effort solution to instructional problems. Both faculty member and consultant must agree that teaching improvement will require intensive cooperative efforts. Those who participate as collaborators come to recognize that teaching improvement is not "once and done" but instead is a continuing process. A major goal of coordinate status consultation is to teach faculty a process for examining their own instruction. Learning the process and feeling comfortable with using it demands time and a willingness to struggle through the process.

Conclusions
The effectiveness of coordinate status consultation depends on the consultant and faculty member establishing and maintaining a relationship in which both are responsible for contributing information, hypotheses, and instructional approaches appropriate to the issue under discussion. Participation by both collaborators is necessary to assure an accurate conceptualization of the instructional process which is necessary for making significant changes in teaching.

Coordinate status consultation offers a powerful approach to improving instruction for several reasons. First, it continually focuses on the concerns of the faculty member and his past knowledge and experience; this focus is required for working effectively with adults as learners. Second, the negotiation of each participant's roles and responsibilities throughout the consultation process enables both the consultant and the faculty member to maintain control over decisions. At the same time the faculty member's ultimate responsibility for student learning and his power in the instructional improvement process are acknowledged. Third, the faculty member's ability to analyze his own instructional setting is improved. Consequently the faculty member becomes more responsible for continually examining his own teaching and seeking the help he needs to make desired changes.

Collaborative consultation based on a coordinate status relationship between consultant and faculty member reflects the realities of teaching. Ultimately, the faculty member is responsible for his own classroom and for making changes in his teaching. Coordinate status consultation merely extends to teaching improvement the collaborative approach faculty have used for research projects. Just as faculty learn to rely on one another's expertise in research methodology, cogent writing, and conceptualization, they can learn to use a consultant's expertise as a collaborator in facilitating improved teaching.

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Aptitude- Versus Content-Treatment Interactions

Implications for Instructional Design

David H. Jonassen
Associate Professor
School of Education
University of North Carolina
Greensboro, NC 27412

Abstract. Interest in adapting instructional methodology to accommodate individual learner characteristics has been stimulated by the recent popularity of aptitude-by-treatment interaction research. While relevant to a descriptive theory of learning, ATI has failed to provide an adequate conceptual or empirical basis for a prescriptive set of adaptive instructional designs. The validity of adaptive designs as a focus for interaction research is questioned. Based upon cognitive task analysis and content analysis, the search for content-treatment interactions and their applications to instructional development should make adaptive designs more feasible, efficient, and consistent as well as developing important cognitive skills that may be short-circuited by learner-adaptive designs. Examples of research-based content-treatment interactions are provided.

Task Analysis

At the heart of the instructional design process is the practice of task analysis. The practice includes analyzing goal states in terms of the prerequisite and component learner behaviors that, if properly sequenced, lead predictably to some pre-stated terminal criterion. Emerging to preeminence with programmed instruction, task analysis provided the sequence for shaping the learner's behavior to produce the terminal objective. Although Davies (1973) identified six types of task analysis, the predominant method that has been employed is based on behavioral analysis. In planning for instruction, behavioral task analysis specifies the order of prerequisite capabilities (learning structure) that will most efficiently yield the prescribed terminal behavior (Gagne, 1970). Learning is conceptualized as associative and cumulative. Task analysis has sought to facilitate vertical transfer up the behavioral hierarchy, that is, to facilitate the acquisition of a series of approach behaviors.

The emergence and application of learning theory derived from cognitive psychology to instructional design has shifted the focus away from behaviorally oriented task performance specifications and hierarchical sequencing. Attention is now being focused on the internal information processing requirements of information acquisition (Low, 1980). Analysis of instructional tasks in terms of formal psychological models is the newest application of cognitive psychology to instruction.

Cognitive task analysis makes a different set of assumptions about learning than do strictly behavioral approaches. It seeks to identify and order the internal information processing operations required to perceive, store, access, and operate on knowledge. Resnick (1976) has constructed a cognitive model of task analysis—rational process analysis. Rational task analysis, an amalgam of Gestalt, cognitive, behavioral, and information processing theories, describes in detail an “idealized” set of operations derived from subject matter structure, i.e., content. These operations and the psychological abilities necessary for their performance are analyzed and sequenced for optimal performance. It functions as an information processing model for the accomplishment of cognitive objectives (Greeno, 1976) and the consequent knowledge acquisition. The key to cognitive task analysis is that in any learning situation, a description of the psychological operations must include representations of the specific content and the operations on it by the learner (Gregg, 1976).

If the product of learning is the arrangement of ideas in an individual's cognitive structure, Wildman and Burton (1981) recommend that cognitive task analysis should consider existing cognitive structure and content structure as input variables and the appropriate sequence of internal processes necessary for constructing the appropriate cognitive structure in the learner, namely accretion, restructuring, and tuning (Rummelhart & Norman, 1978). This is a process that can be accomplished rationally (analytically) or empirically (Winn, 1978). The designer must understand the structural relationship between concepts that form the content, i.e., content structure, developing designs that replicate that structure in the learner’s cognitive structure (Wildman, 1981). Content structure analysis requires the application of rational techniques of task analysis. The most popular methods for performing rational task analysis, active structural networks (Norman, Rummelhart, and LNR, 1975) and digraph analysis based on the theory of directed graphs (Harary, Norman, & Cartwright, 1965; Shavelson, 1972), seek to map the knowledge structures or schemata that exist in memory or in prose respectively. Shavelson extended the techniques suggested by Harary et al. to empirically compare the content structure of a passage with the resulting cognitive structure developed in the learners.

Understanding how to structure content is ultimately predicated on how we represent knowledge in memory. Most contemporary conceptualizations are based on schema theory (Rummelhart & Ortony, 1977), which conceives of memory as a cognitive network of schemata or internal representations of interrelated concepts. These schemata have variables and represent concepts at varying levels of abstraction which embed within each other. As Winn (1978) suggested, designers engaged in
task analysis need to concentrate on the process of learning and the product and structure of knowledge as well as the task being performed. Systems should focus on designs that will facilitate the construction of appropriate cognitive structures. The underlying assumption is that subject matter structure provides an important basis for sequencing and synthesizing instruction (Keigeth, Merrill, & Bunderson, 1978).

Cognitive or information processing task analysis has yet to be widely implemented because the necessary technology has yet to be developed (Wildman, 1981). This brief comparison of task analysis approaches is intended only to establish the conceptual ground for comparing two approaches to instructional design, the first based upon learner analysis and the second on subject matter analysis, another form of task analysis cited by Davies (1973), but rarely implemented.

“Aptitudes refer to any personological variables, including general intelligence, prior learning, personality, or cognitive styles, on which individuals differ and that predict performance from instructional treatments.”

Learner Analysis

According to a recent survey of instructional design models, over two thirds of the models contain some method for assessing learner attributes (Andrews & Goodson, 1980). A review of those would reflect little consistency in what learner characteristics should be assessed or what implications that data should have for the design of instruction.

Interest in learner analysis evolved in the sixties as a complement to task analysis. Three primary purposes for collecting data were identified:
- as criteria for selection to an instructional sequence
- as a measure of prerequisite ability for placement purposes
- as a method for adapting instruction to the learner and vice versa using differential assignment (Schwen, 1973).

The first type of learner analysis was not generally in the domain of the instructional developer; rather it has been employed for making admission decisions based upon the predictive ability of the measure. The assessment of prerequisite knowledge was a function of the behaviorally oriented task analysis procedures prominent at that time. The latter, based on the emerging aptitude-treatment interaction research paradigm, considered a range of learner attributes for making decisions related to differential assignment of learners to treatments. Not only were achievement-related abilities being compared with instructional methods, but also specific personality traits, cognitive styles, and information processing and coding strategies (Snow & Solomon, 1968). A new dimension had been added to task analysis procedures. Fueled by the revolution in learning theory produced by differential psychology, analysis of individual differences and their interaction with design strategies were added to the armamentarium of the instructional developer.

Aptitude-Treatment Interactions

The concept of aptitude-treatment interactions (ATI) is one of the best known in the educational research field today. Its genesis dates back a quarter of a century, when Cronbach (1957) used a correlational approach to relate individual differences and experimental approach. Cronbach and Snow (1969) laid the groundwork for contemporary ATI research by suggesting methodological and conceptual guidelines for its conduct. In essence, ATI is a methodological paradigm that seeks interactions between alternative aptitudes (Cronbach & Snow, 1969), attributes (Tobias, 1976), or traits (Berliner & Calhoun, 1973) and alternative instructional methods. Although these terms make different assumptions about inclusiveness, aptitude is the most common designation. Aptitudes refer to any personological variables, including general intelligence, prior learning personality, or cognitive styles, on which individuals differ and that predict performance from instructional treatments. Treatments consist of the structural and presentation properties of instructional methods that might be expected to interact with the learner characteristics being analyzed. Interactions occur between aptitudes and treatments when individual differences in the former predict different outcomes from alternative treatments. That is, instructional treatments may facilitate learning or they may inhibit learning, depending upon their structural characteristics.

Generalized regression analysis is normally used to produce slopes by regressing the dependent variable (outcome variable) on the aptitude variable. Statistical differences between the slopes (normally assessed by heterogeneity of regression) indicate either an ordinal interaction or a disordinal interaction, which most researchers believe to be the more meaningful. Both have implication for instructional decision making as a guide for assignment of learners to treatment condition.

Cronbach and Snow (1977) suggest that learners with aptitude scores greater than that adjacent to the point of intersection be assigned to one treatment, those with lower aptitude scores to the other, to maximize learner output. Such an assignment may lack the reliability that can be effected by determining the regions of significant differences of outcomes (Berliner & Calhoun, 1973). That is, differential assignment to Treatment A is reliable for aptitude scores somewhat above the intersection of regression lines. Conversely, the region-of-significance for assignment to the alternate treatment is somewhat below the intersection. A number of statistical techniques exist for determining those regions (Cahen & Linn, 1973; Pothoff, 1964; Berlin & Levin, 1980).

Extensive reviews of ATI research (Bracht, 1970; Berliner & Calhoun, 1973; Cronbach & Snow, 1977) have found what Bond and Glaser (1979) indicate are “mostly A and T with not much I.” The lack of consistent support for the ATI hypothesis has resulted from weak conceptual grounding and deficient methodology employed in many of the studies reviewed. Small N's, abbreviated treatments, specialized aptitude constructs or standardized tests,
and a lack of conceptual or theoretical linkage between aptitudes and the information processing requirements of the treatment have often resulted in failure to produce interactions. The following review of these problems is global; an exhaustive review would require several hundred pages, as did Cronbach and Snow (1977). While many of these problems are interrelated, individual enumeration will focus attention on the scope of the problems.

1. **ATI research is largely atheoretical.** While a major goal of aptitude-treatment interaction research has been the derivation of explanatory principles concerning the nature of instruction (Saloman, 1972), most studies have focused on the predictive relationships of aptitudes in the differential assignment of subjects to treatment. ATI have often been empirically conceived, insensitive to the belief that "understanding of the psychological processes of a specific learning task is prerequisite to the development of a theory on the interaction between traits and treatments" (Berliner & Cahen, 1973, p. 59).

The absence of an adequate conceptual basis for selection of aptitude variables for research has often resulted in a shotgun approach. For instance, Seidel (1973) administered 27 instruments measuring 35 variables in an effort to generate significant ATI. Probabilistically, he found a few. The need for better conceptualization of treatments, which considers the information processing requirements called upon by the treatments, is one of the most persistent problems in ATI research (Fagan, 1979).

Recent ATI research models have sought to overcome this problem. If ATI research is to be fruitful, DiVesta (1975) claimed that the "theory underlying TTI research must consider the cognitive processes assumed to be correlated with the traits and/or processes induced by the treatments" (p. 189). This assumption led to his search for TTI's (trait-treatment-process interactions). Snow (1977b) promoted the use of two complexes of aptitude variables, the first of which concerns general mental ability, which has a well established relationship to learning but is too vague to be of use to ATI research. His G-complex consists of crystallized (conceptual-verbal) and fluid (reasoning/non-verbal) intelligence (Cattell, 1971) expanded to include general visualization intelligence (Horn, 1976). Yallow (1980) recently conformed the interaction of these with verbal vs. figural elaboration in instruction. Measures of another factor-derived intelligence model, the structure of intellect (Guilford, 1967) were compared with figural-inductive and symbolic-deductive instruction, producing no significant ATI's (Eastman & Behr, 1977), perhaps because Guilford's model is susceptible to pitfalls of differential methodology because of its failure to specify processing strategies (Sternberg, 1978).

Some of the most significant recent work with intelligence has been conducted by Sternberg. Using componental analysis (Sternberg, 1977), he has developed a theory of human reasoning (Sternberg, 1978), which he used to match treatments to information processing strategies (spacial and algorithmic) for teaching linear syllogisms. When no aptitude-strategy interactions resulted, the aptitude groups were reformed on the basis of models of response latencies, which then produced aptitude-strategy interactions. Recent research has been successful in identifying processing components of intelligence and relating them to aptitudes measured by traditional psychometric instruments. These provide a theoretically rich model for future ATI research.

Snow's (1977b) other general aptitude complex focused on motivation and anxiety. The complex consisted of achievement via independence, achievement via conformity, and anxiety measures as being the most relevant personality variables to learning. A series of long-duration, classroom-based studies have confirmed the usefulness of the complex in producing consistent univariate and bivariate ATI's (Peterson, 1977; Peterson, Janicki, & Swing, 1980).

Some of the most consistent theoretical linkages between aptitudes and treatments have been suggested by Salomon (1979), who applied his own heuristic model for generating ATI hypotheses (Salomon, 1972) in a series of studies which modeled the information processing characteristics measured by the aptitude variables in his treatments, producing a number of meaningful ATI. Even though current ATI research has refocused attention on the processing characteristics of aptitudes and the cognitive structural characteristics of task and achievement (Snow, 1980), much of the existing ATI research base is not generally theoretically based. Rather, hypotheses are still frequently a posteriori, using stepwise procedures to identify the most fruitful. As ATI research based upon coherent and consistent theoretical grounds continues to amass, this deficiency may no longer restrict its application to instructional design, which is also embracing a more cognitive orientation (Low, 1980; Wildman & Burton, 1981).

2. **ATI results are inconsistent.**

"In countless studies, intelligence has emerged as the strongest and often the only predictor, sometimes even when it wasn’t being measured."

Tobias (1981) concluded from several studies that ATI were generally inconsistent. Significant interactions are offset by more non-significant treatment differences. Very few replications of ATI research have yielded significant interactions. In fact, many replications have reversed the findings of the previous study or were followed by non-significant differences. Tobias has also found that different researchers evaluating the same aptitudes or treatments produce dissimilar results. When ATI do occur, most are not strong, i.e., they are ordinal and therefore not useful for differential assignment. Results are often isolated and artificial.

These poorer, fashionable studies that are rarely replicated don't employ generalized aptitude constructs and employ short duration treatments often resulting only in higher order interactions which are uninterpretable (Snow, 1977b). When meaningful conceptually based aptitudes and treatments are employed, replications may occur (Peterson, Janicki, & Swing, 1980). It is recognized that ATI is no more fragile than most areas of educational or social science research.
It is only its applicability to a prescriptive design science of instruction that is being questioned here.

3. **ATI results lack generality.** In addition to the lack of consistency, most ATI results cannot be generalized to similar populations or across time. They lack external validity. Many ATI studies are not classroom-based. When they are, class effects often interact with treatments or aptitudes. Within-class regression analyses have nullified significant grouped (between class) aptitude-treatment interactions (Brophy, 1979; Cronbach & Snow, 1977; Green, 1980; Gustafsson, 1978). The social context of the classroom plays an important role in learning, although it adds another order to the interactions. The interactions both among and between aptitude variables and instructional conditions are so complex as to render generalization impossible (Snow, 1977a). It is impossible to store up generalizations and construct an ultimate assembly into a network (Cronbach, 1976, p. 123). A generalizable theory of aptitude-treatment interactions is not possible. Learning is too context-specific. At best we can hope to develop local instructional theories related to local instructional situations concerned with small portions of the curriculum and small segments of the population (Snow, 1977a). Snow concludes that it is possible, through continuous, systematic, formative evaluations of ATI's over time in a given place to generate a dynamic instructional theory for that place that could not generalize to another.

ATI's do not appear to generalize over time; however, long term, realistic studies suggested by Cronbach & Snow (1977) are capable of producing some interactions. Hickey (1980) found in a semester-long study that internal, high general reasoners benefitted from low instructional support. Unfortunately, this type of longer term interaction is subject to instability over time. For instance, over a sequence of four units, Burns (1980) found that crystallized intelligence (perhaps the best general intelligence construct available) was consistently correlated to performance, yet all other aptitudes fluctuated over time. Burns concluded that the time-dependence of aptitude-learning relations is mainly reflective of the fluctuations in content requirements over time, method requirements being less consistent. Treatment effects may also change over longer periods of time, suggesting what Cronbach (1975) referred to as Decade X treatment interactions. It seems that ATI effects can only be generalized to individual classes in a specific locale during a finite period in history.

4. **ATI also interact with task content characteristics.** To further complicate generalizability, ATI also interacts with processing characteristics of the criterion task to produce complex performance differences (Rhett, 1974). He found that error rates were higher but response latencies shorter for impulsive learners, with opposite prior learning (Tobias, 1976) and anxiety (Tobias, 1977) co-exist, their relative contributions to learning are normally less than mental ability (intelligence) and therefore probably less cost effective. It is doubtful that significant attributes would be of equal importance to instruction in different areas (Tobias, 1976). Snow's work has indicated mental ability is best represented as a complex (see No. 1 above), the sub-components of which may differentially interact with treatment. All of this might suggest

> "It is impossible to adapt reality, to break it down and synthesize it into a different form for each learner, as an ATI-based paradigm suggests. Such an approach is atomistic."

**Results for Reflectives.** Aptitude by treatment by subject (task-relevant) interactions were also reported by Tallmadge, Shearer, and Grevenberg (1968). Rhett (1972) recommended, in fact, that designers first concentrate on the task characteristics (e.g., demands on memory) and then identify the individual difference variables that may be related to those characteristics, a suggestion also recommended by DiVesta (1975). This additional level of interaction is not surprising. It simply adds complexity and ambiguity. How can designers be expected to effectively accommodate aptitude x treatment x class x time x context x task interactions in designing instruction for each objective? Or any objective?

5. **Intelligence is the preeminent/precursive aptitude.** In countless studies, intelligence or mental ability has emerged as the strongest and often the only predictor, sometimes even when it wasn't being measured (Jonassen, Note 1). Since general ability (usually crystallized intelligence) is usually highly correlated with aptitude measures, after it is removed, little variance in dependent scores is left, so ATI are often difficult to isolate (Berliner & Cohen, 1973; DuRapau & Carey, 1981). For instance, IQ scores predicted 50% of the variance while seven other predictors accounted for only 6-8% across tasks (Crocker, et al., 1979). In another recent study, 60% and 78% of the variance accounted for was due to general ability. Although interactions between treatments and such variables as

that the only learner attribute worth accommodating to, if any, is this intelligence complex. However, knowing that brighter learners learn better only confirms intuitions that the Greeks had.

**Trends in ATI research**

The methodological and conceptual problems that have plagued ATI research were explicated by Cronbach and Snow (1977). Trends in research indicate that at least some of the problems are being addressed:

- bivariate and multivariate regression on meaningful complexes of aptitude variables
- longer term, larger scale studies
- laboratory-based studies to isolate and test specific processes operating in ATI (Snow, 1978)
- theoretically oriented methods for deriving aptitude factors
- concern for social, contextual variables affecting ATI

If current efforts are successful, in a decade it may be reasonable to summarily reject most ATI research conducted before the mid to late 1970's, depending upon the reoriented research methodology of the 80's for an accurate picture of learner-environment interactions. At such a point, the previously cited deficiencies in the ATI research base would no longer exist.

**ATI Design Models**

ATI is conceptually based in differential psychology, which focuses on the interactive effects of personological and environmental
variables in behavior. Individual differences identified by this field have obvious implications for the design of individualized systems of instruction.

"All attempts to individualize instruction, it turns out, rest explicitly or implicitly on some kind of ATI idea" (Snow, 1977c, p. 23). The assumption has been that ATI’s that are conceptually coherent and can be consistently generated provide guidelines for accommodating the individual differences they assess. However, the meaning of the word accommodate has been understood.

One of the most prominent adaptive instructional design models promulgated so far is by Parkhurst and McCombs (1979). Believing that “the ATI concept is best applied, not in isolation but as an integral part of the dynamic decision-making instruction environment” (p. 33), they developed a rationally and empirically-based ATI instructional design model. The major steps of the process include:

1. Establish main track (best method) modules.
2. Establish student characteristics (related to criterion performance) data pool.
3. Evaluate main track performance for excessive failure rates/variance.
4. Develop alternative modules based upon predictor/criterion variable relationships.
5. Evaluate alternative modules in terms of cost effectiveness.
6. Implement differential assignments of students to alternative modules and monitor.

The model advocates consideration of a broad spectrum of predictor variables, including cognitive skills, achievement motivation, personality, and achievement characteristics. Its effectiveness has been verified in reducing learning times and improving test scores (McCombs, Note 2) using treatments that generated significant ATI’s (McCombs & McDaniel, Note 3). The key to applying this design resides largely with empirically identifying relevant cognitive and effective variables for each lesson in the design treatments (McCombs & McDaniel, 1981). Adaptive designs, such as those researched by McCombs, tend to be more effective at the microadaptive level and be particularly amenable to computer-based delivery (see also Tennyson, 1980; Tennyson, Tennyson, & Rothen, 1980). A point of concern with the Parkhurst/McCombs design model is its reliance on a "best method" with alternative mediation or modelling (compensation) of deficient skills. Are the assumptions substantively different than those for traditional instructional approaches?

This engenders perhaps the most fundamental yet least considered issue related to adaptive instructional designs—just what are we trying to accomplish? Shuell (1980) asked if we are trying to produce academic equality, eliminate individual differences, or maximize all learners’ outputs. These are mutually exclusive ends. The latter goal, for instance, would expand individual differences, thereby reducing academic equality. Can we afford the social ramifications of reducing academic equality. On the other hand, should we provide unequal opportunity by matching instruction only to the needs and requirements of a few?

Most adaptive instructional designs based on ATI’s employ one of three types of matches: remediation of learner’s deficiencies, compensation for deficiencies by modelling cognitive behavior, and preference, capitalizing on learner strengths (Salomon, 1972). Although these were intended only as heuristics for generating ATI hypothesis, they have formed the basis for the matching model of instruction. Additional methods for matching methods to learners, based on individual differences and the existence of aptitude-treatment interactions, included combination matches (combinations of above) and challenge matches, in reality mismatches that challenge the learner to acquire necessary but currently deficient mental skills (Messick, 1976). Based upon this matching premise, Ausburn and Ausburn (1978) have proposed an approach to instructional design that compensatorily matches instruction to differences in learners’ cognitive styles. The first step, task analysis, determines the stimulus-translation requirements of the task. The second step determines, based upon assessment of learning styles, the group of learners deficient in the processing skill for whom treatment will need to supplant (compensate) the required cognitive process.

Finally, designers must determine how to structure the treatment so that it will supplant that ability, that is, take the learner in Step 2 to the goal stated in Step 1. Predicated only on Salomon’s supplantation hypothesis, which has been empirically supported, this design model ignores Salomon’s belief that mental skills may be, depending upon individual differences, more successfully cultivated by calling-upon rather than supplanting the processing operation (Salomon, 1977). Not all learning processes need
supplantation, so uniform application of this model would be insensitive to learner needs.

An alternative matching model of instruction that has been extensively investigated is based upon Conceptual Systems Theory (Hunt, 1975; Hunt & Sullivan, 1974). This model focuses on individual differences in social cognition within a developmental framework. Based upon person-environment interactions, it seeks to match learner’s conceptual level (degree of cognitive complexity) with the degree of structure provided by the environment (contemporary matching). While Conceptual Systems Theory is one of the most coherent and comprehensive personality theories available, only a small group of studies support the contemporaneous matching hypothesis (Miller, 1981) and many more do not. Four major problems appear to militate against an ATI-based instructional design model in ATI research, whether it seeks to adapt instructional treatments or match learner characteristics.

“...The attempt to accommodate individual differences identified by ATI research in instructional designs is a noble, egalitarian idea, albeit a less practical one. A CTI approach to design is inherently more practical, cost-effective, consistent with theory, and productive.”

1. The conceptual and methodological problems have produced inconsistent and ungeneralizable results. Generalizing procedures from weak data would only produce weak designs. While the very recent ATI research appears to have rectified many of the problems that plagued earlier research and are now producing consistent results, there doesn’t yet exist a large enough database to provide the foundation for an instructional design model based on ATI results. This situation may change in the future.

2. Accommodating individual differences resulting from ATI is not feasible. The logical implication of ATI research is to provide for individualized programs of instruction. The complex nature of higher order interactions that inevitably occur when the range of significant predictor variables are considered, make multivariate individualization impossible and univariate impractical. Different instructional sequences would need to be designed for learners who differ in terms of selected attributes (personality, intellectual, prior learning, etc.) and be implemented in different contexts to teach some or all objectives which vary as to type of learning required (task characteristics).

However, it is foolish even to consider alternate treatments to accommodate aptitude x task x class x time x motivation interactions. So, two problems occur: determining which tasks or context areas are most susceptible to individual differences and then determining which aptitude/attribute variable(s) should be accommodated to by alternate forms of treatments. Schwen (1973) recommended that some form of decision theory (Chonbach & Gieser, 1965) be employed to determine the optimal strategy. It should be obvious that the number of alternate treatments required just to fulfill any part of the curriculum even if only one aptitude were accommodated, would be large. The construction of local theories of instructional improvement from locally based ATI results (Snow, 1977a) “was completely beyond the theoretical, administrative, and financial abilities of all but a handful of school/research partnerships located near major centers of research” (Gehlbach, 1979, p. 9). It is doubtful that even well-funded, task-specific industrial training situations would justify such attempts at individualization. They want designers to produce main effects impervious to ATI regressions. Necessary support systems are nowhere available. As Shapiro (1975) suggested, commercial producers won’t support such efforts to individualize, because it would not be profitable. The economics of publishing compel producers to develop “best method” materials to instruct the broadest range of learners. This discussion simply points to the incredibly complex interaction of events and circumstances (most beyond our control) that exists when any given learner acquires any given skill or knowledge.

The only way to manage and deliver any such ATI-generated program of individualization would be by computer-managed instruction. Resource limitations however would probably prohibit local agencies from developing and testing the software and instructional treatments needed to implement such a program. Because of the very modest gains produced by the very complex, research-intensive techniques they employed, McCombs & McDaniel (1981) questioned the feasibility of large scale implementation based on cost-effectiveness. While the most consistent instructional decisions resulting from ATI occur at the local level, the greatest economies in computer-based instruction are achieved on a micro-level. CMI may not become a viable delivery system for a while.

3. The major purpose of ATI designs should be correction, not adaptation. The implicit assumption of the recommended ATI-based design models is that research results should be interpreted so that instruction may be adapted to individual learner needs. Rather than fitting treatments to learners or learners to treatments as suggested by an ATI hypothesis, designers should progressively modify instructional designs so that they are less vulnerable to learner aptitudes (Gehlbach, 1979). This ATI correction hypothesis would seek to flatten out regression lines, utilizing ATI’s to help identify weak designs. This approach has been used by Henderson (1969) to make micro-adaptations to instructional materials. ATI is an important approach to a descriptive theory of learning. Instructional designs are prescriptive.

4. Instructional designs should not necessarily provide learners instruction in their preferred mode. Practitioners often confuse the prescriptive purpose of an ATI form of learner analysis by inferring that what is sought are interactions between learner preferences and treatments. Others have even promoted it as a design strategy. Merrill (1975) recommended that designers go beyond ATI by allowing the learner to control instruction.

Learner control is premised on two assumptions: (1) All learners know what is best for them at any given time in the instructional sequence, and (2) they are capable of acting on this...
knowledge (Snow, 1980b). The evidence doesn’t support this notion. In fact, Clark (1980) found from reviewing a number of studies that students prefer the method of instruction from which they learn the least. For example, high ability learners prefer more structured, directive instruction but benefit most from non-directive methods. A number of micro-adaptive structural programs that sought to accommodate prior learning (Ross & Rakow, 1980; Seidel, 1973; Tennyson, 1980; Tennyson & Rothen, 1980) have failed to support the effectiveness of learner control of instructional sequence, especially for more positive results. The implication is that content structure, especially for concept acquisition tasks, should be used to determine instructional strategy. The case for learner control of instruction requiring learner self-determination, autonomy, and responsibility simply has not been supported (Snow, 1980b).

The combination of these factors, but especially the feasibility issue, seems to reject the advisability of adaptive, learner-oriented, ATI-based systems for individualizing instruction. Within the decade, the ATI research base and computer-based instructional systems may evolve to the degree where such instructional systems are possible. The fact that only a handful of research-based agencies (most of which are military) are even experimenting with and attempting such designs indicates that widespread acceptance is unlikely. A more feasible, theoretically justifiable alternative will now be presented—content treatment interactions.

Content Treatment Interactions

Task analysis based on the processes required for assimilating and using information is necessarily content specific. Learning content requires a sequence of mental operations. Certain dependency relations between content constituents are necessary to consider when sequencing learning (Kingsley & Stelzer, 1974). These relations can be graphed to form a general cognitive network which is then related to tasks derived from objectives to form the subject matter structure.

A component analysis of the operations implied by any content, therefore, is necessary to select and sequence content (Merrill, 1973). It follows that the structure of the treatment will affect the cognitive operations required to learn that content. The manner in which treatment characteristics interact with content characteristics implies a design model with a different focus than that implied by aptitude-treatment interactions—one which uses task analysis based upon subject matter structure (Davies, 1973).

If we assume that subject matter structures provide an important basis for how to sequence and synthesize instruction (Reigeluth, Merrill, & Bunderson, 1978) and that task analysis should describe the optimal internal mental processes of the learner, based upon subject matter structure as suggested by cognitive task analysis, then designers should be seeking instructional treatments (sequences, codes) that simulate those processes. Just as ATI assumes that no treatment is appropriate for all learners, a content-treatment interaction approach (CTI) assumes that no particular treatment is appropriate for all content. Since subject matter is defined by different types of content (facts, concepts, principles, problems) calling on different mental processes, instructional treatments coded or sequenced to simulate those processes must also differ.

"Rather than shaping the treatment to individual differences in processing, why not shape the processing of individuals? It can be done far more efficiently."

Instructional designers need to know how those processes vary and what the implications of those variances are for instruction. The purpose would be to design sequences of instruction with structural and coding properties as isomorphic to the mental processes required for learning material at different content levels. A CTI approach is premised on differences in cognitive processes required by content that predict different outcomes from alternative treatments. In a number of studies, Salomon (1972, 1974, 1979) has found that instructional treatments that model the internal processing requirements of the task result in superior learning. In an exemplary study, Mayer (Note 4) found significant disordinal interactions between texts with and without advance organizers and degree of transfer required by the test and degree of organization required by the materials. Organizers facilitate transfer but actually inhibit near transfer of learning. They facilitate learning from randomly organized text but inhibit learning from logically organized materials.

Learners should be assigned to the treatment that best simulates the content processing requirements which result in most efficient learning. The most obvious initial criticism of such an approach is that individuals don’t all process information alike, so why instruct them all alike? Three reasons exist.

First, because content process analysis has indicated that a certain sequence of operations is necessary for learning a specific type of content and that a particular sequence, as represented by the treatment, is the most efficient combination of processes.

Second, human learners are very capable of adapting to specific task requirements, even though distinctive, individual learning styles do exist (Rhett, 1972).

Third, entry level learners deficient in certain mental operations will through appropriately structured treatments be able to cultivate them, a proposition that Salomon has argued for a decade. The supplantation model of instructional design (Auburn & Auborn, 1978) without adaptation would represent such an approach. The activation and/or development of mental skills is the foundation for all learning, regardless of how task-specific it may be.

Perhaps the most significant rationale for considering CTIs in instructional design is feasibility. For most cognitive objectives, such an approach would suggest “one best method.” Rather than attempting to adapt instructional methods, it seems preferable to progressively modify instructional designs so they are more uniformly effective (Gehlbach, 1979).

Designing instruction that can teach a content objective as well as the mental skills required for its performance is preferable to the production of a
potentially infinite number of treatments to teach different learner types. Is it educationally feasible to adapt instruction to each learner? Rather than shaping the treatment to individual differences in processing, why not shape the processing of individuals? It can be done far more efficiently. It would be fatuous to assume that such designs would be completely impervious to individual differences or contextual differences as suggested Snow (1977a).

Valid and reliable empirical findings can only supply designers with heuristics for assigning instructional treatments to specific types of learners. Likewise, CTI is not being posited here as a design model. The results of research can provide designers with a cognitive model of information processing for specific learning tasks, which can be translated into treatments.

The remainder of the paper will review briefly instructional methods and principles that have exhibited content-treatment interactions or possess unverified potential. This list is not exhaustive. In essence, they suggest ways for sequencing and presenting instructional treatments based on content structure characteristics. The first two are macroadaptive component analysis strategies, while the next two are microadaptive (lesson-level) strategies. The final group of curriculum strategies are conceptual in nature.

Advance Organizers

Based upon subsumption theory (Ausubel, 1962a), organizers function to bridge the gap between what the learner already knows (present cognitive structure) and what the learner needs to know in order to learn. Organizers provide the ideological scaffolding for incorporating a new piece of information into a person’s cognitive schema (Ausubel, 1963, 1968), i.e., they activate the appropriate existing schema in the learner so that new information can be readily assimilated.

Presented “at a higher level of abstraction, generality, and inclusiveness,” good organizers are concrete models, analogies, examples, and higher order rules (Mayer, 1979a). A recent meta-analysis of 132 studies indicated that organizers do in fact facilitate learning and retrieval (Lutten, et al., 1980) as well as transfer. The case for organizers more recently has been reconceptualized as assimilation encoding theory (Mayer, 1977, 1979a, 1979b), which states that meaningful learning is the reception of material into an existing assimilative context with the assumption that the learner will actively use that context during learning. Observed from this perspective, the use of advance organizers may have several significant content-treatment interactions. Mayer (1979a) found that organizers interacted positively with materials that are conceptual in nature, unorganized, and likely to be unfamiliar to the learner.

Organizers were more effective when they provided a high level context for learning and when the cognitive task was breadth of transfer and not retention. The results of a series of his own studies supported assimilation theory (Mayer, 1979b) and suggested interactions of organizers with learning that require far transfer as opposed to near transfer, discovery learning, application of higher order rules, integration of premises, and the use of linear reasoning. Non-organizer groups tend to focus on detail rather than relating to conceptual units. All of these results suggest the application of organizers and the consequent restructuring of learning materials based upon content analysis, not learner analysis. The research base on advance organizers makes them probably the most readily implementable content-structured learning approach.

Elaboration Theory

Conceptually related to advance organizers is the elaboration theory of instruction. Elaboration theory (Reigeluth, 1979) prescribes a sequence of instruction that provides the learner with an overview (epitome) of the subject and then elaborates one part of the subject to a predefined level of detail. A review includes the epitome and the part just elaborated. Each first level elaboration (only slightly more specific than the overall epitome) is further elaborated to a second level of detail, which is followed by a summary leading to an expanded epitome on that elaboration, and so on. The primary structure of elaboration theory consists of a series of synthesis-analysis-summary operations (Merrill, Wilson, & Keiety, Note 5).

This top-down, general-to-detailed sequence of learning incorporates a fundamental principle from subsumption theory (Ausubel, 1968), progressive differentiation. The theoretical basis for elaboration theory—which is not really a theory, but rather a group of organizing prin-
ciples for instruction or "elaboration technology" (Mayer, 1981)—is schema theory. The learner is provided with a schema or framework for assimilating more specific material. The schemata or epistememes comprise a network for integrating and relating concepts, an internal integrative reorganization process, since relationships between the concepts which form the structure of the content should be taught explicitly. Elaboration theory seeks to make the content structure obvious (Reigeluth & Merrill, 1979). A scheme combining elaboration theory and information processing analysis (P. Merrill, 1978) as a task analysis procedure is described by Reigeluth and Rogers (1980).

Although a paucity of empirical verification of the elaboration theory exists, content-treatment interactions similar to those for advance organizers could be inferred based upon the similarity in their theoretical background. Elaborated lessons would be expected to facilitate the learning of conceptually oriented material requiring transfer rather than recall. Rule using and discovery learning would also be expected to profit from the elaborated morphology provided by such instruction, whereas recall, near transfer and serial learning tasks probably would be inhibited by elaboration theory.

**Component Display Theory**

Component display theory (Merrill, Reigeluth & Faust, 1979; Merrill, Richards, Schmidt & Wood, 1977) has evolved over the past decade into a comprehensive theory (or technology) for designing, sequencing, and presenting instruction. It accommodates not only differences in tasks in its designs, but also considers content types. A set of principles and procedures are prescribed for determining the consistency between educational purpose, objectives, test items, and finally, presentation forms and the adequacy of each in terms of the inclusion of strategies, such as feedback, isolation, prompts, divergence, and matching. The application of these strategies to primary presentation forms varies by task level and content type.

As an instructional theory, it is premised on content x task x treatment interactions. The assumption is that instruction should be organized on the basis of the structural properties of the content and the nature of the interaction between content and the intellectual requirements of the learning task. It predicts that a particular combination of presentation forms will optimally produce learning (Merrill, Kowallis & Wilson, in press).

Such a prediction requires empirical support. In a series of validation studies conducted in real-world settings (Merrill & Wood, 1977) instructional procedures designed using component display theory did not produce significantly better performance or times-to-completion. However, in a post hoc comparison of competing organic chemistry texts, the book that achieved a higher rating on the basis of component display theory variables produced commensurately better student performance. Since component display theory is premised on such well-established principles of instruction, future validation efforts should probably confirm its efficacy as a content structural model of instructional design.

**Discovery Learning**

The popularity of the discovery approach to learning resulted from the advocacy of Jerome Bruner (1961), who promoted a classical, scientific method of discovery—inferring from evidence, gaining insights, allowing students to organize information and later apply it to the solution of learning problems. Early instructional designers working in programmed instruction reduced the discovery-expository dichotomy to testable constructs—RULEG (rule or generality followed by examples) and EGRULE (instances presented to induce rule) (Evans, Homme, & Glaser, 1962). The conclusions can be drawn (Herman, 1969). Content-treatment interactions tend to occur with regard to the information processing requirements of the task, RULE or expository instruction facilitates retention of material whereas EGRULE or discovery methods generally inhibit recall. Remote transfer skills, on the other hand, are facilitated by discovery methods and inhibited by expository (Guthrie, 1967; Worthen, 1968). Some form of intermediate direction (guided discovery) tends to produce superior results regardless of the dependent variable (Gagne & Brown, 1969; Kornreich, 1969).

The results of discovery learning research also provides an heuristic, based on a content-treatment interaction conception, for structuring and sequencing learning. Tasks that entail application and transfer should require the learner to induce or discover the concept or principle defined by the subject matter. A sequence of instances with appropriate prompts can be presented to the learner so as to ensure some success, a necessary ingredient to keep learners on task (Anderson & Faust, 1973). For recall of concepts or principles, an expository or RULEG approach is more efficient, as Ausubel proposed.

**Curriculum Development**

If all of this discussion of instructional methods sequenced and arranged by the content structure of the subject matter gives you the unsettling feeling of deja vu, its understandable. You were there—in the sixties, when curriculm theorists stressed the im-

"Cognitive task analysis makes a different set of assumptions about learning than do strictly behavioral approaches."

former represents an expository and deductive approach to instruction favored by Ausubel (1962b), and the latter, EGRULE, represents an inductive, discovery approach where the learner is required to infer the generalization from the common characteristics represented in the instances.

Despite a number of conceptual (lack of agreement on meaning of discovery) and methodological problems plaguing discovery learning research, some generally consistent importance of the structure of the discipline (Bruner, 1960). The same underlying theories regarding organization of knowledge and its reflection in the learning curricula being homeomorphically reconstructed in the knowledge bases of learners is behind most of the approaches presented here. Content structuring from a curriculum point of view, however, does not begin with assumptions about human learning. That is, sequencing is not based upon principles of cognitive processing. Rather
organization of curriculum and materials is mostly based on characteristics of the knowledge being learned, not on characteristics of human learning. The attempt is to represent things the way they are.

To this end, Posner and Strike (1976) analyzed content structure, dividing it into five major classes including:

- World-related: the way things exist in the world
- Concept-related: organization of conceptual world into logical structure
- Inquiry-related: logic and methodology of discovery
- Learning-related: processes of human learning, including hierarchical prerequisite, prior learning, difficulty, development requirements (related to ATI concept)
- Utilization-related: social, personal, organizational needs

These classes represent a broad range of organizational perspectives, many of which have been verified by a substantial body of human research. Their applicability in learning contexts have been tested over a number of years. Their intuitive value in sequencing instruction is doubtless. Since this paper elaborated from instructional design and task analysis, however, a lengthy review of these content-structuring principles exceeds page restrictions. Suffice it to say they offer the instructional designer a large number of plausible alternative hypotheses for sequencing instruction.

Philosophical Analysis

The final justification for a content-structural approach is philosophical, a consideration traditionally eschewed by researchers concentrating on behavior. If our theories/models won't stand the test of philosophical scrutiny, they perhaps should be discarded.

Content-treatment interactions are premised on the mapping of the structure of ideas represented in the subject matter onto the structure of knowledge in the memory of the learner exposed to that subject matter. This perspective makes certain assumptions about how the learner acquires knowledge. This perspective makes certain assumptions about how the learner acquires knowledge. It assumes a constructivistic position that conceives of man as an organized entity that actively participates in the construction of known reality (Reese & Overton, 1970).

This epistemological distinction has generally eluded research in educational technology, with its rigorous application and sequencing of hierarchical patterns of behavior. Constructionism suggests that we reject such a closed system of ordering learning tasks and procedures into rigid hierarchies. Based largely on the work of Piaget and other structuralists, constructionism suggests that the assimilation of sense data stimulates internal, mental operations that organize that information into schema (a term first used by Kant just over 200 years ago). These operations in effect transform realistic sense data into mental constructs. Knowing reality is a process of constructing transformations that model reality (Piaget, 1970).

The approach to sequencing and synthesizing instruction suggested by content-treatment interaction is inherently constructive. Behavioral analysis, on the other hand, is inherently reductive, seeking to break down a constructive process like learning into its most rudimentary components. Polanyi (1958) has argued that the "comprehensive entity" that defines a person cannot derive merely from an analysis of the laws that apply to its behavior. All learning is surely related to knowing, which entails the internalization of ideas and their effects on an individual's personal identity.

The process of knowing, i.e., constructing personal models of reality, is also inherently individualistic. We all make sense out of the world differently. This should not imply that we can or should attempt to restructure and adopt that reality to accommodate to each individual's existing knowledge structure. If a man is an active organism that actively interacts with his environment, he will interpret the experiences resulting from that interaction and, subsequently construct his own knowledge in his own way. That's what learning is. It is impossible to adapt reality, to break it down and synthesize it into a different form for each learner, as an ATI-based paradigm suggests. Such an approach is atomistic.

Besides (to inject an empirical note), there is evidence (e.g., Alessandrini, 1981) that suggests learners will process information using their most effective strategy, regardless of the mode employed or control (directions) from the instructor. A more appropriate strategy would require the learner to interact with instructional materials and sequences to reconstruct or "re-present" it to his own knowledge structure (Sigel, Note 5). While cognitive psychology does not preclude the role of individual differences and by inference ATI, it is theoretically premised on the construction of knowledge rather than the analysis, reduction, and adaptation of it.

In light of this conceptualization, a humanistic perspective would argue against peremptorily relegateing learners to prescribed modes of learning. The categorization of humans, even along personological dimensions, and consequent assignment to modes of learning is atypical to the humanist's conception of man as a free and independent entity. Becoming an individual is experientially mediated and must be self-determined. While such ethical concerns are not in the normal purview of the instructional technologist, we cannot afford to practice our trade in a socio-philosophical vacuum.

Conclusion

As Olson (1976) concluded, we're a long way from a comprehensive theory of instruction necessary for adequately conceptualizing cognitive processes. Aptitude-treatment interaction techniques remain a valid research model that can, as Snow (1980) suggests, contribute to our understanding of these processes. Although improved methodology and more theoretically-based conceptualizations are producing more consistent and meaningful ATI's, available knowledge about ATI's is far from producing even locally generalizable models of design. CTI designs are more readily generalizable since distinguishable types of content (and to the cognitive process used in
acquiring them) are fewer and more readily classified than the number of personological and environmental variables that may interact anytime a given learner sits down (or stands up) to learn. By analyzing the interactions between treatment and content structure, designers are also contributing to the derivation of theories of instruction as well as producing "idealized" treatments that will lead more efficiently to learning. Summarily stated, instruction derived from cognition is content-specific.

Content treatment interactions, as developed in this paper, do not constitute a model of instructional design or research or the latest panacea for all learning problems, but rather provide a heuristic for researchers and designers. Just as ATI was not conceived as a theoretical rationale for educational research, neither is CTI. The structural properties of content and cognition that form the basis for CTI do represent an appropriate design rationale for instructional designers. The attempt to accommodate individual differences identified by ATI research in instructional designs is a noble, egalitarian idea, albeit a less practical one. A CTI approach to design is inherently more:

- practical
- cost-effective (another issue worthy of elaboration)
- consistent with theories of knowledge acquisition
- productive in terms of curriculum/product development.

Content analysis is a process only alluded to in many instructional design models and completely neglected in others. It is a design competency that is recognized in the new DID list of competency statements (Task Force, 1981), but how successfully are practitioners taught to "analyze structural characteristics of a job task, and/or content"? If they have been, how is such analysis normally transferred to practice? Content analysis is an essential process in instructional design that can be facilitated by a content-treatment interaction approach.

**Reference Notes**


"The logical implication of ATI research is to provide for individualized programs of instruction."

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Awards Program for Outstanding Achievements in Instructional Development

The Division for Instructional Development (DID) has instituted an awards program to recognize outstanding achievements in the instructional development field. The first awards will be presented at the 1983 AECT convention in New Orleans. Award categories this year are:

- Outstanding Practice in Instructional Development
- Outstanding Research and Theory in Instructional Development
- Presidential Award for Outstanding Service to the Division for Instructional Development

The Outstanding Practice Award

This award will be given to those individuals or groups that have applied instructional development procedures in an exemplary manner. Application of the procedures may have resulted in a new or revised instructional product or system, or some other output.

Those who submit nominations for the award should include a brief description of:

- the instructional problem that was addressed
- the instructional development procedures that were employed in order to solve the problem, including any creative techniques that were used
- the output (e.g., instructional product, instructional system, etc.) that resulted from the effort, including any innovative features of the output
- the means by which the output was disseminated and/or implemented
- evidence of reduction or elimination of the problem, as well as other effects of the output, such as performance data, attitude data, and/or cost-effectiveness data

The Outstanding Research and Theory Award

This award will be given to those individuals or groups that have made a significant contribution to the body of knowledge upon which the instructional development profession is based. Any variety of means of communication may have been used for sharing the new knowledge with those in the instructional development field. These communications devices include books, journal articles, dissertations, papers presented at conferences, videotapes, films, etc.

Those who submit nominations for this award should include a brief description of:

- the problem that was studied and how that problem related to a need or gap in the body of knowledge
- the method of inquiry that was employed
- the knowledge that was generated
- the means by which the knowledge was communicated to those in the profession
- the effect the knowledge has had, or is likely to have, upon the Instructional development profession

The Outstanding Service Award

This award will be given to an individual who, over the past 5 years, has performed continuously outstanding work for the Division. Unlike the other award categories, nominations for the Service Award are not necessary. The DID President will choose the winner of the Service Award from among all the members of DID.

How to Make a Nomination

You may nominate any group or individual (including yourself) for the Practice Award and the Research and Theory Award. The work for which a group or individual is nominated, however, must have been completed after December 31, 1979.

Nominations should be in the form of a 3 to 5 page (8½” x 11”) typewritten, double-spaced summary of the work done by the individual or group being nominated. Summaries more than five pages in length will not be considered. The award descriptions contained in this article list the information that should be included when you make a nomination. In addition to that information, be sure to include, on a cover page:

- the award category in which the nomination is being made

(Continued on page 34.)
Design and Use of Student Evaluation Instruments in Instructional Development

Richard A. Schwier
Associate Professor
Educational Communications
College of Education
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0

Abstract. What can student evaluations of instruction contribute to formative evaluation? Five decades of research indicate that student evaluations can be developed which are reliable, and which can reflect student satisfaction. This article discusses the roles played by student evaluations in the instructional development process, reviews issues related to their use, and outlines suggestions for the construction, administration and analysis of student evaluations by the instructional development consultant.

Well-designed instruction can fail as a result of weak teaching performance, and relatively weak instruction can be judged as palatable based upon the performance of a strong teacher. While assessments of instruction can include a variety of strategies such as expert observation, analysis of student achievement data, self-appraisal, videotaping, and peer evaluation, one of the most important sources of diagnostic information has been student evaluations. Although student evaluations are used commonly, they have been subject to controversy. This discussion addresses issues surrounding student evaluations of instruction within the context of instructional development programs and reviews suggestions for the development and utilization of diagnostic instrumentation. The issue of whether or not student evaluations of instruction should be used will not be addressed, although it is noted that some individuals argue that student evaluations are hopelessly flawed. Given the fact that student evaluations are used extensively, the focus here is to explore ways to minimize contamination of these data.

Roles Played by Student Evaluations of Instruction

Student evaluations of instruction are used for three purposes: for promotion and tenure decisions, for diagnosis and remediation of teaching skills, and for student use in selecting courses and instructors (Derry, Seibert, Starry, Van Horn, & Wright, 1973; Kulik, 1976; Sheehan, 1975; Shingles, 1977; University of Alberta, 1979). These purposes do not describe fully the roles that student evaluations of instruction have played in the process of instructional development. How can student evaluations be used in a developmental context?

Placebo. Student data can be gathered and ignored. Although fruitless effort and mindless activity are not generally a good idea, just the act of gathering information can give the client a sense that progress is being made. Obviously, this is not recommended practice in a development context, as it can lead to credibility problems later in a project. Nevertheless, in practice, this is one activity that a client often expects, and meeting the expectations of the client early in the development process can enhance the developer-client relationship.

Ice-breaker. After a relationship between a developer and a client is established, concerns often surface which include: Do the students like the class? Are they bored with this? Do they like me? How am I coming across? Of course these concerns are not always voiced, but it is surely an insensitive consultant who has not felt these questions rumbling just beneath the surface of a conversation. Until these concerns are addressed, meaningful progress may be impeded in other aspects of the development process. Student evaluation data can be used as a reason to address these issues.

Product Appraisal. Student opinions of the instructional product can be acquired through student evaluations. Field testing a product requires sampling the attitudes of those affected, dispassionate or not. Comparing these opinions to other sources of information can often provide insights which are overlooked by persons close to the development process, or overly concerned about content. With due caution about the validity of any type of opinion-sampling procedure, student impressions of the difficulty, sequence, entertainment value, and approach of the task can be useful to the developer.

Instructional appraisal. Student evaluations can be used to identify perceived instructor weaknesses and strengths, and thus be used along with other data sources in a diagnostic role. The developer should handle this information skillfully, or as much harm as good can result. Unless the client is open to criticism, it is better to de-emphasize the role of student evaluations in instructor appraisal, and focus on the appraisal of the instructional product or task.

Given the variety of ways in which student evaluations of instruction can be used in a development context, it is useful to examine some of the issues surrounding their construction and interpretation, and then discuss some strategies which can be used to minimize contamination of these data.

Issues and Variables

There are a number of important issues related to the construction and validation of student evaluations of instruction. A discussion of major issues follows, and each will be preceded by a summary statement, which briefly provides the author's interpretation of available evidence.

Reliability

Student evaluation instruments can be tested for reliability. One of the arguments most often leveled at student ratings of instruction is that such ratings are unstable. This argument
teaching (Hildebrand, Wilson, & Dienst, 1971). Student surveys (Sheffield, 1974) and a review of teacher rating instruments (Wotruba & Wright, 1975) identified similar criteria, and this author noted considerable item redundancy in a wide sampling of instruments used by different universities in North America for student evaluation of instruction. While this could certainly be the result of instrument inbreeding, it can be argued that face validity exists between student rating instruments and the opinions of professionals and students. Many validity issues can be dealt with through a “cafeteria approach,” which is a system used by faculty to create individualized instruments (a more detailed description of this approach follows later).

A popular method of determining validity has been to correlate student evaluations of instructors and student achievement. The obvious rationale is that students learn more from the more effective teachers. This line of study has exhibited its own validity problems, as affective areas of growth have been ignored in favor of cognitive performance. Nevertheless, several studies isolated mild, but consistently positive correlations between instructor evaluations and student achievement (Bryson, 1974; McKeachie, Lin, & Mann, 1971; McKeachie & Solomon, 1958; Meinkoth, 1971; Morsh, Burgess & Smith, 1956; Sullivan & Skanes, 1974). Only Rodin and Rodin (1972) found a negative relationship. The research suggests a small, but significant relationship between student achievement and instructor ratings.

There are several other factors which contaminate the validity of instructor rating instruments (Sheehan, 1975). First, it is difficult to establish norms for the purpose of comparison. While difficult, an existing project (Seibert, 1977) has had considerable success establishing university-wide norms for a pool of 200 evaluation items. Second, rating scales assume that all items are of equal importance, and as this is not usually the case, interpretation of resultant data is invalid. This legitimate criticism can be dealt with through the use of a dual rating scale, one rating instructor performance on the item, and another rating item importance. Finally, influence-peddling tactics by the instructor during the administration of evaluations can contaminate results. This appears to be a significant factor, and certainly guidelines for the unbiast-
ed administration of evaluations are essential.

In a recent report, the University of Alberta (1979) concluded that student evaluations describe teaching accurately, but seem to measure student satisfaction rather than teacher effectiveness. Student-based appraisals are a seductive source of information. Clients often give student evaluation data more credence than they should, even though there are serious validity problems with this source of information. The developer, as moderator between the possible misconceptions of a client and questionable data, must be wary of relying too heavily on student evaluations to assess instructional effectiveness. But as one of a complement of measures, student evaluations of instruction can provide useful information about the attitudes of the consumers of instruction.

Class Size

Small and large classes may rate the instructor higher than other size classes. A myth has developed that teachers with smaller classes receive more favorable ratings by students than teachers with larger classes. Generally, this is not supported by the literature (Costin, Greenough, & Menges, 1971), but Gage (1961) found an interesting interaction between class size and instructor rating such that small and large classes were rated higher than classes with 30-39 students. A recent study (Morsh, Overall, & Kelser, 1979) supported this interesting finding, suggesting that the relationship between class size and evaluations by students is nonlinear. Large and small classes were rated more favorably than other classes, but the magnitude of the effect varied across different components of the evaluation. "Quality of group interaction" accounted for a significant amount of variance, while other components were relatively weak.

Compulsory Instruction

Compulsory classes may result in lower instruction ratings. Perhaps because of negative attitudes of the students toward a required course, and perhaps because of negative instructor attitudes toward having to teach compulsory classes, there is a reason to suspect that the ratings of instructors are affected by this variable. Cohen and Humphries (1960), Gage (1961), Lovell and Haner (1955), and Pohlmann (1975) found that students required to take a course or students in required courses rated instructors
lower than students electing to take courses. An earlier study by Heilman and Armentrout (1936) did not find this relationship, but the evidence is sufficiently persuasive to conclude that compulsory classes are a significant factor, and should be taken into consideration in the interpretation of data for instructor evaluation.

**Personality Characteristics**

"Teachers who exhibit warmth and culture may receive higher ratings. There is considerable evidence to suggest that personality variables, as well as teaching skill, can affect student ratings of instruction. A review of several studies suggested that teacher warmth contributes to perceived teacher effectiveness (University of Alberta, 1979), and Isaacson, McKeachie, & Milholand (1963) concluded that teachers who were cultured (artistic, polished, imaginative, effectively intelligent) were rated favorably on measures of teaching effectiveness by students.

The "Dr. Fox lectures" provided an interesting investigation of the impact of charisma on the evaluation of an instructor (Nafinlin, Ware, & Donnelly, 1973). In this study, an actor lectured professional educators on the topic of "the application of mathematics to human behavior"—a bogus topic. The actor charmed characteristically, but presented irrelevant, meaningless, and conflicting content. Despite the non-substantive nature of the lecture and discussion, the presentation was rated favorably by a wide majority of participants. Costin, Greenough, and Menges (1971) challenged earlier conclusions, stating that design and conceptual flaws in existing studies minimized their worth; however, they agreed that the influence of personality factors on student evaluations of instruction was intuitively persuasive, and that further study was needed in this area, taking both student and instructor personality factors into consideration. Indeed, studying interactions between teacher and student personality factors and instructional methods represents a challenging area of investigation.

**Gender**

There is no significant difference between the ratings of men and women teachers, or between ratings made by male and female students. Most of the studies of student evaluations of instruction were conducted prior to 1970, and relatively few of the studies explored interactions between the sex of the evaluator and the instructor on ratings. Bendig (1953), Caffrey (1969), Downie (1952), Lovell and Haner (1955), and Remmers (1939) reported no significant difference between the sexes on overall ratings. More recent studies reported tendencies for female students to favor instructors who were rated high on skill and structure dimensions (McKeachie, Lin, & Mann, 1971), and for female students to favor female instructors (Walker, 1969). But all things considered, sex does not represent a significant variable in the construction of a strategy for student evaluations of instruction.

**Course Grades**

Actual or anticipated grades do not appear to affect instructor ratings. There is considerable concern expressed that student ratings are affected by the grade received or expected in a course. This line of thinking allows to the logical conclusion that teachers who give "high" grades will be better liked by their students, and will therefore receive higher ratings. Clearly, the literature does not support this contention. No relationship between grades and ratings was found in a number of studies (Cohen & Humphries, 1960; Eckert, 1950; Guthrie, 1949, 1954; Voeks & French, 1960), and several other studies isolated only weak relationships (Caffrey, 1969; Rayder, 1968; Stewart & Malpass, 1966; Treffinger & Feldhusen, 1970; Walker, 1969). Even if the reported correlations were not spurious, the inconsistency of findings suggests that grades are NOT a significant factor.

**Instructional Improvement**

Student evaluations alone do not generally produce instructional improvement. Student evaluations of instruction have not been shown to produce changes in instructional behavior, generally (Centra, 1973; Pambukian, 1974). These studies suggested that this was not true of all instructors, however. Greatest change was noticed in instructors who had raised themselves higher than their students rated them. The need for assistance in the interpretation of evaluations and the improvement of teaching skills was also indicated. It is not sufficient to evaluate instruction; mechanisms must exist for the improvement of teaching behavior based upon the evaluations.

**Design of Evaluation Instruments**

Given this background on the use of student evaluations of instruction, what should be included in an effective evaluation instrument? What characteristics should be evaluated, how should items be written, and what structural characteristics of the instrument are important?

**Selecting Course and Instructor Characteristics**

The number of items which have been developed to test characteristics of instruction is staggering, and many have not been subjected to any form of analysis. Commonly, a developer or instructor has decided what is important in a particular course and devised a series of questions to assess these concerns. This has resulted in a plethora of scales of unknown reliability and validity, which may or may not assess the range of characteristics which affect the instructional process. There is also a smaller yet comprehensive collection of items reported in the literature which has been subjected to rigorous testing, and which displays reasonable reliability (e.g., Hildebrand, Wilson, and Dient, 1971).

There appears to be general agreement on the characteristics of effective instruction, and the instructional developer should take them into consideration when writing evaluation items. These characteristics fall under three major headings: instructor behavior, learner outcomes, and course components (see Table 1). Items related to these three characteristics should be clearly separated for diagnostic purposes.

**Writing Stems**

Scissons (1979) outlines rules for the development of items or statements used for evaluation, sometimes called "stems."

(1) State stems clearly—they should be specific and objective.
(2) Measure only one trait, behavior, or activity with each item (e.g., a single item should not be used to evaluate an instructor's warmth and knowledge of subject matter).
(3) Evaluate only what has happened or is happening. Prediction of future action is unreliable at best.

Examples of well-written and poorly-written stems are presented in Figure 1. In this case the poorly-written stem attempts to measure two traits instead of one.
Table 1.
Categorization of Characteristics of Effective Instruction.*

<table>
<thead>
<tr>
<th>Instructor Behaviors</th>
<th>Learner Outcomes</th>
<th>Course Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>knowledge of subject matter</td>
<td>knowledge and skills interests and curiosity self concept social skills and attitudes vocational skills and attitudes</td>
<td>course applicability written assignments reading assignments textbook examinations grading media teaching assistant laboratory assignments recitation section</td>
</tr>
</tbody>
</table>

*Characteristics drawn from Hildebrand (1972), Kulik (1976), Scissors (1979), Seibert (1979), Sheffield (1974), and Woruba & Wright (1975).

Writing Anchor Points

Anchor points are the descriptors used to evaluate the individual on each stem. Typically, anchor points describe a five-point continuum from "excellent" to "unsatisfactory," or "always" to "never." While such designations are in common use, they do not always exhibit the precision and relevance necessary to adequately describe the characteristic being evaluated.

There are five issues to consider when writing anchor points (Scissors, 1979).

1. Clarity. Use short, simple terms which are easily understood by the intended audience.
2. Consistency. Terms should be consistent with the stem.
3. Definition. Define each point on the scale with a distinct rank position in order to increase precision. The user should not have to guess at the difference between a "three" and a "four" on a five-point scale.
4. Variety. Use diverse cues or language in defining points in order to add variety and precision.
5. Objectivity. Use objective terms. Moral, ethical, or social considerations, or terms such as "good" or "acceptable" actually provide little useful data.

Two examples of anchor points using identical stems are presented in Figure 2. Of course this represents an extreme example, but it illustrates the point that careful use of anchor points can provide the user with more information than carelessly applied anchor points.

The instructional developer must not only ensure that items exhibit sound stem and anchor point construction, but also use discrimination analysis on the item pool. Hildebrand, Wilson, and Dienst (1971) analyzed a large number of items in terms of their ability to discriminate between "good" and "poor" teachers. This was the only study encountered which utilized discrimination analysis, and it appears that this is a desirable procedure in the analysis of items for adoption. Obviously, items which do not discriminate well are not useful for evaluation, although limited diagnostic purposes could be served by weak items.

Using Dual Rating Systems

One of the primary causes of invalidity in student evaluations of instruction is the underlying assumption that all of the items are of equal
importance (Sheehan, 1975). One way to circumvent this is for students to select important teaching behaviors and then rate instructors. In this way, the instructor would learn which behaviors are most important to the students, and ratings would be performed by students who perceive the listed behaviors as important. An alternative approach omits having the students select teaching behaviors. Called the dual or double rating scale, this type of instrumentation allows the students to rate each item as to its perceived importance and independently evaluate the instructor on that item. In this way, an instructor rated very low on two items could select the most important instructional component on which to concentrate improvement resources. Figure 3 provides an example of two items from a dual rating scale.

Utilizing this approach allows the developer and client to evaluate emphasis as well as competence in a number of areas. It is important to note that this will provide a measure of perceived importance. It is possible that the judgements of professionals and students will differ, and consequently, data must be subjected to careful interpretation. (For an interesting discussion of methods of analyzing similar data types, see Misanchuk, 1981.)

**Adopting a Cafeteria Approach**

One of the most flexible approaches to student evaluations encountered to date is called the "cafeteria" system.

Developed by the Measurement and Research Center at Purdue University, the cafeteria approach to instructor evaluation is not a single instrument, but rather a set of procedures which are used by faculty to create individualized inventories. Briefly, a large pool of statements describing desirable teaching behavior is stored centrally on magnetic disks, and a printed catalogue of the items is distributed to the faculty. Using this data base, each instructor can select items which are relevant to specific needs, and the central computer prints out a customized survey form.

The flexibility offered by this system is attractive, and addresses many of the problems faced in the development of standardized evaluation strategies. The problem of increasing volume and heterogeneity of instructor and course evaluations is minimized by centralizing the process and standardizing items. Normative data are collected over time to provide reliability and validity measures and can be used for comparative purposes. The system allows a standardized yet flexible schema for assessing non-parallel teaching situations.

The cafeteria approach does present a problem which has not been addressed in the literature. As instructors are responsible for selecting the majority of the items, there could be a tendency for them to select items which make them look as good as possible. Most instructors are aware of their own strengths and weaknesses, and this system provides the opportunity to exploit those items which tests strengths.

There is a danger that resultant data would reflect the instructor's ability to construct a clever questionnaire. In the same manner, an instructional developer might be tempted to gather biased data which would enhance the image of the instructional product or client.

**Conducting Evaluation**

Since student evaluations are surveys, care must also be taken in standardizing administration procedures to reduce the effect of instructor-imposed bias. Suggested procedures include: (1) Having the instructor leave the room while evaluation instruments are administered, (2) Making a student responsible for administration, and (3) Delaying reporting of results to instructors until grades have been recorded and filed with the university.

**Procedures for Analyzing Data**

It is a relatively easy job to summarize student responses, but without specific mechanisms for making decisions based upon results, the data become useless. The needs of the developer and client will dictate the analytical approach employed, but generally speaking, either norm-free or norm-referenced analysis will be used.

**Norm-Free Analysis**

Analyzing data without reference to established norms assumes that the instructor has established personal criteria for making decisions. Overwhelming positive or negative

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**Figure 3. Dual rating scale items.**

<table>
<thead>
<tr>
<th>Descriptors</th>
<th>Frequency of Occurrence</th>
<th>Importance to the Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructor:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. gives organized lectures</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. motivates the class</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

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**JOURNAL OF INSTRUCTIONAL DEVELOPMENT**
Managing Client Relationships

As a source of formative data, the role to be played by the student evaluation component will dictate the emphasis placed on results. Student evaluations of instruction, serving as either a placebo or an ice-breaker, will lend little, if any, formative information to the instructional development process. Rather, they will merely serve to placate the client. Considerably greater attention will be placed on these data, however, when the purpose is to appraise the instructional product or the instructor. In these roles, the aforementioned suggestions for construction and administration assume greater significance in the process of instructional development.

In addition, given the volatile nature of this source of data, additional cautions are necessary if the in-togetherness of the overall evaluation strategy is to survive.

Use student evaluations only with the informed consent of the client. Of course this principle should be true of any activity an instructional developer carries out on behalf of a client, but it is particularly important for student evaluations. Be sure the client clearly understands the purpose of the exercise, encourages its use, and understands the limitations of this type of information.

Jointly construct or adopt evaluation instruments. Ask the client to participate in the development of evaluation instrumentation. This will not only promote the growth of a healthy professional relationship, it may also help the client and developer articulate concerns. If joint construction is not possible, then you should at least review adopted instruments with the client prior to their administration.

Administer the instruments and summarize the data collected prior to meeting with the client to discuss results. Before meeting with the client, put the data in a form which will promote efficient review. Do this as soon as possible following the administration of the evaluations, because in most cases the client will be anxious to see the results.

Jointly review and discuss results to avoid overinterpretation or misinterpretation of data. Because of personal involvement, the client may focus on certain aspects of the evaluation and miss others. It is your responsibility to bring an objective point of view to the discussion, and to prepare yourself for the meeting by reviewing the information and anticipating client reactions.

Compare the results with other data. Because of the questionable reliability and validity of student evaluations of instruction, it would be unwise to allow student evaluations to represent the only major component in your data collection strategy. Use other data sources, such as expert observation, peer appraisal, and self evaluation, and focus on discussion on data from all of these sources.

Wherever possible, emphasize the positive results of the evaluation. This is not to suggest that you ignore negative feedback; however, you will probably spend a substantial amount of time improving weaknesses as the development process continues, so a positive approach during diagnosis will help promote an open relationship. When negative issues must be confronted, be direct and honest. In other words, deal with positive results first, but do not use them to avoid more difficult discussion.

Be prepared to offer alternative strategies to remediate identified deficiencies. Because you have an opportunity to review the data prior to meeting with the client, areas of concern can be identified and remediation strategies outlined before discussion. This will not only lead to a streamlined meeting, but will also help to alleviate any client anxieties which might arise from negative student feedback. Weaknesses will not seem as threatening if ideas for improvement can be identified immediately.

In conclusion, student evaluations, judiciously employed, can make a contribution to a comprehensive evaluation package. They are a fact of life in most multi-component evaluation strategies, and given careful attention to their construction, administration, and interpretation, they represent an important factor in the instructional development process.

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*Due to the length of this list of references, the reader is encouraged to contact the author for details or copies.*

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(Continued from page 27)

- the name(s), address(es), and telephone number(s) of the nominee(s)
- your name, address, and phone number.

Nominations must be received by the Awards Committee chairman before October 29, 1982.

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Chairman, DID Awards Committee
Center for Educational Technology
1-A Tully Building
Florida State University
Tallahassee, Florida 32306

**The Selection Process**

After the close of the nominations period, the Awards Committee will review all nominations for the Practice Award and the Research and Theory Award. The committee will then select a group of finalists, who will be required to provide the committee with additional information. Based upon a review of this information, the committee will select winners in each category. Winners will be announced at the 1983 AECT convention.

All finalists will be asked to display samples of their work at the convention and either attend the convention themselves or have someone serve as their representative.


Before job aids, procedural documentation, or a behavior modeling script can be developed one must determine the sequence of actions to be performed. In rare cases, task analysis will reveal that the former always follows the same sequence of steps. In most cases, however, the performers must vary their actions according to circumstances that cannot be entirely or specifically outlined in advance. In such circumstances we must assume that the performers will be active interpreters of the environments in which they find themselves, that they will make educated guesses about events that cannot be observed directly, and that they will form inferences about associations and casual relations. In analyzing and designing instruction to teach such cognitive performances, instructional technologists must consider knowledge structures and heuristics.

Knowledge structures are collections of facts, propositions, values, and their interrelationships. They are typically described in terms of beliefs, theories, propositions, models, and schemas that allow the performer to label and categorize objects and events quickly. Knowledge structures help us define a frame or boundary around a problem or situation that limits what we attend to and what we ignore. They also define a set of expectations about the objects and events and suggest appropriate responses to them. Cognitive psychologists view knowledge structures as closely related to memory storage and retrieval mechanisms. The structures are activated when a person interacts with particular environmental situations.

Heuristics are cognitive strategies or rules of thumb. The basic form of a heuristic is IF (conditions), THEN (action). Heuristics aid performers judgment by suggesting plausible actions to follow or implausible actions to avoid. The term “heuristic” was first used by ancient Greek philosophers to refer to the study of methods and rules to aid discovery and invention. The subject owes its revival to the Stanford mathematician Polya whose book How to Solve It (1945) reintroduced the term and suggested a number of specific heuristics to guide individuals in solving mathematical problems. Since then the study of heuristics has been taken up by cognitive psychologists, computer scientists, philosophers, and educational technologists.

When we consider that most instructional technologists not only rely on heuristics to guide their own analysis efforts but are also in the business of creating, identifying, or formalizing knowledge structures and heuristics for programs they are designing, we are lucky that there is a burgeoning literature on both subjects. We are especially lucky that two new publications have summarized two of the most interesting approaches to these important subjects.

The Nature of Heuristics by Douglas Lenat is one of a series of excellent monographs being published by the Cognitive and Instructional Sciences Group at Xerox’s Palo Alto Research Center. The author is a professor of computer science at Stanford University who is interested in developing software that appears intelligent in human terms—software that can play chess, for example, or derive mathematical theorems. Computer programs that become very good at such abstract tasks are referred to as “expert systems.” Instructional technologists can easily read and understand Lenat if they assume that “expert systems” refer to subject matter experts or master performers who they must interview or observe to determine what they will need to know in order to be able to design instruction for a student.

An instructional technologist would study heuristics by observing how expert human performers use rules of thumb to solve particular problems. Lenat, however, has studied how two computer programs, AM and EURIKSO, originate and use heuristics to acquire and develop their knowledge of a subject. AM was initially programmed with 1155 sets of theory concepts and 243 heuristic rules for proposing new concepts, filling in data about concepts, and evaluating the “interestingness” of new concepts. During its longest run (one cpu hour) AM defined two hundred new mathematical concepts, noticed hundreds of simple relationships between its existing concepts, defined natural numbers, found arithmetic and elementary divisibility theory, and began to bog down in advanced number theory. One of the problems AM initially encountered was a combinatorial explosion that would lead the program to consider too many alternatives. To avoid this, the program was modified to limit these extensive searches by increasing the guidance criteria included in a heuristic. Hence, most of the heuristics took the form: IF (conditions), AND (qualifications), THEN (action). (Lenat defines an algorithm as a heuristic that is so powerful or precisely qualified that it guarantees the correct outcome whenever it can be used.)

The second program, EURIKSO, is
especially interesting since it uses its existing heuristics to develop new heuristics to help it increase its knowledge. EURISKO developed new heuristics in three ways, by specialization of a previous heuristic, by generalization from a previous heuristic, and by analogy from a previous heuristic. Interestingly, analogy proved to be the most effective way to generate new heuristics.

Perhaps the most interesting aspect of heuristic development that Lenat considers is the relationship between the knowledge structure and the heuristics. AM and EURISKO acquire knowledge by stages. One set of heuristics will lead a program to the discovery of all that they can at one stage and then trash about for a while until new heuristics are developed that allow the program to start making new discoveries again. The thing that seems to control the ease and rapidity with which the program works its way through these step-like discontinuities is the knowledge structure that the program is using.

Speaking of knowledge structures as representations of the subject being investigated, Lenat observes:

Each kind of representation makes some set of operations efficient, often at the expense of other operations. Thus, an exploded-view diagram of a bicycle makes it easy to see which parts touch each other, sequential verbal instructions make it easy to assemble the bicycle, an axiomatic formulation makes it easy to prove properties about it, etc.

A knowledge structure must be minimal to be effective—neither people nor computers can afford to make an extensive memory search before they move on to action. This is especially true when a person is being introduced to a new subject. Lenat suggests that one way to develop knowledge structures that allow for a steady evolution is by providing several alternate representations. For example, one can provide both a diagram and sequential instructions to help someone assemble a bicycle.

Where The Nature of Heuristics deals with very specific heuristics, a new book by Nisbett and Ross provides a summary of how cognitive psychologists are exploring the use of some of the very general heuristics people use. Beginning with the seminal work of Tversky and Kahneman (1974) on the way people use heuristics to evaluate statistical data, Richard Nisbett and Lee Ross have written a book that examines this topic in considerable and fascinating detail.

Human Inference begins by discussing the way knowledge structures and heuristics interact. Since the book is focused on inference, the authors examine what sorts of theories and beliefs most people have about probability and effective approaches to making inferences. They then proceed to consider the heuristics that people tend to use when they make judgments about problems that involve statistical inference.

The representativeness heuristic is the rule of thumb we apply when we assign an object to one category rather than to another based on the extent to which the object's principle features represent or resemble one category more than another. Thus, for example, if one has grown up with friendly dogs, one is inclined to assume that a new dog is like the other dogs one has known, or vice versa.

The availability heuristic is at work when we assume that objects or events are frequent, probable, or casually efficacious to the extent that they are readily "available" in our memory. If we've encountered two very funny, red-haired ticket salesmen in the past two weeks and suddenly find ourselves in front of another red-haired ticket salesman, we expect that he too will be funny.

Nisbett and Ross explain that these heuristics work well most of the time. Indeed, they explain how people can quickly and successfully solve a wide range of complex problems. Sometimes, however, they lead to errors, and it is the way in which heuristics lead to mistaken judgments that Nisbett and Ross have documented in Human Inference.

To illustrate one way in which knowledge structures interact with heuristics, Nisbett and Ross discuss what they call the Fundamental Attribution Error. This error consists in the tendency to explain human action in terms of the dispositions, attitudes, or goals of the actors involved, rather than in terms of the situation and contingencies the environment places on those actors. Without denying that people's desires affect their actions, the authors argue that most research in sociology and psychology has supported theories that emphasize situational determinants over personal goals.

Thus, if a person uses a theory that holds that an individual will act in the way that most people occupying similar roles act in similar situations, the person will make more successful predictions and employ more appropriate heuristics than if he or she assumes that the individual will act in a different manner that is deemed more consistent with the individual's stated goals, personality style, or religious background. (It's interesting to consider that instructional technologists may be good human performance analysts simply because they more consistently avoid the Fundamental Attribution Error.)

Any instructional technologists involved in developing programs for people who make inferential judgments, especially if they assess probabilities informally, will find Human Inference insightful. As we become more skillful at it, we will, no doubt, use the insights developed by Lenat and others working with "expert" computer programs. Neither of these books is addressed to instructional technologists, as such, and both, combined, fail to offer an adequate general theory of heuristics appropriate for instructional technologists. Both of these works, however, make important contributions toward such a general theory, and any instructional technologist engaged in developing either knowledge structures or heuristics will find them provocative. —Reviewed by Paul Harmon, Harmon Associates, 3752 Sixteenth Street, San Francisco, California 94114.

Notes
1. For a list of publications available from the Xerox, Palo Alto Research Center, write to Ms. Jackie Kean, Cognitive and Instructional Sciences, 2400 Hanover Street, Palo Alto, CA 94304.
2. An excellent prose of Human Inference by Mort Lalbrecque was published in Psychology Today. (See References).

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