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Module 10: Teaching Goals and Strategies

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Introduction

At this time in the workshop you may be wondering how you can begin to use the ideas of stages of reasoning and self-regulation immediately, without writing your own textbook or developing all new laboratory activities. Even though the teaching materials have a strong influence on your course, your own personal actions and approaches to the students can be very important as well. In this module we shall describe procedures that will enable you to make your teaching more effective in stimulating your students to use their existing reasoning patterns and to develop new ones by self-regulation. We shall also ask you to consider how you might balance course goals directed towards course content with other goals directed towards advancing your student's reasoning patterns. At this point we re-emphasize that Piaget views intellectual development as an internal, personal construction. In other words, the formation of new reasoning patterns is really the product of the individual student's mind - hence the term self-regulation.

We believe that the teaching approaches suggested by APPLICATION of Piaget's theory and described in this module are compatible with other theories of teaching and learning. They can best be used as part of an instructional program that also stresses creativity, development of self-worth, self-reliance, and respect for the opinions of others.

Since this module presents the last formal workshop activities, we invite you to bring up, during the discussion, these and any related matters about which you have concerns or questions.

Objectives

To give you practice in designing a learning cycle in your discipline

To assist you in selecting and utilizing teaching strategy that will encourage self-regulation on the part of your students

To assist you in balancing course goals aimed at content with those aimed at improved reasoning

Procedure

Form a small group of colleagues in similar disciplines. Select a topic. Design EXPLORATION, INVENTION and APPLICATION activities for that topic. Attached is an essay Designing Active Learning Based On The Work of Piaget and Karplus. Summarize your Learning Cycle for sharing with the other participants.

DESIGNING ACTIVE LEARNING BASED UPON THE WORK OF PIAGET AND KARPLUS

A Piagetian-based classroom instruction strategy to assist students in the development of logical thought was developed by Robert Karplus. He called it a Learning Cycle. The Karplus Learning Cycle has been modified for college instruction by the ADAPT faculty.

An ADAPT Learning Cycle is divided into three major phases known as EXPLORATION, INVENTION, and APPLICATION. The general characteristics of each phase of an ADAPT Learning Cycle are given below. We have discovered two things about designing Learning Cycles for use in the ADAPT program.

1) Since much of our class work is focused on specific aspects of our discipline, we usually design our Learning Cycles by starting with INVENTION and/or APPLICATION activities. Frequently we have a task we want our students to be able to do, e.g. write an essay on the significance of a poem or determine the density of materials of various sizes and shapes. Then we try to design an EXPLORATION activity, or puzzle, which can be resolved by that INVENTION and/or APPLICATION.

2) We find it very helpful to try out our Learning Cycles on other faculty members (not in our discipline) before using them with students.

As you design your Learning Cycle you may want to consider the following attributes of the three phases of a Learning Cycle.

EXPLORATION - Following a brief statement of topic and direction, students are encouraged to learn through their own experience. Activities are supplied or suggested by the instructor which will help the students to recall (and share) past concrete experiences and to assimilate new concrete experiences helpful for later INVENTION and/or APPLICATION activities. During EXPLORATION the students receive only minimal guidance from their instructor and examine new ideas in a spontaneous fashion.
Emphasis - Concrete experienced with familiar objects and systems.
Focus - Open-ended student activity
Function - Student experience is joined with appropriate environmental options not previously considered by the student.
1. This phase of the Learning Cycle provides students with reinforcement of previous concrete expereince and/or introduces them to new concrete experiences to be related to the later INVENTION phase.
2. EXPLORATION allows for open-ended considerations, encouraging students to use concrete experiences to consider new ideas.
3. During EXPLORATION the instructor supplies encouragement, provides hints, asks questions, and suggests alternatives. The instructor should encourage students to try a variety of experiments.
4. Student behavior during EXPLORATION provides information concerning the student's ability to deal with the concepts and/or skills being introduced. The students will reveal the reasoning skills which they evoke in search for the solution to a problem.

Questioning Skills and Strategies - Open-ended questions are asked to broaden an area of study by generating multiple possibilities. The instructor uses extended wait-time and may even expect no answer at all.

INVENTION - In this phase the concrete experiences of the EXPLORATION are used as the basis for generalizing a concept or for inventing a principle. Student and instructor roles in this activity may vary depending upon the nature of the content. Generally, students are asked to invent part or all of the relationship for themselves with the instructor supplying encouragement and guidance when needed. This procedure allows the students to gain confidence through familiarity with the concepts invented.
Emphasis - Generalization of concrete experiences and INVENTION of hypothetical possibilities.
Focus - Student's active involvement with instructor for generalization.
Function - Students become familiar with generalized concepts and/or skills. 1. During this time students are encouraged to formulate relationships which generalize their new ideas and concrete experiences.

Questioning Skills and Stragtegies - Focusing and valuign questions are asked to encourage trhe transformation of inforAMtion and the determination of appropriateness of results. Such questions require a long waittime, perhaps 5 seconds or more. Some direct inforamtion quesitons are usualy asked so that factual inforamtion can be broadly shared.

APPLICATION - The APPLICATION phase allows each student an opportunity to directly apply the concepts or skills learned during the INVENTION activities. APPLICATION provides the students with additional broadening experiences. They use the invented concepts in different concrete settings. The Learning Cycle allows each student the opportunity to think for himself. The instructor is a present overseer of activity. Yet he must guard against overplaying his role as director and facilitator. He must provide an open classroom atmosphere within a well-defined boundary.
Emphasis - Relevant use of generalized concepts and/or skills.
Focus - Directed student activity
Function - Further use of generalized concepts in other systems. 1. To begin the APPLICATION, the students and the instructor may interact in planning an activity for applying the invented concept and/or skill. The activity should provide a new or unique concrete situation. 2. Students are asked to complete the designed activity to the satisfaction of the instructor. The activities should provide further experience which will act as broadening and stabilizing experiences related to the new skills or concepts.

Questioning Skills and Strategies - Goal-oriented questions are asked that may require directed activity on the part of the students. These are questions that may set the students to work on a common task.

Below is an essay on teaching strategies for self-regulation. We have included a brief summary of the major ideas proposed in the workshop. Please join a group to discuss the relevance of the workshop ideas to your teaching.

As a group prepare to share your insights and questions with others.

1. Essay: Teaching Strategies for Self-Regulation

Here are several procedures we have found useful for encouraging self-regulation with our students. You will find that some can be used with very little effort, while others require substantial planning and preparation. Work together with fellow-teachers in your school and community to try these approaches so you can share any necessary work, discuss student reactions, and learn from one another's experiences.

Introducing a New Topic

1. Arrange your teaching sequence so you can begin with concrete concepts defined operationally through demonstrations, examples and actions. Present more formal definitions of the same concepts and other ones only at a later time.

2. Use EXPLORATION activities at the beginning of a new topic or before introducing a new concept. At this time and on other occasions, give your students opportunities to work with objects and make observations in an environment that allows them to ask their own questions and follow their own interests.

3. Begin class discussions with simple demonstrations and challenge your students to raise questions or predict the outcome of experiments. Then use the actual results for initiating an examination of unexpressed assumptions or expectations.

Following Through

4. Encourage students to interact with one another during discussions, laboratories and problem-solving sessions. By learning about the view points of others, they will become more aware of their reasoning. Students using formal reasoning patterns will serve as role models for the more concrete thinkers. The latter, because of their more limited understanding, will challenge their advanced colleague's short-cuts in reasoning, thus making them rethink their ideas. Furthermore, students are more likely to reveal weaknesses by asking apparently stupid questions of one another, when the teacher cannot hear. Conceptual difficulties that might never have been revealed can then be dealt with by peers.

5. Allow students time and opportunities for abundant and repeated experiences. Material covered in your course may have to decrease. Alternative ways of perceiving relationships help students to resolve contradictions and become aware of their own reasoning. You might then ask them to justify their conclusions, predictions, and inferences regardless of whether these are correct or incorrect. "What makes you sure of that?" "What is the evidence?" "How could you explain that to me?" "What are some other ways of thinking about that problem?" are questions that might be asked of a group or of an individual student.

6. Though you may feel strange at first, allow your students more control of their behavior so they may become aware and critical of their own reasoning. Recognize that many of them are accustomed to teaching that delivers information without challenging reasoning. EXPLORATION activities or open-ended questions are likely to seem strange to them, because they must take responsibility rather than having their teacher decide what is right or wrong.

7. Reason out loud when you present an explanation or answer a student's question. Reveal how you consider alternative possibilities and may at times be unsure how to proceed. Propose hypotheses, make inferences, compare them with other data, and examine evidence. Invite the class to join you in this activity by commenting on your ideas, proposing others, and evaluating their adequacy. Leave some questions unanswered even if you know the answers. Model the reasoning behavior you hope to foster.

8. Try to be as receptive as possible to apparently off-the-track ideas or hypotheses. Don't squelch a timid first attempt, but encourage it to draw attention to its good points and possibly unusual point of view. Suggest a laboratory activity, further reading, or discussion to help the student re-examine an inadequate reasoning pattern or preconception. Emphasize the reasons behind an answer rather than the "right answer" itself.

Using the Laboratory

9. Use the learning cycle to organize laboratory activities. Always begin with twenty to thirty minutes (or more) of EXPLORATION during which the students use the equipment with only a very general goal statement. Encourage students to make discoveries, even those that do not fit your plans for the outcome of the sessions. After EXPLORATION, be clear and explicit in the INVENTION of the new idea or relationship at the focus of the laboratory.

10. As an introduction to a laboratory activity, invite your students to identify the variables that might affect the phenomenon being studied. Then give them a written list of their ideas and encourage them to design experiments for testing their ideas. By examining the outcomes of an inadequate procedure and the list of variables, your students may learn to recognize their shortcomings and control variables more effectively.

11. Before making an assignment from your text, read the selection carefully as we have suggested in Module 7. Identify the demands for formal reasoning it presents and possibly supplement it with short explanations that will help students using concrete reasoning patterns. Note also the clarity of the illustrations and whether they help communicate the message of the text.

12. Assign specially constructed problems that encourage students to evaluate their own reasoning allowing several answers, each justifiable on a different basis. An example might be this:

Two cities are located along a river. Johnstown is five miles up the river from Lafayette. During a strike in Johnstown, thousands of gallons of raw sewage were released into the river. This alarmed the officials of Lafayette as the river was used for swimming. To prevent infection, they dumped large quantities of a strong antiseptic into the river. For some weeks after the antiseptic had washed away, the river was brown and murky and filled with small pieces of plant materials. City officials in Lafayette blamed those in Johnstown for the state of the river. Officials in Johnstown blamed those in Lafayette for dumping antiseptic into the river. Who do you think is to blame? Explain your conclusion.

Managing Small Groups

13. An important characteristic of the learning cycle as implemented in the ADAPT program is the use of small groups of students working together on the tasks set for them. Ample evidence exists on the value of using small groups of students for cooperative learning. This strategy, coupled with an understanding of how students learn based on Piaget's cognitive theory, forms the basis of the learning cycle.

To achieve the full benefit to the students of a cooperative learning environment you need to do more than just turn a group of students loose on a task. Your design of the task should be based on an understanding of how students learn. (That is what this workshop is all about! This point is sometimes missed by proponents of cooperative learning.) The task needs to be designed to foster the necessary cooperation among the members of the group and the students need to learn how to work cooperatively.

Testing

14. When you select items for a test, keep in mind that it makes demands on subject knowledge and on reasoning. Avoid problems in which ingenious reasoning overshadows the subject - use these only in supplementary materials for gifted students.

15. Include test items on which you ask students to justify their answers so you can assess their reasoning patterns as well as their knowledge. Module 6 has more detailed suggestions on this topic.

Course Goals, Content or Reasoning?

16. The teacher who intends to cover new material must expect to allow for self-regulation if he wishes the students to come to a good working understanding of new ideas. How much time will be needed depends on the level of the course and preparation of the students. Less time will be needed in an advanced placement course where most students reason formally and have a background of experience and understanding the subject. More time will be needed in the lower levels and high schools where students are less experienced and may reason predominantly with concrete patterns.

In view of these considerations, we would like to rephrase the question in the title above to "Course Goals: Content With or Without Reasoning?" since the reasoning patterns are closely related to the subject matter you select. Usually teachers define course goals exclusively according to the major topics covered, with a great deal of freedom for the individual teacher as regards emphasis and elaboration of details. Now you may wish to consider including goals related to your students' reasoning. Are these compatible with all the content goals? Are the topics in your course sequenced in order of increasing use of formal reasoning patterns? Is there sufficient opportunity for concrete experience in the laboratory? Are there provisions for making students are of their own reasoning so that they can initiate self-regulation?

Summary of Major Ideas

1. Piaget's theory describes two major stages of logical, operational reasoning in human intellectual development, the stage of concrete reasoning and the stage of formal reasoning. Earlier stages identifiable in the behavior of young children may be called pre-operational.
2. Each of these two major stages is characterized by certain reasoning patterns, used by individuals to classify observations, interpret data, draw conclusions, and make predictions.

CHARACTERISTICS OF CONCRETE AND FORMAL REASONING

CONCRETE REASONING	FORMAL REASONING
Individuals -	Individuals -
(a) Need reference to familiar actions, objects, and observable properties.	(a) Can reason with concepts, relationships, abstract properties axioms, and theories; use symbols to express ideas
(b) Use classification, conservation, and seriation reasoning patterns in relation to concrete items (a) above. Have limited and intuitive understanding of formal reasoning patterns.	(b) Apply classification, conservation, seriation, combinatorial, proportional, probabilistic, correlational, and controlling variables reasoning in abstract items (a) above.
(c) Need step-by-step instructions in a lengthy procedure	(c) Can plan a lengthy procedure given certain overall goals and resources
(d) Are not aware of their own reasoning, or inconsistencies among various statements they make, or contradictions with other known facts	(d) Are aware and critical of their own reasoning, actively seek checks on the validity of their conclusions by appealing to other known information

3. The formal stage is an idealization in that most persons after age twelve use formal reasoning patterns under some conditions and concrete reasoning patterns under others. The latter is likely to occur whenever the subject matter is unfamiliar, as is the case for a student beginning work in a new area. The former is likely to be the case for an experienced worker in the field.

4. The process of self-regulation plays a vital role when an individual advances from the use of concrete reasoning patterns to the use of formal reasoning patterns. Self-regulation begins with one's awareness that the concrete reasoning patterns are inadequate. It proceeds through direct experience with phenomena supplemented by the introduction of related organizing principles and major concepts.

5. A person who uses only concrete reasoning patterns is likely to proceed through self-regulation in a new subject much more slowly than a person who reasons formally in connection with other subjects. The latter individual benefits from the possibility of transferring formal reasoning patterns to the new area, especially if the new and old are closely related as is the case with mathematics and science.

6. Some students who are required to learn formal-level material in a subject in which they so far have only used concrete reasoning may go through self-regulation spontaneously. Other students, with less experience or self-awareness, are not likely to experience the necessary self-regulation; instead, they will memorize certain prominent words, phrases, formulas, and procedures, but will apply these with little understanding unless the teaching program takes their specific needs into account.

7. Tests should be designed to evaluate the students' reasoning and also help them engage in self-regulation.

8. The Learning Cycle can be an effective strategy in classes where some students display concrete reasoning patterns and some formal reasoning patterns.