Module 7: Self-Regulation

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Introduction

How can students be made more aware of their own reasoning? This question identifies one aspect of formal thought. It must be answered if students are to proceed to formal thought by self-regulation, the process whereby an individual advances from one stage of reasoning to the next. We have alluded to self-regulation in several of the earlier modules, but concentrated on the characteristic reasoning patterns associated with each stage. In this module we shall describe self-regulation in detail.

Objectives

To assist you in describing self-regulation.

Procedure

Join with a group of four to eight other participants for this entire module. The introductory group activity will be followed by individual reading of an essay on self-regulation. In conclusion, we suggest a discussion with your group of the concept of self-regulation and some of its implications.
Module 7 Instructional Materials

1. Exploration

In an attempt to simulate the experience of a student using concrete reasoning patterns in a physics class that requires formal thought, we have constructed a puzzle that requires you to make drawings while looking into a mirror. In our experience, only a few persons can make drawings under these conditions with some facility, most have initial difficulty but can teach themselves, and a few have serious blocks that appear to prevent them from mastering the skill.

Join with your group of participants to use the mirror puzzle with pages 7-3 and 7-4 (either furnished separately by the workshop or torn from these instructional materials). Take turns with your colleagues to draw the patterns suggested in items A, B, and C. Try to become conscious of your own technique while you are drawing and observe carefully while your colleagues are working to identify their learning strategies. After each person's turn is concluded, the "observers" might tell him what they thought he was trying to do, and he could then describe how he perceived his own efforts.

After everyone from your group has used the mirror puzzle, exchange ideas regarding your efforts and difficulties. Did your thinking patterns change while you were using the puzzle? What feedback from your actions was especially helpful? What new procedures did you adopt? What errors persisted in spite of your best efforts? What direction and/or shape of line was easiest to draw while looking into the mirror? Which was the most difficult? Did right vs. left-handedness seem to affect the result? Could you do better with your eyes closed than open?

Please stay with your group as you turn to page 7-5 for the essay on self-regulation. The concluding discussion will involve you and your colleagues.
Keep your pencil in contact with the paper as much as possible.

A. Please write your name and look into the mirror.

Write it so it appears normal when read in the mirror.

B. Please trace each of these figures while looking only into the mirror.

C. Please trace each of these figures while looking only into the mirror.
<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image" alt="Diagram" /></td>
<td><img src="Image" alt="Diagram" /></td>
<td><img src="Image" alt="Diagram" /></td>
<td><img src="Image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

C. Please color one or more figures in each rectangle.
2. Essay. Self-Regulation

Self-regulation is the second key concept in Piaget's theory, supplementing the concept of stages of intellectual development introduced in Module 2. Self-regulation is the process whereby an individual advances from one stage to the next, at least within one realm of ideas.

According to the theory, each stage represents a relatively stable state of mind in which feedback derived from a person's thoughts and actions supports the reasoning patterns characteristic of that stage. These patterns form an interrelated system of understandings and operations called mental structures. When you approached the mirror puzzle, you were using structures based on direct visual feedback from your experience without mirror. Your responses to the reflected images may have been at first inappropriate, making you draw lines in the wrong directions. In other words, you interpreted the new experience in terms of your old structures, an action for which Piaget uses the term assimilation. Usually such assimilation results in success -- you don't often use a mirror to write -- but sometimes it does not.

As another and very different example, consider the relationship of pizza price to pizza size. A child using concrete reasoning patterns will expect to pay more for a large pizza than for a small one, but he will not connect the size to the price quantitatively. When asked about the price of a sixteen-inch pizza compared to an eight-inch one, he will predict that it costs twice as much, "Because it's twice as big." Imagine his dismay when he finds that the large pizza costs four times as much! How can that be explained other than in terms of extortion by the pizza parlor proprietor?

Just as in your encounter with the mirror, extended interactions with the environment are likely to lead to contradictions, i.e. situations in which the individual's patterns of reasoning lead to expectations that are not confirmed by what actually happens. Then the stable state of mind is upset and a change in the mental structures must be brought about, a change Piaget called accommodation. The process leading from assimilation to accommodation is called self-regulation.

Self-regulation is an active process whereby a person searches for new reasoning patterns and new relationships that will resolve the contradictions he has encountered. A very important aspect of self-regulation leading to formal thought is awareness of one's own reasoning. You were engaged in "self-regulation" with respect to the mirror puzzle after you recognized your difficulties and were attempting to control your hand movements, perhaps by thinking of the line's appearance on the piece of paper as it would appear without mirror intervention. Or, you might have distinguished between the need to draw toward your hand rather than away from it. Whatever the specific method, when the changes required are not too great, then the individual's further investigations and experiences are likely to lead him to reorganize his patterns of reasoning into appropriate new structures. Confirmation of these new structures through further experiences -- occasions for assimilation -- will maintain the new stable state until additional contradictions are encountered.
If the required changes in mental structures are great, however, a person may be especially susceptible to the influence of peers, teachers, or parents who can suggest useful avenues for investigation or may even describe a more appropriate pattern of reasoning. "It's the area of the pizza that determines the price, and the area varies as the square of the diameter." Such direct teaching, however, is usually not effective unless the learner has had previous experiences with ideas such as area and square, and can subsequently test them against his own observations. He must get encouraging feedback from the environment to make sure that the interplay of thought and action, an essential part of self-regulation, continues until the new mental structures are firmly established.

Unfortunately, Piaget's theory becomes murky as concerns more details about the process of self-regulation and the nature of effective teaching programs that allow self-regulation to be initiated and completed. An individual who uses formal reasoning patterns in some areas of experience is more likely to engage in self-regulation in a new domain because he is aware of his own reasoning, can recognize his shortcomings, and can search more effectively for new structures. To be helpful, a teaching program must strengthen these tendencies and discourage unquestioning acceptance of poorly-understood principles and procedures. In the next three modules we shall present more specific suggestions about how physics instruction can be adapted to facilitate self-regulation.

3. Discussion

Join again with your group to discuss the concept of self-regulation in the light of your teaching experience and what you gained from the earlier modules. You might assume that only a few of your students have formal mental structures for dealing with physics content, that more of them have such structures for dealing with algebra or geometry, and that some have no formal mental structures at all.

Suggested questions:

1. How will the various groups of students respond to text passages like those analysed in Module 6?

2. How will the various groups of students respond to problems like those described in Module 5?

3. How may the various groups of students be helped to initiate self-regulation in regard to Newtonian mechanics?

4. How may the various groups of students be helped to initiate self-regulation with respect to electricity?

5. What role might the physics laboratory have in contributing to self-regulation of the various student groups?
Module 8 Learning Activities for Self-Regulation

Introduction

It is quite clear from the earlier modules in this workshop that a teacher's awareness of students' patterns of reasoning will influence his choice of subject matter, level of presentation, selection of text, and assignment of homework problems. We shall now describe some ways in which the learning activities can be planned so as to enhance the opportunities for self-regulation after a student is introduced to a new idea.

On the basis of Piaget's developmental theory, concrete learning activities play a central role in the improvement of a student's reasoning. The physics laboratory, therefore, is an especially important part of instruction. Does it make any difference what kind of laboratory exercise we ask a student to perform? We believe that the answer is yes, and we shall describe what we have learned from Piaget's work that is applicable to labs and other aspects of teaching. We have called the resulting pattern of instruction a "learning cycle," since it may be used repeatedly for each successive topic or lab session in a course.

Objectives

To enable you to describe the "learning cycle" approach to teaching.

To assist you in designing laboratory activities that encourage self-regulation.

Procedure

This module provides for a laboratory investigation of physical pendula and two essays: on the learning cycle and on the physics laboratory. Please carry out the activities in the order described in the attached instructional materials. We recommend that you find a partner with whom you can compare notes and exchange ideas during this module.