Teaching Critical Thinking Skills in the Psychomotor Domain

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Recent dialogue and reports from the research community (Beyer 1984, Follman 1988, Sternberg and Bhana 1986) support the explosion of interest in critical thinking. The basis of interest and concern appears to focus on the suggestion that teachers should be promoting critical thinking in students by using more divergent learning strategies. Why the resurgence of interest in teaching critical thinking? For one thing, teaching thinking promotes classroom discourse that can rise above the level of learning by rote memorization, drill, and repetition typical of many learning environments. Beyer (1987) asserts that teaching thinking skills can also enhance the excitement and attraction of classroom teaching as well as of learning.

Additionally, our society has entered an era of information processing, and the effect on education has been profound. Naisbitt (1982) has stated that only thirty years ago approximately 17 percent of the work force held information-related jobs. By 1982, this figure had risen to 60 percent, and by the end of the decade, it may increase to as high as 75 percent. To survive in this changing environment, workers will require higher-order thinking skills. As a consequence, tremendous pressure has been exerted on the nation's schools to prepare students for these information-processing jobs. Learning the basic mechanical skills of mathematics, sentence structure, and reading are no longer enough. Students of today, and tomorrow, will need to be able to perform higher-level skills of thinking in order to make the kinds of decisions necessary to cope in a rapidly changing social, political, and economic society. Consequently, we must identify ways and means of teaching students how to draw inferences, solve problems, analyze and synthesize facts—in short, to think independently. The purposes of this paper, then, are twofold: (1) to define critical thinking and (2) to examine four models of teaching whereby critical thinking skills might be enhanced in the psychomotor learning environment.

An ensuing debate in the literature appears to center on the difficulty of identifying and defining critical thinking skills and the challenge set before those attempting to teach critical thinking. Ennis (1985) views critical thinking as "reflective and reasonable thinking that focuses on deciding what to believe or do" (p. 45). Sternberg (1985) interprets the term as comprising the mental process, strategies, and representations people use to solve problems, make decisions, and learn new concepts. Follman's (1988) review of the topic contends that research has produced little consistent data supporting successful thinking programs except with younger, less sophisticated subjects. Skinner (1971) went so far as to state that teaching critical thinking is a myth. Although the task of defining critical thinking has been a topic of considerable debate among educators, common descriptors of critical thinking have included reasoning, evaluation of arguments, recognition of assumptions, and problem solving.

Nevertheless, from the definitions described earlier, it would appear that critical thinking skills may extend across a continuum. On all points, the individual is engaged in mediating a problem, rather than learning through the simplistic stimulus→response mode.

The importance of providing opportunities for critical thinking to develop in the pscyhomotor setting cannot be understated. Physical education presents a unique, yet complementary, role in the development and use of critical thinking skills, and a strong symbiotic relationship between the cognitive and psychomotor domains in which critical thinking may be developed already exists. Contemporary motor-skill learning theory (Schema theory; Schmidt 1988) clearly supports the interaction of cognitive and neuromuscular processes as being necessary for the efficient execution of motor performance. Several of the cognitive functions utilized in the development of one's intellect such as comparing,

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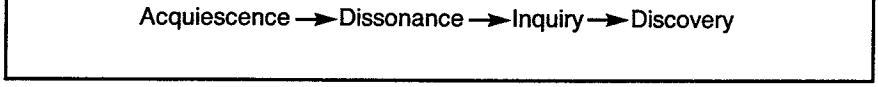
FIGURE 1
An Illustration Based on Bruner's and Festinger's Teaching Models



evaluating, memory, and imagery are also found in the formation and execution of motor programs.

The delivery system for providing critical thinking opportunities in the psychomotor domain already exists, and numerous models of teaching can, with some modifications, be implemented to promote critical thinking. However, in order to invoke critical thinking, students first must be given the opportunity to inquire. Only during inquiry can critical thinking skills be activated through such cognitive functions as comparing, contrasting, categorizing, hypothesizing, synthesizing, extrapolating, and problem solving. Four specific models of teaching formulated by Bruner (1986), Taba (1966), Thelen (1960), and Mosston and Ashworth (1986) serve to illustrate these concepts.

Figure 1 presents a model based on Bruner's (1961) and Festinger's (1957) teaching models. In order to be placed in a state of inquiry (the medium for developing critical thinking skills), the student must move away from cognitive acquiescence (to accept passively) and toward cognitive dissonance (to create an active disturbance). Festinger (1957) contends that a cognitive disturbance (dissonance) creates a desire to inquire and seek solutions. A similar analogy exists with the stimulus → mediation → response (S → M → R) mode. Without the mediation phase, the learner does not engage in critical thinking functions and regresses to a stimulus → response (S → R) mode of learning.

Implications for the Psychomotor Domain

As previously mentioned, numerous models of teaching are available and may be invoked to promote critical thinking in the psychomotor setting. The first to be discussed is the Concept Attainment Model (Bruner, Goodnow, and Austin 1986). This teaching model is designed to develop inductive reasoning as well as concept development. It is based on the premise that in order to deal with the complex environment in which we live, humans invent categories and form concepts. Bruner et al. (1986, 1) view categorizing as the ability to "render discriminably different things equivalent, to group the objects and events and people around us into classes, and to respond to them in terms of their class membership rather than their uniqueness."

Categorizing consists of the act of concept formation and the act of concept attainment. The difference between the two is subtle. In concept attainment, the concept already exists, whereas concept formation is the act by which new categories are formed; it is the act of invention. Concept formation essentially represents the preliminary steps en route to attainment. The learner sorts objects, experiences, and the like into some meaningful set of classes in an attempt to bring order to their diversity. Concept attainment is the "process of finding predictive defining attributes that distinguish exemplars from nonexemplars of the class one seeks to discriminate" (Bruner et al. 1986, 22).

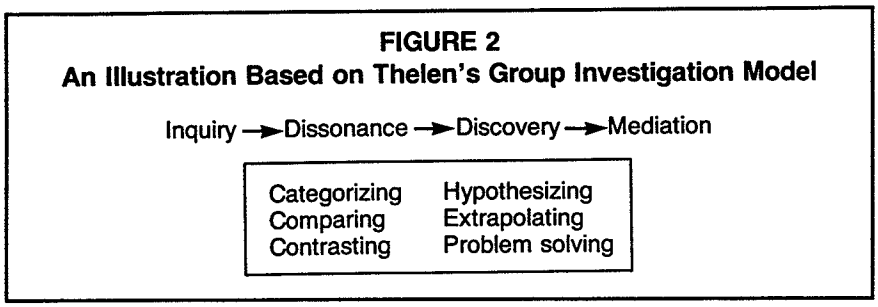
When teaching concept attainment, students are provided with information and examples that are similar in some respects and different in others, and they then try to use the information provided by the teacher to identify and define that concept. Because information is received (through yes or no responses), learners constantly formulate and modify hypotheses in an attempt to determine the identity of the targeted concept.

The Concept Attainment Model can easily be adapted to the psychomotor domain and is well suited for teaching children such fundamental movement concepts as time, weight, space, and flow. The concept of time (fast/slow) will be used as an example. To illustrate, the teacher might generate a list of sports activities in which fast- and slow-moving participants represent the key concept. Fast-moving activities might include foot races, downhill snow skiing, ice hockey, and basketball. Slower-moving activities could involve the high-balance-beam performer, synchronized swimmers, and certain weight-lifting events. Once identified, movement experiences can then be introduced to allow further exploration of this concept. In this way, students are engaged in inductive reasoning as well as organizing data in an attempt to reduce the complexity of their environment.

When examining potential teaching models that focus on concepts, one cannot overlook Hilda Taba's (1966) Inductive Thinking Model. She identified three inductive thinking tasks for the collection, organization, and manipulation of data. They include (*a*) concept formation, (*b*) interpretation of data, and (*c*) the application of principles.

During concept formation, the learner identifies and then categorizes data based on identified similarities. Where Bruner's model culminates in only one concept, Taba's model permits students to group information together and form as many groups as required. Through such overt behaviors of enumeration, grouping, and categorizing, students are exposed to such covert opera-

FIGURE 2
An Illustration Based on Thelen's Group Investigation Model



tions as differentiation, identifying commonalities, and organizing information in a hierarchical fashion. During the interpretation-of-data phase, students learn how to draw inferences and make generalizations about the information they have amassed.

The final cognitive task is that of applying principles gained from the first two tasks to make predictions about new information. Here the students generate hypotheses, are held accountable for supporting these hypotheses, and are expected to be able to verify any predictions. Through this process, students learn how to analyze a problem, how to use relevant information to generate and support hypotheses, and, finally, how to use logic to apply this information to other conditions or situations. All three phases are prompted by the teacher's use of questions that require more than simple recall responses on the part of the learner.

A third model that may have application in the psychomotor area is classified as a social interaction model. Herbert Thelen's (1960) Group Investigation Model attempts to combine the democratic process with the process of academic inquiry. Through group investigation and scientific inquiry, students work together to generate and test hypotheses.

Central to this model is the posit that life is social and one cannot act without reference to others. Consequently, rules of conduct must be established in order to allow all members of a society to function in unison and to maintain order. Because the classroom represents a microcosm of the larger society, Thelen's framework has merit. Student's operate under a set of rules, establish their own culture, and establish a definite social structure within the classroom setting. Thelen would have the class function as a miniature democracy and, through problem solving, attack problems and acquire new knowledge. As a result of the process of problem solving and inquiry, the students would become more effective as a social group.

There are also three basic components to Thelen's model. They include (*a*) inquiry, (*b*) knowledge, and (*c*) group dynamics. Inquiry occurs as a result of a problematic situation. The students are stimulated and begin inquiring into a question while simultaneously assuming the roles of participant and observer. The individual both actively contributes to the problem and listens to alternative ideas from other group members. Through this social process, new data are continually generated, resulting in data assessment, concept formation, hypothesis formation and testing, and considering alternatives—all key critical thinking skills.

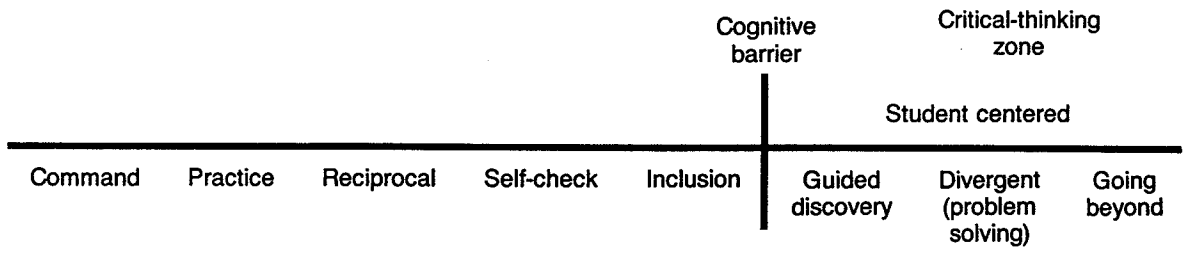
Knowledge results from the inquiry phase. The way in which the knowledge evolves from the dynamics created from the learning group, however, is crucial to Thelen's model. As stated earlier, the process of discovering knowledge and the principles of inquiry are important. So, too, are the ways in which group members relate and interrelate amongst themselves. Finally, the emotional element represents another key component to the inquiry process.

Individuals are forced to confront their own anxieties and concerns as other points of view are introduced in the group situation. The learner becomes involved with exerting his role as an individual, yet still wants to maintain acceptance within the group social structure. Thelen believes that the social aspects of the group investigation leads the way to disciplined academic inquiry.

Thelen recommends groups of between ten to fifteen students per investigating group. This number allows for a diversity of responses but is still small enough to permit individual participation. In order for the group to function effectively, there has to be sufficient commonality of values among the learners so that communication is simple. However, there must be enough differences among group members to allow for alternative reactions. Thelen also requires a common level of sophistication about the knowledge area. If the range is too great, the levels of conceptualization may be too diverse to generate effective group interaction.

Thelen's model also lends itself to application in the psychomotor learning domain. The social group investigation process is ideally suited to activities associated with the new games concept (Fluegelman 1976). This approach requires students to work together in group situations to confront problematic situations. One such problem, by way of illustration, requires a group of ten to fifteen students to join hands randomly with other members of their group. Without separating, the group tries to undo this human knot to form a large circle.

FIGURE 3
Teaching Styles Continuum



The dynamics of the learning groups are self evident, as are the processes of inquiry and knowledge. Although the teacher provides the problem situation, the students, as inquirers, must pursue the solution on their own. The learners identify the problem, analyze ways in which it may be solved, organize their efforts, act, and then constantly evaluate and reevaluate the results. The process is repeated until the group can resolve the problem. The teacher, in accordance with the model, acts as a facilitator in an atmosphere that requires both reason and negotiation.

The fourth teaching model to be discussed is Mosston's and Ashworth's (1986) proposed concept of a continuum of teaching styles. According to Mosston's basic tenents, teaching styles may be placed on a continuum representing the amount of teacher-centered and student-centered decision making. The line of demarcation between styles that are based on student acquiescence and emergence into the "discovery zone" is also provided (see figure 3).

The first five styles (command to inclusion) are characteristically teacher centered. The instructor makes most of the decisions related to subject matter and the conditions surrounding the learning-teaching process. The importance of good demonstrations that serve as models (correct solutions) the instructor wishes the student to replicate is emphasized. If the teacher were to use the first five styles with the same general subject matter, the emphasis would move from a very direct teacher-student relationship (command) to practicing specifically described skills at stations (practice), to working with partners on prescribed tasks (reciprocal), to performing the tasks individually (self-check), or to being allowed to achieve objectives within prescribed performance levels (inclusion).

Mosston makes clear that the continuum is not a style-versus-style situation, nor does it constitute a target that should move progressively from left (command) to right (going beyond). Styles are selected based on such considerations as desired learning outcomes, time, class size, facilities, discipline, and perceived maturity of the class.

Although these styles provide the teacher with several options for producing learning outcomes, little opportunity for exploring new or alternative solutions through inquiry exists. As noted earlier, the common factor in the teacher-centered styles is the reproduction of demonstrated skills or knowledge content. Research indicates that although student scores on basic skills tests have improved under direct instruction (teacher centered), students have not performed as well on tests measuring critical thinking (Burns 1986; Marzano et al. 1988). In fact, Knight and Waxman (1987) found that teacher-centered lessons produced a negative overall effect on student's critical thinking.

Although Mosston's model has not been empirically validated, the student-centered teaching styles are of particular importance, because they do provide the opportunity for inquiry and critical thinking. Beginning with guided discovery, the student and teacher theoretically cross a "discovery barrier" and enter the discovery zone.

With guided discovery, the student is led into the discovery zone with guidance that proceeds in a step-by-step converging process. Although the student is provided with a problem that has a predetermined solution, opportunities for critical thinking are offered. If the student ventures too far from the path toward discovery, additional guidance is provided. The teacher, however, never volunteers the correct solution. Students are allowed to "discover" this solution for themselves.

The divergent teaching style—sometimes referred to as problem solving—further invokes the development of critical thinking by allowing numerous acceptable solutions to a problem. Where guided discovery converges to a somewhat specific solution, the divergent style engages the brain to seek multiple solutions to a problem. Additional cognitive operations such as categorizing, synthesizing, and hypothesizing are frequently engaged. With this style, the student determines which solutions are applicable to the problem and, therefore, has greater control over the specifics of the subject matter.

With gymnastics and aerobic dance, for example, students may be provided with an opportunity to create timed (e.g., 5 minutes) routines with the skills learned during the unit. The instructor needs to keep in mind that making the process as self-teaching as possible is a

basic tenent. This objective extends to the ultimate goal of creating critical thinkers who are capable of independent inquiry and discovery.

Why Teach Critical Thinking in the Psychomotor Domain?

Previous discussion has revealed that opportunities to stimulate critical thinking are available through the selection of appropriate teaching models. Because the teacher has several options available for presenting subject matter, the relevance of selecting teaching models that are critical thinking oriented should be addressed.

Germane to the relevance of developing critical thinking skills is the generally accepted notion that physical education is not limited to its contribution to fitness and the development of fundamental movement and motor skills. While physical education does present unique contributions to human development, it also strives to enhance cognitive and affective behaviors. The goal of producing individuals who can work independently and create new alternatives to accomplish desired objectives is universal to education. Physical educators know that individuals who merely replicate a demonstration or respond to a teacher stimulus are being limited in both their movement and cognitive development.

Most would agree that advanced levels of dance, gymnastics, and many sports are best exemplified when individuals organize their movement repertoires into original movement sequences. While this process is clearly exhibited in demonstrations, critical thinking plays a vital role in this development. When learners are placed in game situations that occur in open environments, that is, when conditions are constantly changing, players are required to generate cognitive strategies quickly. Racquetball, basketball, and soccer represent but a few examples of this phenomenon. The old saying that "experience and cunning are more valuable than youth and skill" may well be relevant to this point.

In conclusion, all educators must learn to promote critical thinking. Just as such fundamental motor skills as throwing, catching, and kicking are taught, so too can such fundamental critical thinking skills as problem solving, deductive reasoning, and categorizing information. The opportunity exists to develop individuals who not only possess a large repertoire of motor and fitness skills but also possess the ability to initiate learning and to think critically—in and out of the psychomotor environment. The time to act is now.

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