Comment and Response

Discovery Teaching and Discovery Learning: A Comment on Stewart*

Hugh Munby
queen's university

As I understand it, the intent of Professor Stewart's piece is to determine if "discovery" could be counted as a teaching strategy, and the upshot is that it could. I have no quarrel with what strikes me as a sensible conclusion nor with the arguments which lead to it, so this brief essay is not written as a critique or as a response to Stewart's; instead, it is written to show that some points Stewart makes have interesting if not important implications for two areas of educational activity: the planning and evaluating of teaching, and the views on discovery learning which can be found in educational psychology, particularly in the work of David Ausubel.

NOT ONE, BUT SEVERAL STRATEGIES

The first point which the present paper addresses is that it is potentially misleading to speak of discovery teaching as a teaching strategy if there is any possibility that the recipient of this message (such as a student teacher) might believe this to mean that there is a single teaching method associated with discovery and readily distinguished from lecturing or some other strategy. The concern here is not for the obvious danger of forcing things into simple dichotomies, but for what can happen if a student teacher comes to think that "discovery" covers one particular style of teaching which has identifiable and common compounds. At best, this could lead to the view that there are common teaching moves which can be fruitfully employed in all instances of discovery teaching; and, at worst, it could lead to the belief that such common teaching moves lead to the same sort of learning — discovery learning. Neither of these two beliefs, as I hope to show, are particularly satisfactory when it comes down to the matter of planning instruction so that specific learning can occur. Some of Stewart's paper gives us important cues to the fact that this is so.

* This comment is made on a previously published article by J. Douglas Stewart, "Teaching Strategies: Is Discovery One of Them?" *Canadian Journal of Education*, 1979, *4*(2), 55-65.

For a start, we can consider the examples Stewart (1979) gives in his paper of "discovering":

> (1) Robinson Crusoe discovering footprints in the sand; (2) Galileo discovering spots on the sun and Archimedes discovering why an object floats in water; (3) a doctor discovering that his patient has cancer; (4) a child discovering an egg in the robin's nest or a sand dollar on the mud flats; (5) a student discovering that the next member of the series 0, 3, 8, 15 . . . , is 24; (6) an adolescent discovering he is in love (or that his teacher dislikes him); and so on. (p. 61)

Stewart then proceeds to distinguish between what he calls the strong and weak senses of discovery, the strong sense referring to discoveries which are "unmistakably novel not only to the discoverer but to the world" (p. 61). His treatment of these examples of discovery closes with the observation that some sorts of concepts acquired through prior learning are prerequisite to discoveries.

As I have already said, there can be little quarrel with Stewart's treatment. However, it seems crucial that we do not pass too quickly over Stewart's examples of discovery, for the very fact that they are examples of different sorts of discovery suggests that different kinds of activities are needed in teaching to bring about these different kinds of discovery. (And, as will be suggested later, different kinds of discovery can be expected to result in different kinds of discovery learning — a thesis which rides on Stewart's contingent relationship between teaching and discovery.)

We can readily detect differences within Stewart's examples of the sorts of things discovered. Discovering footprints in the sand, sunspots, eggs, and sand dollars involves coming across the objects in some way in the material world. Yet, Archimedes' discovery of the flotation principle is the discovery that a way of thinking (about phenomena) is very fruitful because of its explanatory power. This may be contrasted with the adolescent's discovery that he is in love. Assuming that this is his first such experience, then it could be said that his discovery is the discovery of what adults and his older peers mean by the word love — it's the word to use to capture all of those unusual and exciting feelings. (Readers will recognize similarity between this sort of discovery and Wittgenstein's [1968, §384] description of coming to learn the concept "pain"!) It need hardly be said that this type of discovery is different from discovering the next member of a number series, which involves determining the rules governing the series and then applying them. (The reader can continue this sort of analysis and find that within the general idea of a doctor's discovering what his patient "has" lie several types of discovery. Sometimes we find physiological "entities," such as growths and fractures; sometimes we find no such entities but invoke a name to describe the symptoms, for example, "schizophrenia.")

There may be other types or senses of discovery, but just working with the above allows us to generate a list of discoveries together with comments

about some of what must be provided in the instructional strategies so that the intended discovery has a chance to occur. Here, then, are five distinct senses of discovery, with the concomitant understanding that what follows is not intended to be taxonomic or categorical.

THE OBJECT SENSE OF DISCOVERY

This sense of discovery is intended to capture the idea of discovering something which is "out there," simply speaking. Crusoe and Galileo had that much in common with their discoveries, though the similarity probably ends there, for Crusoe probably knew what it was that he had discovered whereas what Galileo discovered was a rather novel bit of solar phenomena. Classroom instances of this sense of discovery are likely to be legion and to be found at all educational levels: discovering superconductivity phenomena in the university's physics laboratory, discovering the contents of a frog's stomach by dissection, and discovering aphids beneath honeysuckle leaves in a backyard biome. The principal condition that must be satisfied in the instruction so that discovery can occur is that the thing to be discovered is available so that it can be discovered. It might be necessary, too, that the instruction ensure that learners have the concepts associated with the discovery, as Stewart (p. 61) has suggested. Yet, despite another suggestion of Stewart's, these discoveries do not have to be novel to the learner — "I discovered that the cork's weight was unchanged.", "The aphids are still there!", etc.

THE MESSAGE SENSE OF DISCOVERY

It is no accident, of course, that the notion of novelty is often conveyed by the concept of discovery for, while not a necessary condition for discovery, we use the word "discovery" to convey the idea of having heard, seen, or learned something novel. The message sense of discovery is intended to capture the sort of thing we mean when we say, "I just discovered (from the weather forecast) that they had 15 centimetres of snow in Timiskaming." This sense of discovery seems legitimate; it is suggested by Scheffler (1965, p. 10), and could also be what Stewart had in mind for the doctor who, upon reading the biopsy report, discovered that his patient had cancer. But it is rather likely that educators would shy away from the message sense, for under it most of what happens in classrooms might get termed discovery teaching (or discovery learning) and the phrase would swiftly lose its distinctiveness.

For the sake of completeness, the conditions required of instruction would be that the discovery is understood and that it is true (Strike, 1975).

THE PROBLEM SOLVING SENSE OF DISCOVERY

It could be that a good deal of discovery in education is, to be more specific, problem solving: finding the next member of a number series, perform-

ing qualitative analysis on an unknown chemical compound, calculating how much it costs to buy three kilograms of steak at $15 a kilogram, and so on. The essence of this sense of discovery is rules which are to be followed if the solution is to be attained. Accordingly, for the instruction to have a change, the rules must be presented at some point beforehand or during it. (Of course, the solution of a problem might involve finding the appropriate rule or rules, yet the above condition still applies.)

THE INVENTION SENSE OF DISCOVERY

The senses of discovery described so far do not demand that the discovery be novel to humanity, although it may well be for the discoverer. The invention sense of discovery points to novelty, but not to novel phenomena. Here what is discovered is, in essence, a novel way of looking at things or explaining them. Stewart's example of Archimedes' discovery is a case in point because we can presume there was nothing novel to Archimedes in discovering that he could float in the allegorical bathtub and that water slopped over the edges. The novelty was in hitting upon a way of explaining flotation by voicing a previously unvoiced idea or principle. This, as Stewart shows, is the sort of discovery that Toulmin (1960) discusses in his treatment of the idea that light travels in straight lines.

There are two highly significant points to note about the invention sense of discovery when it comes to education. First, it is a highly demanding intellectual task: It leads to the invention of the concepts superego, ego, and id, to the idea that human behavior is a function of heredity and environment, and — lest we be accused of siding with the angels — to the theory that everyone is promoted to his level of incompetence. Second, it is by no means clear that discoveries of this sort can be arranged by appropriate instruction. Not only does the notion of their novelty suggest this, but that such discoveries in the past have emerged without much forewarning suggests that the search for patterns and thus categories may well be fruitless.

We can conclude, then, that there are no identifiable prerequisites for the invention sense of discovery except for the necessary but insufficient ones that apply to the other senses. It might be objected that some science courses provide students with the opportunity to make scientific discoveries. In all likelihood what happens is replication of a problem-solving sort which for Stevens (1978) promotes the "looking for the right guess" syndrome. Strike's (1975, p. 476) view that induction is an incorrect way of speaking of discovery is pertinent here, too.

THE PSYCHOLOGICAL OR CONSTRUCT SENSE OF DISCOVERY

The idea of the psychological or construct sense of discovery can be seen in Stewart's example of the adolescent's discovery that he is in love. Perhaps crudely, it is sometimes referred to as the "Aha! experience," a term

used to describe what we feel when we see the point of something or get the meaning of something else. Understanding a construct is central to this sense of discovery; but the sense is not restricted to the "Aha!" we might feel, for it is intended to cover what Ausubel and others refer to as meaningful learning (Ausubel, Novak, & Hanesian, 1978). Their sense of discovery is clearly psychological, and so accompanies the other senses of discovery already noted, and for psychological discovery to occur the incoming information must connect meaningfully with the learners' existing sets of meaning.

This excursion through a number of ways in which discovery can be used shows not only that there are differences, but that these differences point very clearly to quite different sorts of instructional strategy which, normally, might well all come to be called discovery. We have seen that this is not the case, and that just as there are different senses of discovery, so there are different requirements for meeting them in the classroom. This thinking has several implications for teaching, especially in the areas of teacher training and evaluation. First, as cautioned beforehand, it is now quite plain that talk of "discovery teaching" is fraught with ambiguity. Certainly the phrase cannot connote a unique teaching approach characterized by a limited number of generally characteristic moves on the part of the teacher. Accordingly, it would be unwise for teachers in training to understand discovery teaching as a simple contrast to, say, didactic teaching. Second, and following from the first, evidently the significance of the label "discovery teaching" pales against the importance of the different sorts of learning that we might wish youngsters to attain, simply because the clearest formulations of what might be meant by something called discovery teaching come to light only when we think about what is meant to happen to the learner. All of this supports the view that a major source of teaching strategies flows from careful thinking about what the teaching is intended to accomplish and what sorts of moves make provision for these intents to occur.

So far as evaluating teaching goes, it seems hardly necessary to state that it would be difficult to identify any particular teaching as discovery teaching without knowledge of the particular objectives of the strategies employed. Thus, at the minimum, evaluation of a discovery teaching strategy would require knowledge of the intents, a measure of their achievement, and a careful scrutiny of the devices the teacher uses in the classroom. Anything less than this would seem to leave too much room for dubious inferences about the quality and success of the teaching.

SIMILAR PROBLEMS WITH "DISCOVERY LEARNING"

As already stated, Stewart argues in his paper that the relationship between teaching and learning is a contingent one, and so it is not unreasonable to ask what the above discussions might have to show about the

concept of discovery learning which seems quite securely planted in educational psychology. Of course, the literature in discovery learning is extensive, yet will not be reviewed here since that would serve little purpose. Attention is directed instead to what Ausubel says of discovery learning and to his distinction between discovery and reception learning. As we examine these ideas in light of the "sense of discovery" described in the previous section, we find that there is space for further confusions of the notion of discovery.

The most recent account of discovery and reception learning appears in *Educational Psychology: A Cognitive View* (Ausubel, Novak, & Hanesian, 1978). Because of its significance to the present argument, it is presented quite fully.

> The essential feature of discovery learning, whether concept formation or rote problem solving, is that the principal content of what is to be learned is not given but must be discovered by the learner before it can be meaningfully incorporated into the student's cognitive structure. The distinctive and prior learning task, in other words, is to discover something — which of two maze alleys leads to the goal, the precise nature of the relationship between two variables, the common attributes of a number of diverse instances, and so forth. The first phase of discovery learning involves a process quite different from that of reception learning. The learner must rearrange information, integrate it with existing cognitive structure, and reorganize or transform the integrated combination in such a way as to generate a desired end-product or discover a missing means-end relationship. After discovery learning itself is completed, the discovered content is made meaningful in much the same way that presented content is made meaningful in reception learning. (pp. 24-25)

So, as Ausubel and his collaborators state, "reception and discovery learning are two quite different processes" (p. 25). But it is not that evident that the two processes are quite different. In fact, at the end point of discovery learning, the proposition, or "discovered content," is learned in much the same way that a proposition is learned in reception learning. And so the difference between discovery and reception learning is in the *antecedent conditions*. As the authors state later:

> In reception learning [the] content is presented in the form of a substantive or non-problem-setting proposition that the learner need only understand and remember. In discovery learning, on the other hand, the learner must first discover this content by generating propositions that represent either solutions to the problems set or successive steps in their solutions. (p. 60)

That is, for reception learning, the antecedent conditions of presenting the proposition to be learned are managed by the teacher, whereas in discovery learning, the antecedent conditions, which might invoke rearranging, integrating, and transforming information, are managed by the learner. No one would deny that when the learner arranges these antecedents he is performing cognitively in a way that is different from his performance in reception learning. But what is equally clear is that the

sorts of cognitive performance involved in discovery learning vary according to the sort of discovery that is to be made, and so the phrase "discovery learning" turns out to be almost as ambiguous as the phrase "discovery teaching."

Again then, the preservice teacher might well be cautioned against the use of such dichotomies as "discovery learning" and "reception learning" for they fail to go very deeply into revealing the essential tasks which both teacher and learner must accomplish if the goal is to be achieved, in just the same way that phrases like "discovery teaching" and "didactic teaching" do not signal unequivocally what teaching moves are appropriate.

Stewart's work in "Teaching Strategies: Is Discovery One of Them?" is an important contribution in its own right. As I have shown here, some of his points can be taken further to reveal the awkwardnesses of using educational terms in a less than careful manner.

REFERENCES

Ausubel, D., Novak, J., & Hanesian, H. *Educational psychology: A cognitive view.* New York: Holt, Rinehart and Winston, 1978.

Scheffler, I. *Conditions of knowledge: An introduction to epistemology and education.* Glenview, Illinois: Scott, Foresman and Co., 1965.

Stevens, P. On the Nuffield philosophy of science. *Journal of Philosophy of Education,* 1978, *2,* 99-111.

Stewart, J. D. Teaching strategies: Is discovery one of them? *Canadian Journal of Education,* 1979, *4*(2), 55-65.

Strike, A. The logic of learning by discovery. *Review of Educational Research,* 1975, *45,* 461-483.

Toulmin, S. *The philosophy of science: An introduction.* New York: Harper and Row, 1960.

Wittgenstein, *Philosophical investigations.* Oxford: Basil Blackwell, 1968.

Hugh Munby is an Associate Professor and Chairman of Curriculum Studies in the Faculty of Education at Queen's University, Kingston, Ontario K7L 3N6.