AMONG the repertoire of accepted pedagogic techniques available to teachers, learning by discovery enjoys a proper and established place. For certain purposes and under certain conditions, this procedure has a defensible rationale and undoubted advantages. Hence the issue is not whether it should or should not be used in the classroom, but rather for what purposes and under what conditions.

Typically, however, both the proponents and opponents of learning by discovery tend to take an all-or-none position regarding its usefulness. Advocates of a subject-matter-oriented approach, for example, traditionally tend to de-emphasize the importance of psychological, developmental, and pedagogic factors that affect the meaningfulness of academic materials. They tend to assume that meaningfulness inheres in the logic of subject matter itself, irrespective of how it is presented and irrespective of the developmental status of the learner. Hence, from their standpoint, if an academically competent teacher presents subject matter logically to intellectually normal students, meaningful learning outcomes can always be taken for granted. It is hardly surprising, then, that they regard learning by discovery as inefficient and inadvisable under any circumstances, on the grounds that the learner is, by definition, insufficiently competent in any subject-matter field to learn effectively by himself.

On the other hand, as in the case of many other pedagogic devices, enthusiastic advocates of learning by discovery are prone unwarrantedly to extrapolate the advantages of this technique to all age levels, to all levels of subject-matter sophistication, to all kinds of educational objectives, and to all types of learning tasks. They tend to assume that all problem-solving and discovery experience is inherently and necessarily meaningful, and that all expository-verbal teaching necessarily leads to rote memorized glib verbalisms. They commonly assert that regardless of cognitive maturity or subject-matter sophistication, knowledge can only be meaningfully acquired if students have current or recently prior concrete-empirical experience with the actual realities to which new ideas refer, if they acquire subverbal insight into these ideas and apply them in problem-solving situations before verbalizing them, and if they discover these insights autonomously.

David P. Ausubel is Professor of Education, Bureau of Educational Research, University of Illinois, Urbana.
They insist, further, that problem solving and discovery methods must be the chief means of transmitting subject-matter content, even if considerations of time-cost render these methods less efficient than expository techniques—both because the resulting knowledge is invariably more meaningful, and because “more basic than the attainment of concepts is the ability to inquire and discover them autonomously” (p. 168).1

For these reasons it might be useful to define in some detail the psychological and educational indications and contraindications for discovery methods of teaching. What can learning by discovery reasonably hope to accomplish? When is its use feasible and unfeasible? For what age levels and degrees of subject-matter sophistication is it suitable?

Meaningfulness

Meaningfulness is perhaps the central issue underlying the learning by discovery controversy. However, reactionary critics of public education tend to regard this issue as merely a smokescreen for adulterating the curriculum with “soft” subject matter. “Give the prospective teacher sound academic training,” they say, “and he will automatically be able to present subject matter meaningfully to students.” Yet actually, subject-matter knowledge per se is only potentially meaningful. Such knowledge will only be learned meaningfully if the learning task can be related in nonarbitrary, substantive fashion to what the learner already knows, and if the learner adopts a corresponding learning set to do so.

It follows, therefore, that meaningful learning in students does not necessarily take place just because the teacher is academically knowledgeable. To relate a new abstract-verbal learning task to their existing knowledge in nonarbitrary, substantive fashion, students require an adequate repertoire of abstract terms and symbols based on previous concrete experience. They must also be sufficiently mature from a cognitive standpoint to carry out this operation without the benefit of current or recently prior concrete-empirical props. Furthermore, the new material will not be very meaningful unless they possess an adequate background of organizing, explanatory, and integrative concepts, and unless they can satisfactorily discriminate between new ideas in the learning task and previously learned propositions. Obviously, then, the problem of meaningful instruction can ignore neither the developmental status of the learner nor various substantive and programmatic aspects of presenting subject matter.

Thus it is true that much potentially meaningful knowledge taught by verbal exposition results in rote memorized verbalisms. We can expect such rote outcomes whenever purely verbal techniques are prematurely used with cognitively immature pupils, when discrete facts are arbitrarily presented without any organizing or explanatory principles, and when new learning tasks are not integrated with previously acquired knowledge.

Contrary to the assertions of some discovery enthusiasts, however, these rote outcomes are not inherent in the expository method per se, but rather in such abuses of this method as fail to satisfy the criteria of meaningfulness. True, to be meaningful, expository teaching must take various developmental and pedagogic considerations into account. But

under no circumstances must one dis-
cover knowledge by oneself before it 
can be meaningful. Meaningfulness no
more inheres in discovery than it does 
in the internal logic of subject matter.

Both expository and problem-solving 
techniques can be either rote or mean-
ingful depending on the conditions un-
der which learning occurs. Just like ex-
pository teaching, laboratory work and 
problem solving are not genuinely mean-
ingful experiences unless they are built 
on a foundation of clearly understood 
concepts and principles, and unless the 
constituent operations are themselves 
meaningful. Performing laboratory ex-
periments in cookbook fashion, or me-
chanically solving “type problems” and 
manipulating algebraic symbols obvi-
ously confers no more genuine under-
standing than does rote memorization of 
a teacher’s lecture.

Presentation of Subject Matter

Generally speaking, problem-solving 
or discovery techniques are unnecessary 
and inappropriate for teaching subject-
matter content, except when pupils are 
in the concrete stage of cognitive de-
velopment. Even during this latter develop-
mental period, these techniques can only 
be justified as an auxiliary and occasional 
means of presenting such content.

During the concrete stage, roughly 
covering the elementary school years, 
children are restricted by their depend-
ence on concrete-empirical experience 
to a semi-abstract, intuitive understand-
ing of abstract propositions. But even 
during these years, the act of discovery 
is not indispensable for intuitive (sub-
verbal) understanding and need not con-
stitute a routine part of pedagogic tech-
nique. The only essential condition for 
learning relational ideas during this pe-
riod is the ready availability of current 
or recently prior concrete-empirical ex-
perience.

Thus, for teaching simple and rela-
tively familiar new ideas, either verbal 
exposition accompanied by concrete-
empirical props, or a semiautonomous 
type of discovery accelerated by the ju-
dicious use of prompts and hints, is ade-
quate enough. When the new ideas to 
be learned are more difficult and unfa-
miliar, however, it is quite conceivable 
that autonomous inductive discovery en-
hances intuitive understanding. It pre-
sumably does this by bringing the stu-
dent into more intimate contact both 
with the necessary concrete experience 
and with the actual operations of ab-
stracting and generalizing from empiri-
cal data.

During the abstract stage of cognitive 
development, however, the psychological 
rationale for using discovery methods to 
teach subject-matter content is highly 
questionable. Students now form most 
new concepts and learn most new propo-
sitions by directly grasping higher-order 
relationships between abstractions. To 
do so meaningfully, they need no longer 
depend on current or recently prior con-
crete-empirical experience, and hence 
are able to by-pass completely the in-
tuitive type of understanding reflective 
of such dependence. Through proper 
expository teaching they can proceed di-
rectly to a level of abstract understand-
ing that is qualitatively superior to the 
intuitive level in terms of generality, 
clarity, precision, and explicitness. At 
this stage of development, therefore, it 
seems pointless to enhance intuitive un-
derstanding by using discovery tech-
niques.

It is true, of course, that secondary 
school and older students can also profit 
sometimes from the use of concrete-em-

November 1962
prical props and from discovery meth-
ods in learning subject-matter content
on an intuitive basis. This is so because
even generally mature students still tend
to function at a relatively concrete level
when confronted with a new subject-
matter area in which they are yet totally
unsophisticated. But since abstract cog-
nitive functioning in this area is rapidly
achieved with the attainment of a min-
imal degree of subject-matter sophisti-
cation, this approach to the teaching of
course content need only be employed
in the early stages of instruction.

From a practical standpoint, learning
by discovery is unfeasible as a primary
means of teaching subject-matter con-
tent because of the inordinate time-cost
involved. It could only be justified on
the grounds of psychological necessity
or other unusual pedagogic advantages.
But since discovery learning is never in-
dispensable for meaningful learning and
offers unique educational advantages
only under the two special circumstances
considered above, the time-cost factor
becomes the dominant consideration. If
secondary-school and university students
were obliged to discover for themselves
every fact and principle in the syllabus,
simply on a time-cost basis they would
not progress much beyond the rudiments
of any discipline.

Another disadvantage of using a dis-
covery approach for the transmission of
subject-matter content is the fact that
children are notoriously subjective in
their evaluation of external events, and
tend to jump to conclusions, to gener-
alize on the basis of limited experience,
and to consider only one aspect of a
problem at a time. These tendencies in-
crease further the time-cost of discovery
learning in the transmission of knowl-
edge. Moreover, children tend to inter-
pret empirical experience in the light of
prevailing folklore conceptions that are
at variance with modern scientific the-
ories. Lastly, one might reasonably ask
how many students are sufficiently bril-
liant to discover everything they need
to know. Most students of average abil-
ity can acquire a meaningful grasp of
the theory of evolution and gravitation,
but how many students can discover
these ideas autonomously?

Discovery methods are primarily use-
ful not for transmitting subject-matter
content, but for evaluating meaningful
learning outcomes and for teaching
problem-solving techniques, apprecia-
tion of scientific method, and awareness
of the sources of knowledge. To ascer-
tain whether students genuinely under-
stand or have merely memorized a given
abstract proposition, there are few better
methods than to require them to solve
problems involving applications of that
proposition.

Quite apart from its usefulness in eval-
uation, however, the enhancement of
problem-solving ability as an end in it-
self is one of the most important ob-
jectives of education. Hence it is highly
defensible to utilize a certain proportion
of classroom time in developing appreci-
ation of and facility in the use of
scientific methods of inquiry and of
other empirical, inductive and deductive
problem-solving procedures. There is no
better way of developing effective skills
in hypothesis making and testing, “de-
sirable attitudes toward learning and in-
quiry, toward guessing and hunches, to-
ward the possibility of solving problems
on one’s own . . . [and] attitudes about
the ultimate orderliness of nature and
a conviction that order can be discov-
ered.”

J. S. Bruner. The Process of Education.
20.
This is a far cry from advocating that the enhancement of problem-solving ability is the major function of the school. To acquire facility in problem solving and scientific method, it is also unnecessary for learners to rediscover every principle in the syllabus. Since problem-solving ability is itself transferable, at least within a given subject-matter field, facility gained in independently formulating and applying one generalization is transferable to other problem areas in the same discipline. Furthermore, overemphasis on developing problem-solving ability would ultimately defeat its own ends. Because of its time-consuming features, this would leave students with insufficient time in which to learn the content of a discipline; and hence, despite their adeptness at problem solving, they would be unable to solve simple problems involving the application of such content. Knowledgeability, in other words, is a necessary although not a sufficient condition for successful problem solving.

One of the more fashionable movements in curriculum theory today is an attempt to enhance the critical thinking ability of pupils apart from any systematic consideration of subject-matter content. An entire course of study is pursued in which pupils perform or consider an unrelated series of experiments in depth, and then concentrate solely on the inquiry process itself rather than on this process as it is related to the acquisition of an organized body of knowledge. A major difficulty with this approach, apart from the fact that it fails to promote the orderly, sequential structure of knowledge, is that critical thinking ability can only be improved within the context of a specific discipline. Countless research studies have confirmed the proposition that grand strategies of inquiry, discovery, or logical analysis are not transferable across disciplinary lines. Also, it hardly seems plausible that a strategy of inquiry, which must necessarily be broad enough to be applicable to a wide range of disciplines and problems, can ever have, at the same time, sufficient particular relevance to be helpful in the solution of the specific problem at hand.

A second significant difficulty with this latter approach is that its proponents tend to confuse the goals of the scientist with the goals of the science student. They assert that these objectives are identical, and hence that students can learn most effectively by enacting the role of junior scientist. Actually, however, the scientist is engaged in a full-time search for new general or applied principles in his field, whereas the student is primarily engaged in an effort to learn the basic subject matter in this field, as well as something of the method and spirit of scientific inquiry.

Thus, while it makes perfectly good sense for the scientist to work full-time formulating and testing new hypotheses, it is quite indefensible for the student to be doing the same thing. Most of the student's time should be taken up with appropriate expository learning, and the remainder devoted to sampling the flavor and techniques of scientific method. It is the scientist's business to formulate unifying explanatory principles in science. It is the student's business to learn these principles as meaningfully and critically as possible, and then, after his background is adequate, to try to improve on them if he can. If he is ever to discover, he must first learn; and he cannot learn adequately by pretending he is a junior scientist. (p. 39-39)

See, for example, Suchman, op. cit.

* * *
