A Categorization Scheme for Principles of Sequencing Content

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The question of how content should be sequenced or ordered has been the subject of educational debates for at least the past 70 years (Dewey, 1902; Rugg, 1927; Tyler, 1950; Taba, 1962, Ausubel, 1964; Bruner, 1960; Suppes, 1966; Gagné, 1970; Popham & Baker, 1970; Posner, 1974). However, no satisfactory answer has been developed, and no adequate prescription is expected in the near future.

In order to properly deal with the prescriptive question, How should content be sequenced? we need first to ask the prior descriptive question, In what ways can content be sequenced? That is, what principles can be used to sequence content?

We have very little information, based on hard data, regarding the consequences of alternative content sequences and will need a good deal more research effort before we are able to satisfactorily suggest how content should be sequenced. Our intention here is to consider the question, What are the alternatives?

This article was presented in a preliminary form entitled “An Analysis of Curriculum Structure” at the meeting of the American Educational Research Association, Chicago, 1974 (Note 1). The study was supported, in part, by a Hatch Research Grant.

The authors wish to thank Donald Nyberg, Alan Rudnitsky, and Laurie Wimer for their help in the preparation of this manuscript.
Definition of Terms

In this analysis we will talk generally about content elements. A content element, for the purpose of this analysis, is a proposition, concept, skill, or attitude that is to be taught to pupils.

Content sequences are part of the overall content structure. Content structure refers to the content elements and the ordering relationships that exist between them. Paradigmatically, the problem of content structure can be considered a sequencing or ordering problem. Most questions about content structure can be reduced to questions concerning what content comes before what other content and the rationale for that order (i.e., the sequencing principle or, more precisely, the ordering relation). Occasionally the problem of content structure is concerned with grouping principles. In these cases the important structural relationships hinge on the relationship among content elements to be taught in conjunction, and the order of the elements may be a matter of relative indifference. (See Posner, 1974, for an elaboration of the sequencing-grouping distinction.) As it turns out, the major types of sequencing principles are also the major types of grouping principles. Differences between grouping and sequencing principles occur at the level of subtypes.

Sequencing Principles: An Overview

There are many sequencing principles, i.e., rationales for ordering content elements in particular ways. The purpose of the present article is to explicate a plausible set of concepts useful for theory, research, development, and evaluation concerned with content sequencing. These concepts provide a framework for discussing sequencing alternatives and their implications.

This framework is in the form of a categorization scheme for sequencing principles summarized by the following questions:

1. What are the empirically verifiable relationships between the phenomena (people, things, or events) in the world about which the pupil is to learn, and in what ways can content be sequenced so that the organization is consistent with the way the world is? Subcategories include relationships based on space, time, and physical attributes.

2. What are the conceptual properties of the knowledge that the pupil is to learn, and in what ways can content be sequenced so that it is logically consistent in organization to the organization of the concepts? Subcategories include relationships based on class relations, propositional relations, sophistication level, and logical prerequisites.

3. How do propositions and concepts come about, and in what ways can content be sequenced so that it is consistent with this
process of inquiry? Subcategories include relationships based on the logic and the empirics of inquiry.

4. How does the pupil learn, and in what ways can the content be sequenced so that it is consistent with the learning process? Subcategories include relationships based on empirical prerequisite, familiarity, difficulty, interest, internalization, and development.

5. How will the pupil utilize the content after he has learned it, and in what ways can the content be sequenced so that it is consistent with the utilization process? Subcategories include relationships based on procedure and anticipated frequency of utilization.

Derivation of the Categorization Scheme

A set of concepts of this sort is difficult to argue in its initial conception. The reason for this is that the main function of a set of concepts is to organize a range of phenomena in a coherent, but above all, a useful way. However, it is virtually impossible to decide whether a given conceptual scheme is useful until it has been used.

To warrant an attempt at utilization, however, it is reasonable to expect a set of concepts to meet some criteria of initial plausibility. Two such criteria appear appropriate. First, a set of concepts should, to paraphrase Aristotle, "divide nature at her joints." That is, it should incorporate what appear to be major distinctions in or about the phenomena of interest. Second, a set of concepts should yield a plausible categorization of the phenomena of interest given what is currently known or being proposed about them.

We believe that they meet the first criterion, since the categories employed are well grounded in what have proven to be useful distinctions in epistemology. The major distinction on which the categories are constructed is the distinction between the world and the language and concepts used to think or talk about the world, i.e., between the empirical and the conceptual (see Chisholm, 1966, chap. 5; Lewis, 1962). This distinction, which led to the five basic categories, is depicted in Figure 1.

Initially it seemed reasonable to divide the empirical world into two classes. One class of empirical properties characterizes the phenomena of a given subject matter, and a second class deals with the empirical properties of learners and of the learning

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1 Many authors consider the distinction between the conceptual and the empirical to have a vague boundary line (cf. Quine, 1961, and Kuhn, 1970). Furthermore, there are numerous cases where the distinction may be difficult to apply clearly. However, we have found only a few cases where these matters of technical philosophy have proven to be related to the use of our categorization scheme.
A representation of the scheme in terms of the conceptual-empirical distinction.
process. These classes seemed to be the dominant “joints” in the world from the perspective of curriculum theory (Ausubel, 1964; McClellan, 1961). We, thus, arrived at the categories we have labelled “world-related” and “learning-related.”

Later we were led, both by our attempts to apply our categories to various curricula and by the writings of certain curriculum theorists, to identify a third class of facts about the world. The use to which some knowledge or skill might be put (prompted by Broudy, Smith, & Burnett, 1964, chap. 3 & 4; Broudy, 1970; Walker & Schaffarzick, 1974) seemed also to determine the way it can be sequenced in the curriculum. “Utilization-related” could have been treated as a subset of “world-related,” but it seemed both sufficiently important and sufficiently different from the basic conception of “world-related” to stand as an independent category.

At this point we had four categories, which we have called “concept-,” “world-,” “learning-,” and “utilization-related.” The last three began as subsets of a more general class of empirical properties about the world. However, once we had identified the major subsets of this class, the class seemed no longer to perform a useful role. Thus, “empirical” was eliminated as a category, and the subsets were elevated to major categories.

The final category, “inquiry-related,” was added because there is a substantial literature in curriculum linking the sequencing of content to features that have to do with how knowledge is generated (see Shulman, 1970; Shulman & Keislar, 1966; Strike, 1975). This category, too, seemed important and resistant to subsumption under any of the others. It is also noteworthy that this category mixes both empirical and conceptual aspects.

Concerning the second criterion for a set of concepts, we have tested the plausibility of the categorization scheme both against the organization of several extant curricula (Posner & Nyberg, Note 2) and against the literature on sequencing (see discussion on Ausubel and Gagné later in this article). The concepts, especially in their detail, have undergone some modification as a consequence. However, the major categories in the scheme appear to stand up.

One such conceptual test of the major categories against the available literature revolves around the interaction of the learner and the subject matter and whether the subject matter or the learner should serve as the basis for content selection and organization. This interaction has been the topic of much discussion in the literature (see Ausubel, 1964; Dewey, 1956; and Gagné, 1970). Therefore, if the categorization scheme is to be conceptually useful, it should help organize and clarify thought regarding this interaction. Figure 2 depicts a model of this interaction in terms of the categorization scheme.
Figure 2.
The interaction of the learner and the subject matter.
The reader will note that there are two distinct "regions" in the model. One "region" is the subject matter "region" and includes knowledge and the way that knowledge comes to be. Thus, subject matter is shown to include three distinct aspects, namely, properties of phenomena in the world, knowledge about the phenomena (i.e., conceptual systems), and the process by which such knowledge is produced (i.e., inquiry).

The second "region" in Figure 2 is the learner "region" and includes two processes, namely, the learning process and the utilization process. The former process results in learning outcomes, whereas the latter process utilizes the learning in pursuit of life goals. In contrast to the subject matter "region," the learner "region" is more concerned with human purposes and psychologies and with economy of learning for the individual learner.

It should be noted that many decisions regarding the sequencing of content are not based on any of these five major categories of sequencing principles, but, instead, on factors relating to implementation of programs in specific situations. Such factors as materials and facilities available, time schedules, weather and climate, location of the school, transportation needs, and teachers' interests or competencies are likely to be powerful determinants of sequencing. These factors have been referred to as "frame factors" (Dahllof & Lundgren, Note 3) and may be considered a sixth type, termed "implementation-related." Implementation-related principles, however critical in organizing programs, are dependent not on relationships among content elements (the focus of the present article) but among the content and the administrative, physical, personnel, societal, and time frames of teaching. As such, this type of sequencing principle has not been included in the present scheme.

Sequencing Principles: The Types and Subtypes

The five major types of content sequence will be discussed here in greater detail. In addition, several of the more interesting and important subtypes will be described for each major type. (The scheme is presumed to be comprehensive for the major types, but not for the subtypes.)

Purity of types. The examples used to illustrate each subtype were selected on the basis of their relative "purity," but not on the basis of their representativeness. Typical instances of actual content sequences are blends of several of the subtypes and even several of the major types. This is not only expected but probably desirable. The types and subtypes, although conceptually distinct, are rarely found in programs in their "pure" form. For example, it is unlikely to find any whole program that is a "pure"
world-related type, much less a pure example of a world-related subtype (e.g., "space"). However, it is not unreasonable to expect to find particular sequences that emphasize a particular type or even subtype. This article makes no claim as to the desirability of such "purity" in actual programs. Such questions of optimal kinds of sequence need to be answered by empirical research.

_Categorical dominance._ It should also be noted that although the types and subtypes are conceptually distinct, there is the danger of allowing one category to subordinate another. A pair of content elements may be related to each other on one basis (e.g., Empirical Prerequisite) by virtue of their being related on another basis (e.g., Logical Prerequisite). In a sense, the former basis dominates the latter one.

This phenomenon of "categorical dominance" is particularly common with (though not limited to) the subtypes Empirical Prerequisite, Difficulty, and Interest. For example, Bloom (1971) attempts to account for learner interest solely on the basis of past success and achievement of prerequisites. Stoker and Kropp (1964), on the other hand, define prerequisite relationships in Bloom's taxonomy in terms of difficulty level. Although such conflation of subtypes is common in the literature, preservation of conceptual distinctions can be fruitful in thinking about the relative merits of conflicting sequencing principles and the way alternative patterns reflect or contribute to cognitive operations. This matter is elaborated later in this article in a discussion of Gagné's work.

1.0 _World-related._ World-related sequences are those sequences in which there is consistency among the ordering of content, on the one hand, and relationships between phenomena as they exist or occur in the world on the other hand. That is, the content structure reflects empirical relationships among events, people, and things (Anderson, 1969, 1971). World-related subtypes include spatial relations, temporal relations, and physical attributes, to name just a few. An example of this type is the typical sequencing of history content based on the chronological sequence of events (i.e., the subtype, Time).

1.1 _Space._ Sequences based on spatial relations are those in which the content elements are ordered in accord with the physical arrangement or position of the phenomena of interest (Anderson, 1969, pp. 18-19; 1971, pp. 9-10). Sequencing principles of this subtype include closest-to-farthest, bottom-to-top, east-to-west, etc.

_Examples:_ Teach the positions of the offensive line, the half-backs, and the quarterback in that order. Teach the parts of a plant from the root, to the stem, to the leaves and flower, in that order. Teach the names of the states according to geographical location.
1.2 Time. A temporal relationship between content elements reflects an antecedent-consequent order between events, or outcomes of events. That is, often the content (most typically history content) is sequenced chronologically from the earliest to the most recent events (Anderson, 1969, pp. 20-21; 1971, pp. 10-11). Sequences embodying a temporal dimension include those based on cause and effect and on ideological influence.

Examples: Teach the major ideas of Marx before teaching about the nature of the Russian revolution (ideological influence). Teach the names of the states in order of admission to the Union (historical chronology).

1.3 Physical Attributes. World-related content sequences may be based on physical characteristics of the phenomena of interest such as size, age, shape, number of sides (e.g., in geometry), brightness (e.g., in astronomy), hardness (e.g., in geology), empirical complexity (e.g., in comparative anatomy), and countless other physical (and chemical) characteristics. This subtype is most commonly employed in the natural sciences, since these disciplines are concerned with properties of things in the natural world.

Examples: Teach the hardness scale for minerals from softest to hardest (hardness). Teach the names of the states in size order (size). Teach the relative proportions of helium and hydrogen in stars from those of greatest absolute brightness to those of least absolute brightness (brightness). Teach the anatomy of an amphibian, then a shark, then a cat (empirical complexity). Teach the structure of a primitive society before teaching about a complex industrial society (empirical complexity).

2.0 Concept-related. World-related sequences are assumed to reflect the organization of the empirical world, whereas concept-related sequences reflect the organization of the conceptual world. That is, a sequence in which content (here, concepts) is structured in a manner consistent with the way the concepts themselves relate to one another is termed a concept-related sequence. Often referred to as the "logical structure," this type focuses on the properties of knowledge in its "final" form when relationships between premises and conclusions can be analyzed. Four concept-related subtypes are described below: class relations, propositional relations, sophistication level, and logical prerequisite. A traditional curriculum embodying concept-related sequences is geometry when taught deductively (i.e., the subtype termed Propositional Relations). More recently developed curriculum approaches placing a high priority on the organization of concepts include most of those curricula developed during the 1960's "curriculum reform movement" (e.g.,
BSCS biology, ESCP earth science, PSSC physics, CHEM Study chemistry). These curricula were described by the slogan "the structure of disciplines" (Elam, 1964; Ford & Pugno, 1964; Goodlad, 1966; Kliebard, 1965; Schwab, 1962). This slogan describes a curriculum approach in which the "fundamental" concepts of a discipline (i.e., those concepts that subsume many others) are used as the central themes of the curriculum for purposes of grouping and sequencing content (Bruner, 1960). One of the arguments for this approach is that since the occurrence of the "knowledge explosion," the student can no longer learn everything. Therefore, an analysis of each discipline is needed to determine those fundamental ideas that form the structure of the disciplines (Bruner, 1960, 1966). By learning this structure, the student can learn the essence of the discipline in the most economical manner, without having to learn every one of the many facts subsumed by each "basic" concept.

2.1 Class Relations. A class concept is a concept that selects or groups a set of things or events as instances of the same kind of thing because they share common properties. Typical class relations are inclusion, membership, union, and intersection. The concepts superordinate and subordinate sometimes denote class relations. This subtype serves as both a common grouping and sequencing principle. Sequences embodying this subtype include the teaching about a general class prior to teaching about its members or prior to investigating the properties of a class. Grouping of content according to this subtype consists in either teaching the characteristics of the class before teaching about the members of the class (Ausubel, 1968) or vice versa (Bruner, Goodnow, & Austin, 1967). In either case, the order of teaching the members of the class is less important than the fact that they are taught in conjunction and taught separately from the class concept.

Examples: Teach about mammals before teaching about specific animals in that group. Define "discrimination" before examining racial and sex discrimination. Investigate various forms of democratic governments through case study before attempting to define "democracy." Compare sound and light before teaching the concept of wave motion.

2.2 Propositional Relations. A proposition is a combination of concepts that asserts something. Common relations between propositions include entailment, reduction, contradiction, theory-application, premise-conclusion, theory-evidence, and rule-example. Sequences of this sort include teaching evidence prior to the proposition that the evidence
supports, teaching a theory prior to the facts that the theory explains, or teaching micro-laws prior to teaching macro-laws. This sequencing principle focuses on the relationship between propositions rather than what one does with propositions (see 3.1, Logic of Inquiry).

Examples: Teach an overview of the theory of natural selection before studying the adaption of Darwin’s finches (theory-instance). Teach the principle of “equal protection under law” before studying the 1954 Supreme Court decision on Civil Rights. Teach in deductive order the steps in a geometric proof. Teach the volume of a gas at several temperatures and pressures before teaching Boyle’s Law (evidence-conclusion). Teach about chemical compounds before teaching about biological organisms (reduction). Teach about atomic structure before teaching about chemical compounds (reduction).

2.3 Sophistication. Concepts and propositions can differ in their level of precision ("acceleration" is less precise than "v/t"), conceptual complexity (the number of concepts subsumed by a concept), abstractness (the distance from particular things or facts; usually the opposite of concrete), vagueness (the extent to which a concept bears a "family resemblance" to other concepts; usually the opposite of clarity), range (the number of instances to which a concept refers) and level of refinement (adding qualifications to a concept or proposition refines it). Sophistication embodies all of these aspects, and the above list is intended to be representative rather than exhaustive. The concept of sophistication here is similar to Bruner’s (1960) in his discussion of the “spiral” curriculum that returns periodically to concepts at higher and higher levels of sophistication.

Examples: Teach the real numbers before teaching about imaginary numbers (abstractness). Teach how events can be ordered chronologically before teaching the concept of time (abstractness). Teach what “acceleration” means before teaching it as “v/t” (precision). Teach the concept of “stimulus” before the concept of “conditioning” (conceptual complexity). Teach Newton’s Laws before Einstein’s refinement of those laws in his Special Theory of Relativity (level of refinement).

2.4 Logical Prerequisite. A concept or proposition is a logical prerequisite to another concept or proposition when it is logically necessary to understand the first concept or proposition in order to understand the second (Phenix, 1964, chap. 22). It should be noted that the prerequisite relationship is a logical one (i.e., it is a priori) where sequencing depends on
the relations between concepts rather than the relations between their referents (Phillips & Kelly, 1975, pp. 359-62).  

*Examples:* Teach what "velocity" means before teaching that "acceleration" is the change in velocity. Teach the concept of set before the concept of number.

3.0 *Inquiry-related.* Inquiry-related sequences are those that derive from the nature of the process of generating, discovering, or verifying knowledge. Therefore, such sequences reflect the nature of the logic or methodology of a given area of thought (Parker & Rubin, 1966; Schwab, 1964b). Dewey's (1916, chaps. 11 and 12) attempt to structure teaching according to his analysis of the scientific method is a major example of an Inquiry-related approach to sequence. There are two subtypes, which we shall call the Logic of Inquiry and the Empirics of Inquiry.

3.1 *Logic of Inquiry.* Logic may be narrowly defined as the science of valid argument or more broadly as the analysis of the norms of adequate inquiry. Sequencing principles rooted in logic will reflect views of valid inference. For example, two different logics (epistemologies) yield differing sequencing principles concerning discovery learning. A view that considers discovery to be a matter of generalizing over numerous instances (i.e., induction) will provide instances of a generalization prior to attempting to have the student discover the generalizations (Glaser, 1966). A view that considers discovery to be a matter of testing bold conjectures will seek to elicit hypotheses and then turn to a process of evidence collection (Bruner, 1960; Popper, 1959). (See Shulman, 1970, for a comparison of these two approaches to discovery learning.) This subtype obviously has a relation to the subtype concerned with relations among propositions (see 2.2) under the major category, Concept-related. An Inquiry-related sequence which depends on the logical features of inquiry does so because of the logical relations between propositions. However, this subtype differs from Propositional Relations in that Inquiry is concerned with what one does with propositions and concepts rather than with the propositions themselves.

*Examples:* Explain how Galileo arrived at the hypothesis that the change in velocity per unit of time for a freely falling object is a constant; then have pupils find that the acceleration of any object allowed to fall freely is $9.8\,\text{m/}\text{sec}$. as long as air resistance is not a factor (hypothesis generation-evidence collection). Discover ways to light a bulb with a battery, then generalize a rule (induction).

3.2 *Empirics of Inquiry.* Some features of proper inquiry are rooted in descriptions of how successful scientists actually
proceed or in the social or psychological conditions of fruitful inquiry. Let us suppose, for example, that successful inquirers were found to study a problem area before working on specific problems. This might lead to sequencing content in such a way that it emphasizes the need for a general survey of an area prior to consideration of special problems. 

*Examples:* Teach what other researchers have discovered about reinforcement schedules before teaching pupils to frame hypotheses about optimal reinforcement schedules. Teach how to write grant proposals before teaching how to collect data.

4.0 *Learning-related.* Learning-related content sequences draw primarily on knowledge about the psychology of learning as a basis for curriculum development and instructional planning. Most psychologists, although they might disagree about the particular instructional approach to be used, argue that the nature of the subject matter is not as relevant to sequencing content as are empirical claims about the way people learn (see, for example, Gagné, 1970, pp. 26-27; and Ausubel, 1964). Five learning-related subtypes are described below: Empirical Prerequisite, Familiarity, Difficulty, Interest, Development and Internalization. Examples of sequences of this type can be found in AAAS' *Science—A Process Approach,* which emphasizes the subtype termed Empirical Prerequisite relationships (and conflates it with the Logical Prerequisite subtype), and ESS science, which emphasizes Interest.

4.1 *Empirical Prerequisite.* If it can be determined empirically that the learning of one skill facilitates or makes possible the learning of a subsequent skill, the first skill can be termed an empirical prerequisite of the second (Gagné, 1970). Empirical Prerequisite contrasts with Logical Prerequisite (see 2.4) in that the latter is concerned with relations based on logical (or a priori) properties of concepts and the former is concerned with empirically based relations (typically between skills) regardless of their logical necessity. Naturally, what is logically necessary usually turns out to be empirically verifiable, but the converse does not hold. 

*Examples:* Teach discrimination between initial consonants; then teach the use of word attack skills; then teach reading. In basketball teach passing skills before teaching the fast break. Teach alphabetizing words before dictionary skills.

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2We have found that the tendency to conflate each of these subtypes with each other and with other subtypes is great. As we mentioned earlier, the conceptual distinctiveness of each subtype can be increased through attention to "categorical dominance."
4.2 *Familiarity.* An individual's past experiences are often the basis of sequencing. Familiarity refers to the frequency with which an individual has encountered an idea, object, or event—i.e., how commonplace it is to the individual. Phenomena that he has never seen or phenomena that he has heard about only occasionally are considered remote from the individual's experiential past. Sequences of this subtype order elements from the most familiar to the most remote (Dewey, 1938, chap. 7).

*Examples:* Teach about American schools before teaching about Swedish schools. Teach the various occupations in the local community before teaching about careers in other communities and in other nations. Teach American before metric units.

4.3 *Difficulty.* Factors affecting difficulty as conceived here include (a) how fine a discrimination is required, (b) how fast a procedure must be carried out, and (c) the mental capacity required for learning (e.g., memorizing five names is typically more difficult than memorizing two names). Sequences of this subtype teach the less difficult before the more difficult content (see Suppes, 1967).

*Examples:* Teach long vowel sounds before short ones. Teach weaving slowly, then teach the pupil to speed up. Teach the spelling of short words before longer words. Teach rhymes before blank verse.

4.4 *Interest.* Content elements that are intrinsically interesting are commonly those that refer to phenomena about which the learner has had some limited experience (i.e., not totally unknown to him) but remain a challenge, retain the potential for surprise, or can arouse curiosity. Although interest is more often attributable to instructional method than to the nature of the content element, there appear to be some elements that have more potential for learner interest (Kilpatrick, 1925). The most commonly prescribed sequence of this subtype is to begin with those elements which are more likely to evoke pupil interest. The "activity" and the "children's interest core curriculum" (Smith, Stanley, & Shores, 1957) serve as illustrations of this subtype.

*Examples:* Teach pupils how to pick a lock before teaching them how a lock works (Mager & Beach, 1967, p. 60). Teach pupils to dig out a local cellar before teaching archeology.

4.5 *Development.* A human development category is not strictly speaking a sequencing category. That is, there is a distinction between sequencing and grade or age placement. Some theorists, most notably Smith, Stanley and Shores
(1957), equate the two considerations. Although the present authors agree with Johnson (1967, p. 138) that content ordering disregards temporal spacing (i.e., grade or age placement), the authors include a “development” subcategory, since the work of Piaget and Kohlberg have served as a focus for much of the current dialogue on sequencing and structure of subject matter (see, for example, Sullivan, 1967). Much of this dialogue centers on the importance of sequencing content in a way that reflects the manner in which children develop psychologically. Developmental psychologists, such as Piaget and Kohlberg, contend that content is best learned when the learner is developmentally “ready” to learn it. That is, “the ideal order of studies is one in which each experience is introduced at the most propitious time in the person’s development” (Phenix, 1964, p. 291). Development should be distinguished from the Empirical Prerequisite subtype; the latter deals with content elements that are presumed to be learned, and Development deals with changes in the learner that occur as a result of the maturation process. Or simply stated, Empirical Prerequisite deals with those changes in the learner not attributable to Development. (See Strauss, 1972, for a more extensive comparison of Gagné’s and Piaget’s approach to sequencing content.)

Examples: Teach pupils to base their concept of morality on authority, then on democratically accepted law, and finally on individual principles of conscience (Kohlberg, 1963).

4.6 Internalization. When the educational intent of a sequence is to have the pupil internalize an attitude or value, elements can be ordered in a manner that reflects an increasing degree of internalization. Stages or levels of internalization have been suggested by Krathwohl, Bloom, and Masia (1964) as follows: (a) Receiving, (b) Responding, (c) Valuing, (d) Organization, (e) Characterization by a Value or Value Complex. Weinstein and Fantini’s (1970) “trumpet” model is also representative of this sequencing principle.

Examples: Teach pupils to listen willingly to Marxian ideas, then teach them to voluntarily interpret events in terms of a Marxian ideology, then teach them to view the world based on a Marxian value system. Teach pupils to recognize certain behaviors in others, then in themselves.

5.0 Utilization-related. Content (including skills) can be utilized in three possible contexts: social, personal, and career. These three contexts can serve as foci for grouping content.

Organizing or grouping content around the personal and social
needs of the learner has been an approach advocated by some leading proponents of the "core curriculum" (Giles, McCutchen, & Zechiel, 1942). After needs are identified by "experts" (i.e., psychologists, sociologists, anthropologists, etc.), content is organized around them. The "adolescent-needs core," the "social-functions core," the "social-problems core" (Smith, Stanley, & Shores, 1957, pp. 343-381) and the "life activities curriculum" (Saylor & Alexander, 1966, pp. 173-176) are representative of this approach.

Another Utilization-related approach to grouping content employs vocational and career-based topics around which to organize content. Saylor and Alexander (1966) describe how:

units of study are organized on the basis of the knowledge and skills needed to perform an occupation or to carry out the duties required in a job. The mode of organization is determined by an analysis of what workers do in a particular job and what responsibilities they fulfill as a part of the job. (pp. 179-180)

The personal, social, and career contexts discussed above are appropriate primarily as categories of grouping principles. Within each of these three utilization contexts, content can be sequenced (a) in a way that reflects procedures for solving problems or fulfilling responsibilities, or (b) according to the utilization potential for a given content element. These two sequencing principles comprise the subtypes of Utilization-related sequences.

5.1 Procedure. In training programs when a procedure or process is being taught and the content elements represent steps in the process, it is often appropriate for the sequence to reflect the order in which the steps will be followed when carrying out the procedure. One important type of procedure that is often taught is the procedure used in confronting personal (Smith, Stanley, & Shores, 1957, pp. 343-356) or societal (Smith, Stanley, & Shores, 1957, pp. 372-381) problems (e.g., career decision-making or air pollution). When content elements are selected for the purpose of enabling the pupil to solve these types of life-related problems, the elements may be sequenced in an order consistent with the individual's utilization of knowledge for this purpose.

Examples: Teach the effects of air and water pollution (i.e., establish a phenomenon as a "problem"), then teach the causes (i.e. analyze the problem), and then teach how to eliminate or correct the factors that cause pollution (i.e., suggest solutions). In landscape architecture teach pupils how to analyze a site, then how to choose landscape structures and construction materials, then how to
fit trees, shrubs, and flowers to the plan, and then how to design the public and living areas. Teach proper golf grip before teaching address of the ball.

5.2 Anticipated Frequency of Utilization. Some curriculum designs begin with the most important content, where “most important” means that which the pupil is likely to encounter most often. That is, the likelihood of encounters the pupil will have with various phenomena is predicted, and the order of the phenomena taught is based on the anticipated frequency of utilization in the pupil’s future experiences. Note the difference between this subtype and Familiarity. In Familiarity, sequence is based on an estimate of the number of past encounters the pupil has had with the phenomenon. In contrast to Familiarity, Anticipated Frequency of Utilization bases sequence not on past encounters but on predictions of future encounters.

Examples: Teach the use of chi-square and correlation coefficients before factor analysis. Teach compound interest before stock transactions. Teach a television repairman how to change a tube before teaching him to change a resistor (Mager & Beach, 1967, p. 61).

An Analysis of Gagné and Ausubel

The types and subtypes described above represent relatively pure categories conceptually. However, in practice and even in theory such purity of concepts is not always possible or even desirable.

In theory, for instance, the works of Gagné and Ausubel, although not representatives of “pure” types, do stand out as benchmarks in current thought on content structure. Therefore, it will be helpful to discuss at least briefly the ideas about content structure of each of these two men in the light of the scheme just presented.

The Gagné approach. Gagné serves as the leading advocate of prerequisite relations through his work in curriculum development (see AAAS' Science—A Process Approach), curriculum evaluation (Gagné, 1967), curriculum research (Gagné & Paradise, 1961), learning theory (Gagné, 1970), and curriculum theory (Gagné & Briggs, 1974). Furthermore, Gagné’s work has served as one of the bases for a promising approach to schooling, namely, Bloom’s “mastery learning strategy” (see Block, 1971). Gagné’s work illustrates how two conceptually distinct subtypes, namely, Logical and Empirical Prerequisite, can be blended into an approach to content sequencing.

For example, at one point the AAAS curriculum suggests
teaching how to apply "a rule that the speed with which an object changes position is the distance moved per unit of time" (Science—A Process Approach, Part D, lesson o). This content element, along with "a rule that relates circumference and diameter of a circle" (Science—A Process Approach, Part E, lesson t) and several other elements, is supposed to precede teaching the pupil to apply "a rule relating linear speed, angular speed, and the circumference of a wheel..." (Science—A Process Approach, Part E, lesson t). This is a clear example of the Logical Prerequisite subtype, since the sequence is based on relations between propositions (here, rules). As such, the rationale for the sequence rests on a priori rather than strictly empirical grounds.

At another point in the curriculum the pupil is taught to identify "the stimulus [S] and response [R] in the observed behavior of animals" before "describing a behavior in terms of stimulus and response" (Science—A Process Approach, Part C, lesson t). These two content elements are prerequisites only to the extent that identifying S-R behaviors is empirically found to be a prerequisite to describing S-R behaviors (i.e., the Empirical Prerequisite subtype). The prerequisite relationship has nothing to do with logical (or a priori) relations between concepts or propositions.

It is clear from these examples, and from others that could be cited, that Gagné makes no distinction between logical and empirical prerequisites. Although blending empirical and logical prerequisites may be a useful approach to sequencing content, recognition of the conceptual distinction between them is important for curriculum research, evaluation, and planning. Identification or justification of logical prerequisites depends on logical analysis. In contrast, identification and justification of empirical prerequisites depends on empirical research and evaluation. Furthermore, the validity of an empirical prerequisite may vary among individuals, whereas a priori relationships would not depend on personological variables. For these reasons it would seem fruitful to make the empirical-logical distinction when dealing with the concept of prerequisite. (Phillips & Kelly, 1975, pp. 359-62, make a similar point.)

By reducing all sequencing principles to one based on empirical prerequisites, Gagné's approach tends to obscure the diversity of underlying bases for prerequisite relationships. This masking of ordering relations may also obscure the relationship of content structure to cognitive operations. If the conceptual properties of content are important to the ability of an individual to think, a fuller description of that content structure is desirable for investigation of this relationship (Strike & Posner, 1976).

The Ausubelian approach. Like Gagné, Ausubel considers the
structure of the disciplines to be an inadequate basis for sequencing. Ausubel (1964, 1968) contends that the introduction of a learning sequence with a generalized abstract overview (i.e., an "advance organizer") that links up with the pupil's existent "cognitive structure" provides the pupil with the necessary "subsumers" for the subsequent learning to become "meaningful." In terms of the present categorization system, these "advance organizers" appear to be a juxtaposition of the Class Relations subtype (since the organizer subsumes the subsequent learning) and the Familiarity subtype (since the organizer must "fit" the pupil's cognitive structure, a product of his past experiences). Therefore, Ausubel's "advance organizers" may be considered an interesting marriage of Concept-related and Learning-related bases. He appears to have adopted a sequencing principle of one type and tempered it with a principle of another type. Perhaps his integrative approach explains his ability to engage in productive dialogue with other theorists like Gagné (Gagné & Briggs, 1974) and Schwab (1964a) who represent divergent approaches to sequence.

It appears, then, that the categorization scheme presented here can be used as a common set of concepts for thinking about sequencing content. Also, it seems clear that highly sophisticated approaches to program development employ more than one sequencing principle.

Implications

The categories of sequencing principles presented here can be considered a set of concepts. As such, their ultimate value is in providing tools of thought. These concepts can presumably help guide the thought of the curriculum developer, evaluator, and researcher.

Curriculum development. Two major tasks facing the developer of a content sequence are the selection and the sequencing of content. Of course, the selection and sequencing of content elements, in most cases, are not independent procedures. For example, a decision that an "advance organizer" (Ausubel, 1964) is to be taught first (i.e., a sequencing decision) necessarily entails a decision that an "advance organizer" is to be taught (i.e., a selection decision). As a matter of fact, although the focus of this article has been on the sequencing task, the five types of ordering relations also turn out to be types of selection criteria.

In the selection process, curriculum developers can be guided by various comprehensive frameworks available in the literature, such as the "taxonomies of educational objectives" (Bloom, 1956; Harrow, 1972; Krathwohl et al., 1964) and "realms of
meaning" (Phenix, 1964), to mention only two. If they do not want to state their objectives themselves, curriculum developers may even buy objectives from one of the available "banks" (e.g., the Instructional Objectives Exchange in Los Angeles).

When it comes to sequencing the content, however, curriculum developers have no comprehensive framework (i.e., one which includes a diversity of bases for sequencing) that can serve as a reference. One use of the categorization system presented here is to fill this void. It can serve as a "shopping list" of sequencing principles for curriculum developers, whether they be individual teachers or state syllabus writers. Use of this model increases the probability that they will sequence the content in a particular way because the chosen sequence is the most appropriate for their purposes, not because they have never thought of any alternative sequences. That is, the use of the model will presumably lead to greater flexibility by developers of content sequences.

Curriculum evaluation. The curriculum evaluator often needs to examine the content itself in addition to the measured outcomes of the program. Previously this type of "intrinsic" evaluation (Scriven, 1967) has been limited to classifying the objectives and content and comparing the objectives and content with the philosophy and with the teaching strategies designed for their implementation (Stake, 1967). The framework presented here adds to these kinds of potential descriptive data by making it possible to describe the kinds of content sequences employed. This type of data may have some utility, especially when comparing competing educational programs. However, for this data to have much meaning in decision making, the sequence types must be shown to relate to other significant educational variables (e.g., learning outcomes). That is, the use of descriptive data on content sequences for decision making presupposes research regarding the effect of a particular sequencing approach on the educational process or its products.

Curriculum research. Although content sequence is acknowledged to be an important area of educational theory and research (Bruner, 1966; Johnson, 1967), the three most thorough reviews of the literature (Briggs, 1968; Heimer, 1969; Tennyson, 1972) reveal a paucity of definitive studies. This deficiency in the research may be attributable in part to a failure "to describe, let alone to measure, how the programs in 'experiments' and 'control' situations actually differ from one another—or even to certify that they do" (Charters & Jones, 1973). This potential lack of "construct validity among treatments" (Posner, 1973) may, in fact, result in the researcher comparing "non-events" rather than "events" (Charters & Jones, 1973).
This problem could be resolved by the use of techniques for describing or representing the content structure of experimental and control treatments such as those developed by Shavelson (1974) and modified by Rudnitsky and Posner (Note 4). These techniques, together with the categorization scheme presented here, offer replicatable methods for assessing in qualitative and quantitative terms the content structure of instructional materials.

With these tools, a whole set of research questions becomes possible: What kinds of content structures do different kinds of curricula (e.g., academic versus occupational) employ? Are some types of sequencing principles (e.g., Inquiry- and Concept-related) appropriate and typical for only certain curriculum areas (e.g., the disciplines of mathematics and science)? Are some types of sequencing principles (e.g., Utilization-related) typically found only in certain kinds of curriculum (e.g., occupational education) but are appropriate and perhaps desirable for all curriculum areas?

Another important and related area of research concerns the differential consequences of using various sequencing principles. What has been termed the “hidden curriculum” has received much attention lately. Typically this phrase refers to the bureaucratic organization of the school and what this administrative arrangement teaches pupils (see, for example, Apple, 1971; Dreeben, 1968). However, the “hidden curriculum” may also refer to that which is contained in the curriculum but not stated as an objective. According to Johnson’s definition, a curriculum is more than a set of intended learnings; it is a structured series of intended learnings (Johnson, 1967). Therefore, when a particular element of content is learned, it is learned with other elements, so that relationships between content elements may be learned in addition to the content elements themselves. This fact is often overlooked by educational psychologists and others (see, for example, Anderson, 1968; Gagné & Bassler, 1963) who think of content sequence only as a determinant of how well or how many elements are learned, i.e., the quantity of “nodes” (Mayer, 1975). They ignore the fact that how content is sequenced may also determine, in part, what is learned.

Research by Geeslin (1974), Johnson (1969), Mayer and Greeno (1972), Shavelson (1972), and Rudnitsky and Posner (Note 4) indicates that the nonexplicit content structure of instructional materials is, in fact, learned by pupils. This basic finding is consistent with theory and research findings in reading and cognitive psychology (Frederiksen, 1972, 1975; Grimes, 1972; Myer & McConkie, 1973; Sachs, 1967, 1974).

A research question concerned with this kind of “hidden cur-
riculum” is as follows: In pursuing a particular educational goal, what are the differential effects (in terms of a wide range of outcomes) of sequencing instructional content according to divergent sequencing principles? Although different content sequences may result in equally effective programs (in terms of achieving the educational goal), each sequence may result in different conceptions of the subject matter, the way to continue learning, how to use knowledge in solving problems, and other important but often overlooked outcomes.

If differing content sequences result in differing cognitive structures and differing cognitive and/or affective orientations (Rudnitsky & Posner, Note 4), then the research question that becomes significant concerns the long-term consequences of these kinds of outcome on learners. For example, the researcher might ask, What kinds of cognitive structures and orientations are most likely to lead to the utilization of content in an individual's daily living and occupational situation?

Although the categorization scheme itself cannot answer any of these questions, it does provide the concepts needed to ask the questions. Whether or not these and other questions derived from the scheme prove fruitful is the ultimate test of the scheme's worth.

Reference Notes


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