

Scientific Method in Curriculum-Making

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Since the opening of the twentieth century, the evolution of our social order has been proceeding with great and ever-accelerating rapidity. Simple conditions have been growing complex. Small institutions have been growing large. Increased specialization has been multiplying human interdependencies and the consequent need of coordinating effort. Democracy is increasing within the Nation; and growing throughout the world. All classes are aspiring to a full human opportunity. Never before have civilization and humanization advanced so swiftly.

As the world presses eagerly forward toward the accomplishment of new things, education also must advance no less swiftly. It must provide the intelligence and the aspirations necessary for the advance; and for stability and consistency in holding the gains. Education must take a pace set, not by itself, but by social progress.

The present program of public education was mainly formulated during the simpler conditions of the nineteenth century. In details it has been improved. In fundamentals it is not greatly different. A program never designed for the present day has been inherited.

Any inherited system, good for its time, when held to after its day, hampers social progress. It is not enough that the system, fundamentally unchanged in plan and purpose, be improved in details. In education this has been done in conspicuous degree. Our schools today are better than ever before. Teachers are better trained. Supervision is more adequate. Buildings and equipment are enormously improved. Effective methods are being introduced, and time is being economized. Improvements are visible on every hand. And yet to do the nineteenth-century task better than it was then done is not necessarily to do the twentieth-century task.

New duties lie before us. And these require new methods, new materials, new vision. The old education, except as it conferred the tools of knowledge, was mainly devoted to filling the memory with facts. The new age is more in need of facts than the old; and of more facts; and it must find more effective methods of teaching them. But there are now other functions. Education is now to develop a type of wisdom that can grow only out of participation in the living experiences of men, and never out of mere memorization of verbal statements of facts. It must, therefore, train thought and judgment in connection with actual life-situations, a task distinctly different from the cloistral activities of the past. It is also to develop the goodwill, the spirit of service, the social valuations, sympathies, and attitudes of mind necessary for effective group-action where specialization has created endless interdependency. It has the function of training every citizen, man or woman, not for knowledge about citizenship, but for proficiency in citizenship;

not for knowledge about hygiene, but for proficiency in maintaining robust health; not for a mere knowledge of abstract science, but for proficiency in the use of ideas in the control of practical situations. Most of these are new tasks. In connection with each, much is now being done in all progressive school systems; but most of them yet are but partially developed. We have been developing knowledge, not function; the power to reproduce facts, rather than the powers to think and feel and will and act in vital relation to the world's life. Now we must look to these latter things as well.

Our task in this volume is to point out some of the new duties. We are to show why education must now undertake tasks that until recently were not considered needful; why new methods, new materials, and new types of experience must be employed. We here try to develop a point of view that seems to be needed by practical school men and women as they make the educational adjustments now demanded by social conditions; and needed also by scientific workers who are seeking to define with accuracy the objectives of education. It is the feeling of the writer that in the social reconstructions of the post-war years that lie just ahead of us, education is to be called upon to bear a hitherto undreamed-of burden of responsibility; and to undertake unaccustomed labors. To present some of the theory needed for the curriculum labors of this new age has been the task herein attempted.

This is a first book in a field that until recently has been too little cultivated. For a long time, we have been developing the theory of educational method, both general and special; and we have required teachers and supervisors to be thoroughly cognizant of it. Recently, however, we have discerned that there is a theory of curriculum-formulation that is no less extensive and involved than that of method; and that it is just as much needed by teachers and supervisors. To know what to do is as important as to know how to do it. This volume, therefore, is designed for teacher-training institutions as an introductory textbook in the theory of the curriculum; and for reading circles in the training of teachers in service. It is hoped also that it may assist the general reader who is interested in noting recent educational tendencies.

The technique of curriculum-making along scientific lines has been but little developed. The controlling purposes of education have not been sufficiently particularized. We have aimed at a vague culture, an ill-defined discipline, a nebulous harmonious development of the individual, an indefinite moral character-building, an unparticularized social efficiency, or, often enough nothing more than escape from a life of work. Often there are no controlling purposes; the momentum of the educational machine keeps it running. So long as objectives are but vague guesses, or not even that, there can be no demand for anything but vague guesses as to means and procedure. But the era of contentment with large, undefined purposes is rapidly passing. An age of science is demanding exactness and particularity.

The technique of scientific method is at present being developed for every important aspect of education. Experimental laboratories and schools are discovering accurate methods of measuring and evaluating different types of educational processes. Bureaus of educational measurement are discovering scientific methods of analyzing results, of diagnosing specific situations, and of prescribing remedies. Scientific method is being applied to the fields of budget-making, child-accounting, systems of grading and promotion, etc.

The curriculum, however, is a primordial factor. If it is wrongly drawn up on the basis merely of guess and personal opinion, all of the science in the world applied to the factors above enumerated will not make the work efficient. The scientific task preceding all

others is the determination of the curriculum. For this we need a scientific technique. At present this is being rapidly developed in connection with various fields of training.

The central theory is simple. Human life, however varied, consists in the performance of specific activities. Education that prepares for life is one that prepares definitely and adequately for these specific activities. However numerous and diverse they may be for any social class, they can be discovered. This requires only that one go out into the world of affairs and discover the particulars of which these affairs consist. These will show the abilities, attitudes, habits, appreciations, and forms of knowledge that men need. These will be the objectives of the curriculum. They will be numerous, definite, and particularized. The curriculum will then be that series of experiences which children and youth must have by way of attaining those objectives.

The word *curriculum* is Latin for a *race-course*, or the *race* itself—a place of deeds, or a series of deeds. As applied to education, it is that *series of things which children and youth must do and experience* by way of developing abilities to do the things well that make up the affairs of adult life; and to be in all respects what adults should be.

The developmental experiences exist upon two levels. On the one hand, there is the general experience of living the community life, without thought of the training values. In this way, through participation, one gets much of his education for participation in community life. In many things this provides most of the training; and in all essential things, much of it. But in all fields, this incidental or undirected developmental experience leaves the training imperfect. It is necessary, therefore, to supplement it with the conscious directed training of systematized education. The first level we shall call undirected training; and the second, directed training.

The curriculum may, therefore, be defined in two ways: (1) it is the entire range of experiences, both undirected and directed, concerned in unfolding the abilities of the individual; or (2) it is the series of consciously directed training experiences that the schools use for completing and perfecting the unfoldment. Our profession uses the term usually in the latter sense. But as education is coming more and more to be seen as a thing of experiences, and as the work- and play-experiences of general community life are being more and more utilized, the line of demarcation between directed and undirected training experience is rapidly disappearing. Education must be concerned with both, even though it does not direct both.

When the curriculum is defined as including both directed and undirected experiences, then its objectives are the total range of human abilities, habits, systems of knowledge, etc., that one should possess. These will be discovered by analytic survey. The curriculum-discoverer will first be an analyst of human nature and of human affairs. His task at this point is not at all concerned with "the studies"—later he will draw up appropriate studies as *means*, but he will not analyze the tools to be used in a piece of work as a mode of discovering the objectives of that work. His first task rather, in ascertaining the education appropriate for any special class, is to discover the total range of habits, skills, abilities, forms of thought, valuations, ambitions, etc., that its members need for the effective performance of their vocational labors; likewise, the total range needed for their civic activities; their health activities; their recreations; their language; their parental, religious, and general social activities. The program of analysis will be no narrow one. It will be wide as life itself. As it thus finds all the things that make up the mosaic of full-formed human life, it discovers the full range of educational objectives.

Notwithstanding the fact that many of these objectives are attained without conscious

effort, the curriculum-discoverer must have all of them before him for his labors. Even though the scholastic curriculum will not find it necessary to aim at all of them, it is the function of education to see that all of them are attained. Only as he looks to the entire series can he discover the ones that require conscious effort. He will be content to let as much as possible be taken care of through undirected experiences. Indeed he will strive for such conditions that a maximum amount of the training can be so taken care of.

The curriculum of the schools will aim at those objectives that are not sufficiently attained as a result of the general undirected experience. This is to recognize that the total range of specific educational objectives breaks up into two sets: one, those arrived at through one's general experiences without his taking thought as to the training; the other, those that are imperfectly or not at all attained through such general experience. The latter are revealed, and distinguished from the former, by the presence of imperfections, errors, shortcomings. Like the symptoms of disease, these point unerringly to those objectives that require the systematized labors of directed training. Deficiencies point to the ends of conscious education. As the specific objectives upon which education is to be focused are thus pointed out, we are shown where the curriculum of the directed training is to be developed.

Let us illustrate. One of the most important things in which one is to be trained is the effective use of the mother-tongue. It is possible to analyze one's language activities and find all of the things one must do in effectively and correctly using it. Each of these things then becomes an objective of the training. But it is not necessary consciously to train for each of them. Let an individual grow up in a cultivated language-atmosphere, and he will learn to do, and be sufficiently practiced in doing, most of them, without any directed training. Here and there he will make mistakes. *Each mistake is a call for directed training.*

The curriculum of the directed training is to be discovered in the shortcomings of individuals after they have had all that can be given by the undirected training. This principle is recognized in the recent work of many investigators as to the curriculum of grammar. One of the earliest studies was that of Professor Charters.¹ Under his direction, the teachers of Kansas City undertook to discover the errors made by pupils in their oral and written language. For the oral errors the teachers carried notebooks for five days of one week and jotted down every grammatical error which they heard made by any pupil at any time during the day. For the errors in writing they examined the written work of the pupils for a period of three weeks. They discovered twenty-one types of errors in the oral speech and twenty-seven types in the written. The oral errors in the order of their frequency were as follows:—

1. Confusion of past tense and past participle	24
2. Failure of verb to agree with its subject in number and person	14
3. Wrong verb	12
4. Double negative	11
5. Syntactical redundancy	10
6. Wrong sentence form	5
7. Confusion of adjectives and adverbs	4
8. Subject of verb not in nominative case	4
9. Confusion of demonstrative adjective with personal pronoun	3
10. Predicate nominative not in nominative case	2
11. First personal pronoun standing first in a series	2

12. Wrong form of noun or pronoun	2
13. Confusion of past and present tenses	2
14. Object of verb or preposition not in the objective case	1
15. Wrong part of speech due to a similarity of sound	1
16. Incorrect comparison of adjectives	1
17. Failure of the pronoun to agree with its antecedent	0.3
18. Incorrect use of mood	0.3
19. Misplaced modifier	0.3
20. Confusion of preposition and conjunction	0.2
21. Confusion of comparatives and superlatives	0.1

Each error discovered is a symptom of grammatical ignorance, wrong habit, imperfect valuation, or careless attitude toward one's language. The nature of the deficiency points to the abilities and dispositions that are to be developed in the child by way of bringing about the use of the correct forms. Each grammatical shortcoming discovered, therefore, points to a needed objective of education. It points to a development of knowledge or attitude which the general undirected language experience has not sufficiently accomplished; and which must therefore be consciously undertaken by the schools.

Scientific method must consider both levels of the grammar curriculum. One task is to provide at the school as much as possible of a cultivated language-atmosphere in which the children can live and receive unconscious training. This is really the task of major importance, and provides the type of experience that should accomplish an ever-increasing proportion of the training. The other task is to make children conscious of their errors, to teach the grammar needed for correction or prevention, and to bring the children to put their grammatical knowledge to work in eliminating the errors. In proportion as the other type of experience is increased, this conscious training will play a diminishing role.

In the spelling field, Ayres, Jones, Cook and O'Shea, and others have been tabulating the words that children and adults use in writing letters, reports, compositions, etc. In this way they have been discovering the particularized objectives of training in spelling. But words are of unequal difficulty. Most are learned in the course of the reading and writing experience of the children without much conscious attention to the spelling. But here and there are words that are not so learned. Investigations, therefore, lay special emphasis upon the words that are misspelled. Each misspelled word reveals a directed-curriculum task. Here, as in the grammar, error is the symptom of training need; and the complete error-list points unerringly to the curriculum of conscious training.

In the vocational field, and on the technical side only, Indianapolis has provided an excellent example of method of discovering the objectives of training. Investigators, without pre-suppositions as to content of vocational curriculum, set out to discover the major occupations of the city, the processes to be performed in each, and the knowledge, habits and skills needed for effective work. They talked with expert workmen; and observed the work-processes. In their report, for each occupation, they present: (1) a list of tools and machines with which a workman must be skillful; (2) a list of the materials used in the work with which workers need to be familiar; (3) a list of items of general knowledge needed concerning jobs and processes; (4) the kinds of mathematical operations actually employed in the work; (5) the items or portions of science needed for control of processes; (6) the elements of drawing and design actually used in the work; (7) the characteristics of the English needed where language is vitally

involved in one's work, as in commercial occupations; (8) elements of hygiene needed for keeping one's self up to the physical standards demanded by the work; and (9) the needed facts of economics.

Many of the things listed in such a survey are learned through incidental experience. Others cannot be sufficiently learned in this way. It is by putting the workers to work, whether adolescent or adult, and by noting the kinds of shortcomings and mistakes that show themselves when training is absent or deficient, that we can discover the curriculum tasks for directed vocational education.

The objectives of education are not to be discovered within just any kind or quality of human affairs. Occupational, civic, sanitary, or other activity may be poorly performed and productive of only meager results. At the other end of the scale are types of activity that are as well performed as it is in human nature to perform them, and which are abundantly fruitful in good results. Education is established upon the presumption that human activities exist upon different levels of quality or efficiency; that performance of low character is not good; that it can be eliminated through training; and that only the best or at least the best attainable is good enough. Whether in agriculture, building-trades, housekeeping, commerce, civic regulation, sanitation, or any other, education presumes that the best that is practicable is what ought to be. Education is to keep its feet squarely upon the earth; but this does not require that it aim lower than the highest that is practicable.

Let us take a concrete illustration. The curriculum-discoverer wishes, for example, to draw up a course of training in agriculture. He will go out into the practical world of agriculture as the only place that can reveal the objectives of agricultural education. He will start out without prejudgment as to the specific objectives. All that he needs for the work is pencil, notebook, and a discerning intelligence. He will observe the work of farmers; he will talk with them about all aspects of their work; and he will read reliable accounts which give insight into their activities. From these sources he will discover the particular things that the farmers do in carrying on each piece of work; the specific knowledge which the farmers employ in planning and performing each specific task; the kinds of judgments at which they must arrive; the types of problems they must solve; the habits and skills demanded by the tasks; the attitudes of mind, appreciations, valuations, ambitions, and desires, which motivate and exercise general control.

Facts upon all of these matters can be obtained from a survey of any agricultural region, however primitive or backward. But primitive agriculture is the thing which exists without any education. It is the thing education is to eliminate. The curriculum-discoverer, therefore, will not investigate just any agricultural situation. He will go to the farms that are most productive and most successful from every legitimate point of view. These will often be experimental or demonstration farms which represent what is practicable for the community, but which may not be typical of actual practices in that community. Where such general practices are inferior, agricultural education is to aim not at what is but at what ought to be.

When the farming practices are already upon a high plane, education has but a single function: it is to hand over these practices unchanged to the members of the new generation.

Where the practices of a region are primitive or backward, education has a double function to perform. It is not only to hand over to the new generation a proficiency that is equal to that of their fathers, but it is also to lift the proficiency of the sons to a height much beyond that of their fathers. Within such a region, therefore, agricultural

education has the additional function of serving as the fundamental social agency of agricultural progress.

What we have said concerning agriculture is generally applicable throughout the occupational world. For discovering the objectives for a training course in bricklaying one will analyze not the activities of bricklayers in general, but those where bricklaying has been carried to its highest practicable level of efficiency—as this efficiency is judged on the basis of all legitimate standards. Education will aim, not at average bricklayers, but at the best types of bricklayers.

When stated in broad outline, the general principle is obvious. In practical application, it presents difficulties. Men do not agree as to the characteristics of the most desirable types of work. The employers of the bricklayers will be inclined to use maximum productiveness as the criterion of superior work; and unquestioning obedience to orders and contentment with any kind of hours, wages, and working conditions as proper mental attitudes. The employees will judge otherwise as to some of the factors. The employers will invite the curriculum-discoverer to investigate situations where productiveness in proportion to costs is greatest; the employees, where the total welfare of the worker is considered alongside of the factor of productiveness. Both sides will agree that education should aim at the best and that scientific investigations as to objectives should seek to discover the characteristics of only the best. They disagree as to what is the best, and therefore where the investigations are to be made.

The general principle of finding the scholastic curriculum in the shortcomings of children and men is quite obvious and entirely familiar to teachers in its application to the curriculum of spelling, grammar, and other subjects that result in objective performance, such as pronunciation, drawing, music, computation, etc. It is not so clear in connection with the highly complex subjects of history, literature, geography, etc. What are the social shortcomings that are to be eliminated through a study of these social subjects? Our ideas are yet so vague, in most cases, that we can scarcely be said to have objectives. The first task of the scientific curriculum-maker is the discovery of those social deficiencies that result from a lack of historical, literary, and geographical experiences. Each deficiency found is a call for directed training; it points to an objective that is to be set up for conscious training. The nature of the objectives will point to the curriculum materials to be selected for these subjects. A major obstacle is lack of agreement as to what constitutes social deficiency. There is however no justification for scholastic training of any kind except as a gap exists between the training of general experience and the training that ought to be accomplished.

Society agrees sufficiently well as to many social shortcomings. Education needs to assemble them in as accurate and particularized a form as possible. They can then be used as the social symptoms which point to the objectives of history, literature, geography, economics, and other social studies. Society will disagree as to many suggested deficiencies. A program can be scientific, however, without being complete. The thousand spelling words presented by Mr. Ayres is a good list notwithstanding the fact that it presents not more than a quarter of the words needed. It is a secure beginning that can be completed by further studies. In the same way in our social training, we shall do very well if we can set up a quarter of the desirable objectives. That would be a great advance over none at all, as at present; and would provide the nucleus, the technique, and the vision of possibilities necessary for gradually rounding out the list.

The principle involves us in similar difficulties in its application to civic, moral, vocational, sanitational, recreational, and parental education. It is equally valid, however, in

connection with each of these. Only as we agree upon *what ought to be* in each of these difficult fields, can we know at what the training should aim. Only as we list the errors and shortcomings of human performance in each of the fields can we know what to include and to emphasize in the directed curriculum of the schools.

Note

1. Charters, W. W., and Miller, Edith. A Course of Study in Grammar based upon the Grammatical Errors of School Children in Kansas City, Missouri. University of Missouri, Education Bulletin, no. 9.