Engineering Theory: A Conversational Bridge Between Theoreticians and Practitioners in Discussion of Curriculum Development and Dissemination as Used in the *DASH* Program

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ABSTRACT

This paper advances the thesis that the barrier separating curriculum theorists and practitioners is more than a difference in experiential and methodological orientation and is in part a product of a lack of appreciation of the complexities involved in curriculum development and dissemination. Discussed here is the possible use of engineering theory to facilitate meaningful communication and understanding about products and development. This work is an extension of the observation that curriculum development and dissemination can be characterized as an engineering process and shows how engineering theory provides connectivity between the multiple embedded domains of theory and of practice. To illustrate the thesis this paper offers an analysis of the *Developmental Approaches in Science, Health, and Technology (DASH)* program that has employed engineering theory in curriculum construction and dissemination. In this study, the role and place of engineering theory as applied to the *DASH* program is discussed to show how the components were designed and assembled into a fully functional curriculum and dissemination system. Engineering theory is presented as an interfacing organizer with the potential to facilitate meaningful communication between theorists and practitioners.

Key words: engineering theory, curriculum development, and dissemination

I. Introduction

Though the idea of theory guiding practice is given much lip service in education and science education in particular, theoretical discussion of curriculum is spare in its considerations of practical application. Not unexpectedly, practical discussions of curriculum only superficially consider theoretical relationships. Conversational barriers between theory and practice seem to be a natural outgrowth of the experience of theorists and practitioners. Most people involved with curriculum, including those who write science programs, draw their insights from personal work with students and the literature of practice. Theoretic models when employed become unchallenged mantras. Theorists have difficulty fully making the connection with practice because their methods of inquiry lend themselves more to abstract generalizations and less to

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the detail of practical matters. Teachers, principals, and lay persons generally view theory as hallowed or impractical and seldom know how to make it useful (Ornstein & Hunkins, 1998; Son, Pottenger, Lee & Chung, 1999; Son, Pottenger, King, Young & Choi, 2001). This despite the asserted power of theory (Bruner, 1977).

It is suggested here that the barriers in discussion between theorists and practitioners of curriculum development and dissemination are more than a difference in experiential and methodological orientation of explainers and users. It is suggested that to some considerable measure barriers are the products of a lack of appreciation by both theorists and practitioners of the complex of interactive involvement of theory, research, lore, and experience in the development and operation of a curriculum system, and it is suggested that conceptual and methodological tools that can meaningfully connect the several realms of curriculum theory and practice exist in an engineering theory. To illuminate this thesis, this paper offers an analysis of a curriculum system that has intentionally employed engineering methodologies and theory to guide developmental use of philosophy, research, practice, and multiple theories from diverse disciplines. The curriculum is the nationally disseminated and much recognized K-6 *Developmental Approaches in Science, Health, and Technology (DASH)* program produced by the Curriculum Research & Development Group (CRDG) at the University of Hawaii. The program has been field tested and localized in over 1,500 elementary schools in conjunction with the University of Hawaii and Eastern Washington University, Carnegie Mellon University, Shippensburg University, East Carolina University, Florida Atlantic University, the University of North Alabama, and Louisiana State University. Some 9,000 teachers in 38 states in the United States are using *DASH* (CRDG, 1998a; CRDG, 2000).

This paper explores the design process and how the DASH components were assembled into a fully functional system guided by a curriculum engineering theory. It is the argument of this paper that curriculum engineering theory can provide insights into the complexities of the contributions of component theory as well as research, lore, and experience evident in a curriculum system and that engineering theory can be used as a bridge to more effective conversation between curriculum theorists and practitioners.

Ⅱ. Curriculum Engineering Theory

The claim has long been made that creating and maintaining a curriculum system is an engineering enterprise. In America this claim has relatively deep roots extending back to F. W. Taylor's 1911 "principles of scientific management" and F. Bobbitt's notions of "educational engineering" (Montgomery, 1994). From the beginning the observation has been that the steps in producing a curriculum system are very much the same as those for the production and maintenance of any new commodity, for example, a car. Basically they involve conceptualization, design, research, production, sales (dissemination), use (implementation), evaluative feedback to improve the next model (version), and maintenance. Carrying on this tradition, Beauchamp (1968) described curriculum engineering as development and maintenance and all process systems of the school's functions focusing on curriculum, instruction, and evaluation. This he called a "curriculum system." CRDG has endorsed Beauchamp's interpretation of curriculum engineering and extended the concept of curriculum system to include not only processes within schools but also processes of external curriculum research agencies such as CRDG and their development, dissemination, inservice maintenance, and evaluation of curricular materials for schools (Pottenger, 2000a).

The engineering theory reflected here is in the form of descriptive functional definitions whose operational constructs and assumptions are shaped by the knowledge and product- making processes common to technologies. Engineers as technologists take on tasks that bear on the well-being or perceived interests and pleasures of humans. Engineers use methods that are eclectic, imperial, product-oriented, and subject to satisficing evaluation. The term "satisficing" is taken from Herbert A. Simon (1999), who observed that technologists seldom get the yes-no response from evaluation of their products that natural scientists seek in their experiments but must settle for some degree of satisfaction of their intention, thus the term satisficing. Both the curriculum worker and the engineer confront reasonably well-defined problems, invent and design product solutions, construct products, test those products, modify products, and submit final products for public appraisal. The engineering approach to curriculum has great advantages: It encourages intellectual freedom, giving license to seek out and use functional parts of the several current philosophical, sociological, psychological, and pedagogical theories and techniques along with the lore of teaching (Pottenger, 2000b).

1. Curriculum Engineering Theory and Its Operational Domain

From the onset the comments on engineering theory came out of the experience of work done in a major curriculum research and design center, CRDG. At CRDG curriculum system engineering is applied in a curriculum research environment, and products are later disseminated to user schools. CRDG programs undergo first testing in a special curriculum research laboratory school and are then pilot tested in selected U.S. schools including schools in Hawaii. The components of the curriculum system described here are particular to the *DASH* project, and though most are found in other curricular systems, they have taken their particular shape under the engineering prerogatives of the *DASH* development group.

Engineering can be conceived as operating on the basis of an input-output model. In the case of curriculum engineering, the input components are kinds of knowledge, the processors are some forms of engineering, and the output components are products satisfying some need of the school pertaining to teaching students. Description of these components and processes can be generalized or particularized as needed. At this point a general description will suffice.

Knowledge-input components consist of
a. educational lore
b. educational experience
c. educational and other theory
d. educational research
e. educational and other constraints

Engineering processors consist of
a. considered engineering
b. action engineering

Product output components consist of
a. curriculum
b. teacher-training experience
c. trained teacher
d. lesson plans
e. student learning
f. administrative support

2. Knowledge Input Components

The generative capacity of a curriculum engineer is usually influenced by practical and formal knowledge experience. As a rule of thumb, the wider the experiential background of a curriculum engineer, the greater the probability of success in inventing and carrying out the task of curriculum systems development. A brief detailing of knowledge inputs is worthwhile.

Lore. The lore of education refers to those "every professional knows" bits of practical wisdom passed down and successfully used but for which there is little verifying research. These would include such things as wiping mud from shoes outside the classroom door keeps the classroom clean; every text has to have a book cover if it is to be usable next year; when reciting, have one child speak at a time; and many, many etceteras.

Personal experience. Much like lore, personal experience often gives deep insights into situations that have been thought through but never made part of the general knowledge of the profession. So-called "born" administrators and teachers often have this reflective quality and a reservoir of practical experience that makes them invaluable as inventors of the new and different.

Knowledge of theory. Knowledge of the theories of education, psychology, business, and other disciplines greatly increases the potential for inventive and critical contribution in the devising of a curriculum system. Knowledge alone, however, is insufficient to carry out the development agenda. It can only nurture inventive inspiration. As with other knowledge, the engineer must treat all theory with a degree of critical skepticism, and theoretic tenets must be tested for applied validity before being fully accepted in contexts of application.

Knowledge of research. Like knowledge of theory, knowledge of research provides a catalog of techniques, behavioral responses, and other operational information that can be drawn on to give some surety to invention. As in the case of theory, research results too must be treated with a degree of skepticism until tested in a particular application

Constraints. The curriculum engineer at every step in the creation of a curriculum system must have in mind knowledge of the constraints that are imposed by forces outside of system and inside the system being created.

- Externally to schools and teachers served, there are the expectations of the sponsor groups funding the engineering enterprise, and these constraints are normally expressed in the explicit needs being addressed. Additional external constraints may be imposed by a wider community of advocates and critics.
- Internally, there are expectations of the clients in the schools who will implement the system. Constraints are found in assessment questions: What are the schools to be served like? Are they similar or diverse? What are the teachers and administrators in these schools like? Are they educationally up to the changes proposed? What are the students and parents like? Are they from urban ghetto, rural, middle-class suburban, a mix, or other?

3. Curriculum Engineering

Two relatively distinct genre of engineering processes are evident, the first can be characterized as being long-term *considered* and the second short-term *action* product engineering. Considered engineering is tangible product oriented, producing teacher guides, textual materials, trainer manuals, and so forth. Action engineering is oriented to maintenance and immediate response to demand situations. Curriculum engineering is basically a linear process, though several parties working together may operate in parallel.

Considered curriculum engineering

Considered curriculum engineering follows the general sequence of process that is associated with other product-oriented technologies. Generation normally flows something like this:

a. identify curriculum systems task or need
b. invent response
c. design reification of the invention
d. create reification of the invention
e. design test of reified invention
f. test reified invention
g. determine the degree of satisficing revealed by test
h. decide to abandon, modify, or use reified invention

Be it noted that the ideal linear rigor suggested is most often abandoned in favor of a freer, less formal movement between various steps. For example, an invention may immediately be tested verbally with a colleague or in the case of science activity, at the laboratory bench.

Task identification. This is a wide-ranging operation often resulting from federal or state initiatives, more rarely from district, school, or teacher initiatives. In the case of *DASH*, initial task identification resulted in a federally identified need for improved elementary science curricula. Speaking from this base, the discussion in this paper will be most applicable to funded responses to federal and state originations requests for curriculum. Task identification remains the first step in all engineering-What needs to be done?

Invention. Invention is the central activity of all curriculum systems development. It is the creative part that brings the new into being. Without it there is no challenge or alternative to that which is now. In curriculum engineering, invention is ongoing and a part of every step of development of a curriculum system. There are few momentous breakthroughs and many slight modifications of things that have long residency in older systems. In the reality of creating a curriculum system, reorganization of existing components is often the prime invention.

Curriculum engineering theory encourages eclecticism, drawing insights for invention from existing and diverse bodies of knowledge, including various disciplinary and applied theories, research, professional lore, personal experience, hunches, and functional expediency or convenience. From the beginning the engineer must treat all knowledge inputs with a measure of skepticism. The proof of their validity or usability must be found in successful function in the product created-Does it work? That which worked elsewhere may not work here. When theory or research is found wanting, it should be eliminated without concern for explanation unless the program is founded in them. An invention must work to the satisfaction of the inventor and sponsoring and using publics.

Design and constraints. Every step in the engineering process will have background noise of constraints, and these are most often satisfied at the design step, be they financial, philosophical, theoretic, or stipulated characteristics of some population served. Design is a formal step taken to prepare and mold an invention for testing. The product of design is the blueprint of what is to be reified in a testable form, whether it is an experiment, a procedure, a written text, or other.

Products. First products flowing out of a design are ideally tentative in nature, and though advanced as adequate will undergo either intentional or unintentional testing at the time of their first use. Several comments need be made about products:

- For reasons of economy (time, money, or other) there is a temptation to cut off the engineering process at the first product stage. This is a common practice in textbook preparation.
- In the early development of products, a very fruitful procedure is to go directly from invention to product making and testing, skipping the intricacies of formatting and other niceties of the design phase. This allows quick exploration of ideas with peers or students before a potential product is endowed with the refinement of design.

Test design. Considerable attention must be put into testing of products. Formative, qualitative testing normally provides the most information during the early stages of development and is best done using persons well acquainted with the product under test. A first formative testing should be designed as a search for trends and feasibilities rather than full-measure satisficing. This was the procedure used in *DASH*. A mature and refined product is normally subject to more rigorous quantitative or qualitative summative-type testing, and this is often designed and carried out by some agency outside the curriculum engineering group.

Testing. Again, first use of an engineered product be it a sub-component or major component of instructional materials, instructional delivery, professional development, or other is ideally tentative and done as a preliminary field test. Formulative evaluation commissioned or done by a development group allows for modification and refinement of product. Some form of a concluding summative evaluation cannot, however, be avoided. Such evaluation will either be designed or contributed to by developing engineers or will come solely out of cumulative responses from users when the curriculum system is openly disseminated. *DASH* has used formal summative and consumer evaluation to judge its product.

Progress decision. Once testing has been done, sponsors, engineers, or others must make the decision whether a product should be used as is, modified, or abandoned.

Action engineering

Action engineering has two manifestations, preinitiated and responsive as illustrated by two different functions of railway maintenance. Preinitiated action engineering is seen in the routines of the railroad traffic engineer who directs the proper routing of trains over a known routing system, attending to simple impediments. Responsive action engineering is seen in the immediate response action that a civil engineer takes in restoring traffic around a flood-broken causeway. Actors in a curriculum system may play both engineering roles and must be prepared to do so.

Preinitiate action and responsive action. Preinitiated action engineering involves carrying out a plan through various vicissitudes. For example, it can flow out of the suggestions in an administrator's guide for presenting the design of a new curriculum to parents or suggestions in a teacher's guide for a lesson plan. Responsive action engineering is part of the inventive involvement of persons in situations that must be quickly attended to. Both processes are linear in structure and call on lore, experience, and previously provided formulations. Both forms of action engineering have the same generally structure though where the steps are spontaneous, they must be captured in ultra-slow motion to be observed. The sequence goes something like this:

a. identify task
b. invent response
c. create reification of the invention
d. test reified invention

Identifying task. In the case of preinitiated action illustrated in the guided conference or lesson plan, the task is preidentified and actions move with anticipated progression. Responsive actions are normally uncomplicated and may be inaugurated by a simple question, improper use of equipment, a need for information, and so forth. These are things that have dimensions that are not anticipated in the normal production of a product but can be prepared for in teacher training.

Invented response. Invention in preinitiated action involves seeing that the plan is maintained and not derailed. In the case of responsive action engineering, the teacher or administrator must invent a quick if not immediate response to the situation. The sources drawn upon in invention are once again lore, experience, the insights developed in training, and knowledge of products that are in use. Responsive actions seldom draw on theory or research since responses are normally informed by prior instruction in use of a program or a personal repertoire of experience.

Create reified invention. Reified invention is the delivery step of both forms of action. Note that in the responsive mode the invented response may institute further interaction needing repeated response.

Test reification. Testing of preinitiated action is seen in the completion of a plan of action. In responsive action, testing may be as simple as judging the adequacy of verbal response of a student, teacher, or other interactor. It may involve observing some product or action such as a report, plan, and so forth produced as a result of an interaction.

4. Product Outputs

Product outputs of the curriculum system satisfy the needs that drove their creation. All needs evolve out of the assumed needs of the ultimate client student learner. The products listed here are large-scale products that factor out into smaller components in the building of a system.

Needs statement. The first step in all engineering is to identify needs that the engineer is attempting to satisfy. Large funded curriculum systems design project start out with a sponsor's identification of global needs. It is up to the project engineer to redefine these in particular needs statements.

Curriculum. "Curriculum" as used throughout the paper is the component in the larger curriculum system housing the instructions for classroom delivery of programs and for information repositories (texts, videos, graphic materials, and other visuals, computer materials, and so forth) that collectively are used to develop learning experiences.

Teacher training. Necessary to a full curriculum system such as *DASH* is a teacher-training component that produces the experience for effective execution and delivery of the specifications of the curriculum. This is a component seldom included as part of the more common textbook systems.

Trained teacher. The teacher-training component augments teachers' existing experiences, enabling them to carry out the intent of a program. The capacities of trained teachers to carry out preinitiated and responsive action engineering are markedly enhanced.

Lesson plans. It is at the point when lesson plans are being constructed that the engineering system passes into the hands of the trained teacher. The lesson plan is an invented creation of the teacher influenced by personal bodies of lore, experience including the training experience of the curriculum, and the materials of the curriculum. It must be adjusted to the evident characteristics of a particular group of learners. It is normally created using a combination of preinitiated and response engineering.

Student learning. At the heart of all needs around which a curriculum system is created is some improvement in student learning; therefore, student learning is the ultimate product of the system.

Administrative support. Administrators are essential to the external and internal functioning of curriculum. They are the first interface between parents, boards of education, the media, and others. They are the determiners as to who is involved in curriculum and who controls vital purse strings. Attention to their needs is vital to the success any curriculum system. For this reason in the *DASH* curriculum system a separate administrative guide is provided, and administrators ideally take training with their teacher staffs.

5. The dynamics of the engineering system in use

Components of the *DASH* curriculum system are hierarchical in structure and operation. The following schema show the hierarchical engineering development of the output products in the *DASH* curriculum system. The first illustrates the vertical engineering of the curriculum as a product and the derivative products necessary to achieve the ultimate end product, student learning (See Fig. 1). The second shows the separate engineering of the administrative support component (See Fig. 2).

Ⅲ. The Thesis

It was proposed in the beginning of this paper that a kind of barrier exists between educational theorists and practitioners of curriculum development and use and that this is includes difference in experiential and methodological orientation. But, it is also suggested that to some considerable degree this barrier is a product of a lack of appreciation by both theorists and practitioners of the complexities resulting from the multiple influences of theory, research, lore, and experience in the development and operation of a curriculum system. It was further suggested that understanding of the way engineering theory is applied may provide a conversational bridge between practitioners and theorists.

1. Difference of methodologies

The first assumption, difference in methodologies, has face validity. Theorists seek to describe and explain their domains of interest so that predictions are possible. Educational practitioners as engineers seek to operate in their domain to make a product work as they desire. Theorists look at what is and try to predict what will be according to some set of principles. The outcomes are different but certainly mutually useful.

2. Difference of experience

The second assumption of difference in experience, too, has a kind of face validity. Educational engineer-practitioners spend their time working to make things happen in a desired

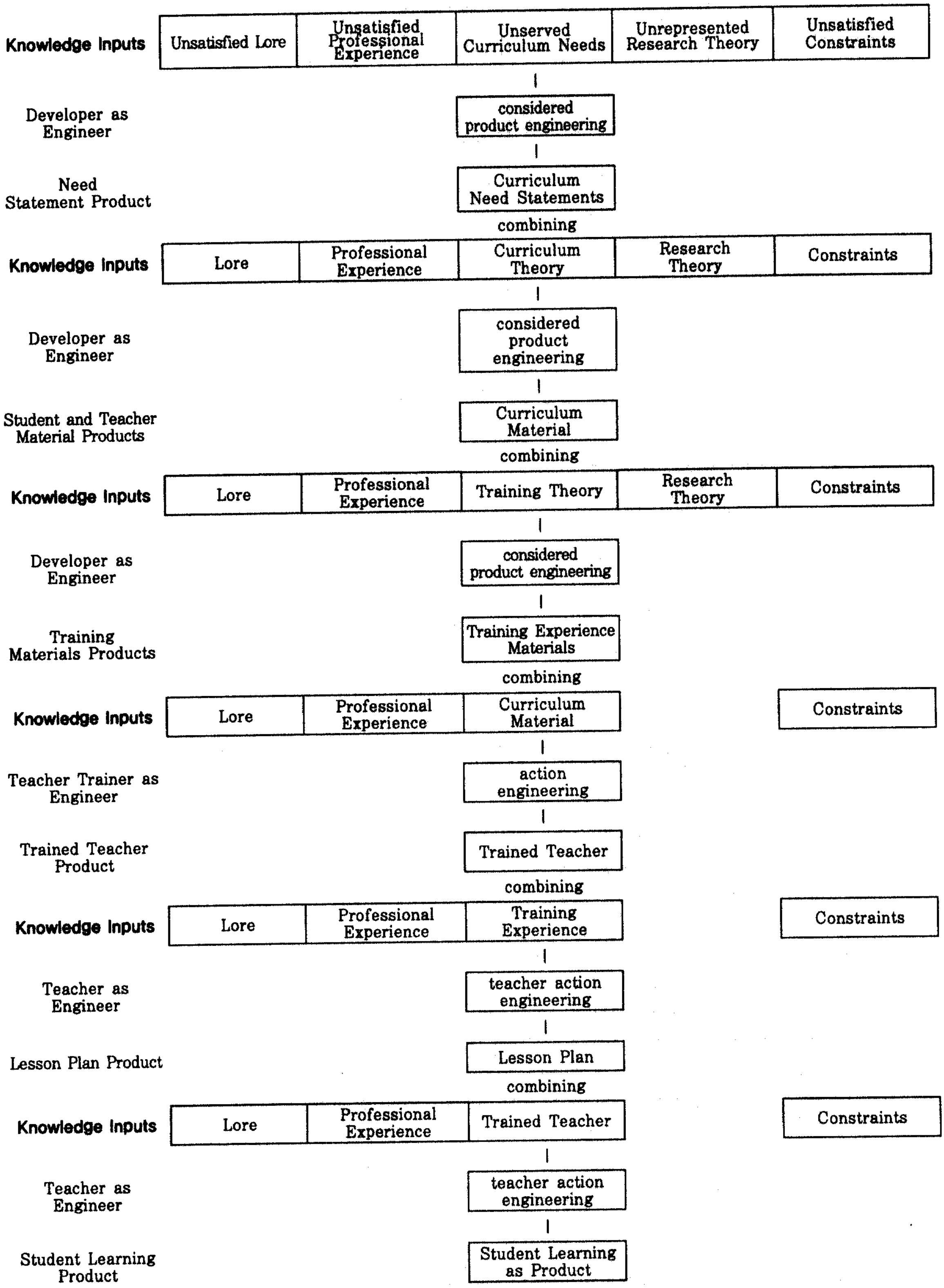

Fig. 1. Engineering schema for the *DASH* curriculum material component

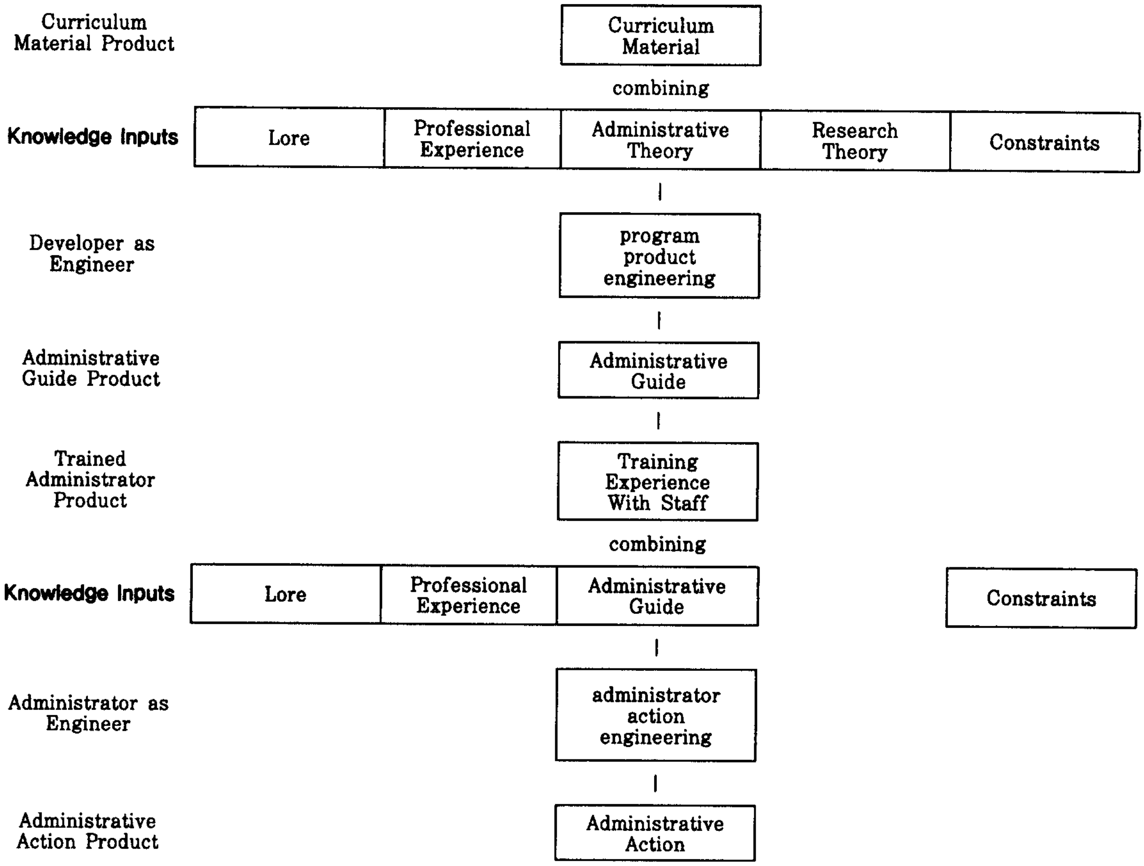

Fig. 2. Engineering schema for development of administrative support

way, using their existing understanding and the understanding of others to bring about some desired change. Theorists operate to create new understanding out of past experience. Though different, the two endpoints are complementary and should command mutual interest.

3. Complexity of an engineered curriculum system

This leads to the assumption that there is need for a better grasp on the part of both theorists and practitioners of what their roles in engineering of a curriculum are and where in the engineering process there are strong links of understanding and where those links are weak or fail. Strong links are seen in exploring elements of the engineering of the DASH curriculum.

Needs. The *DASH* project was initiated in the 1980s in response to a federally identified need to strengthen the nation's elementary science education. The expanded needs statement that would guide work on *DASH* included the following:

> [*DASH* should give] . . . authentic science and technology experiences that [can] be fabricated and maintained in the [elementary] classroom using inexpensive, readily available materials . . . and

> [be] appealing to and [be] accessible to both female and male students of all ethnic and socio-economic groupings; assuring the fidelity of delivery of program through teacher training; and integrating and articulating [its] content with other school subjects(CRDG, 1998a; CRDG, 2000).

This was a rich and stimulating statement, the stuff needed to activate a group of eager curriculum engineers. However, this enthusiasm was more likely to be shared by historians of science education than theorists. It is an engineering needs statement, not a statement of a theoretical research problem.

A beginning interface with disciplinary theory can be seen the first assemblage of content as suggested by the needs statement:

> Content was drawn from the physical, biological, earth and space science; medicine, public health, and nutrition; and technologies, including agriculture, engineering, urban planning, transportation, and communication (CRDG, 1998a).

The influence of Spencerian recapitulation theory (Kuhn, 1977; Spencer, 1860; Pottenger, 1996) begins to emerge at this point with the content selection of basic technologies (agriculture, food preparation, simple engineering) and natural sciences for first development.

Organizational invention. The first evidence of organizational invention occurs as health study is combined with biological science to gain additional space in the instructional day:

> It makes no theoretic or practical sense to teach (health and science) as separate subjects. In fact, to continue the practice of teaching science and health as separate subjects in the elementary curriculum leads only to wasteful redundancy and confusion about our biological nature (CRDG, 1998d; CRDG, 1998e).

Learning/theory-derived inventions. The strong influence of reinforcement in learning theory (Hunter, 1987) is found in special invention of reinforcing tools:

> *DASH* encourages the daily keeping of records of things studied, connections made, questions unanswered and answered, and definitions developed. There are special devices to support record keeping, including the Learning Calendar, a daily log of things observed and things studied usually kept on a continuous roll of paper. Other devices include a Working Dictionary for evolving definitions, a Wonder and Discover Book for interesting questions, and a Connections Book (CRDG, 1999).

Developmental theory. Another set of theoretic influences identified is seen in the building of materials that satisfy the developmental needs of children:

> An important organizing structure is taken from the spiral curriculum idea popularized by Jerome Bruner (1977). Bruner, adapting Piaget(1969)'s ideas on cognitive development, argued that concepts are internalized or represented in different models by children at different ages and,

> therefore, must be taught with increasing sophistication at different educational levels (CRDG, 1998b; CRDG, 1998c; Matthews, 1998).

Teacher training. The engineering of the *DASH* teacher-training component gets at the engineering:

> The *DASH* teacher intensive, program-specific training prior to implementation. This training is designed to provide hands-on experience with teachers becoming learners. Teachers go through each grade-level activity. This allows modeling of desired techniques and discussion of the teaching strategies (CRDG, 1998d).

This structuring came out of many years of CRDG experience in teacher training and is fully backed by the theoretical community (Fullan, 1997).

Engineering the classroom. We find that the DASH teacher' s engineering of the classroom to allow students to live the life of science and technology. This is a time-honored idea enshrined in Dewey' s theory (Dewey, 1899):

> The children in *DASH* take the roles of scientists, health workers, and technologists learning about and using fundamental ideas. Content focus is on the basics of today' s disciplines (CRDG, 2000).

4. Analysis of the engineering hierarchy

This foregoing analysis has been undertaken to point up the strong of influence of theory and other consideration in the engineering of *DASH.* Analysis shows that in the hierarchical operation of engineering the components of the *DASH* curriculum system there is an ever decreasing reliance on theory and research by practitioners as the curricular products with which they work are further removed from the work of developers and become more focused on the direct needs of operations in the classroom. Systems engineers are far more theory-oriented than teacher trainers, who in turn are more theory-oriented than teachers. Note that administrators are about as theory-knowledgeable as teachers. The final object of all the labors of these engineers is students' learning, yet students are almost completely unaware of a connection between theory and what they are learning. Maybe it is because we seldom share educational theory with students that they enter adulthood with little understanding of the curriculum enterprise.

Curriculum engineers. Looking at the development of the full curriculum system, it is those engineers who do the development of the curriculum who must be aware of the scope of the inputs in the many products to be produced. The successful developer will normally be able to discuss the basics of impinging theory and research with those versed in theory and research and outline the influence on an impending curricular product. As long as the first-level developers are involved, conversation between practitioners and theorists can be open and fluent.

Teachers, trainers, and administrators as engineers. Once the engineering is passed on to others-trainers, administrators, and teachers-there is a diminished reference to theory because the focus is on personal action engineering of the product curriculum for use with learners and the public. The delivery of the program is the focus of the trainer who leads a teacher through the exemplary preinitiated engineering process, and it is the focus of the teachers who must engineer lesson plans and engage in action engineering as they work with learners. It is the focus of the administrator who must rationalize the operations of the school with its many publics. The primary residuum of the influence of theory and research is found in trainer and teacher guides and vague memories of mention of theory in training sessions.

At the administrator, teacher-trainer, and teacher levels of operation of a curricular system, there is indeed a barrier to conversation. It is submitted that this barrier does not impede program delivery. In the *DASH* curriculum system, well-trained teachers can maintain a high level of functionality without their becoming engaged in any of the rich literature or any personal conversation with theorists. There are, however, many reasons to aspire to change this condition, including the simple observation that without theory we are much more likely to be trapped in the here and now. The linear diminution of the influence of theory and research shown in Figs. 1 and 2 includes reference to constraints. The great constraint imposed on all efforts to increase conversational fluency between theorists and practitioners is time. Provided the luxury of additional time, a well-developed curriculum such as *DASH* has the potential through its embedded linkages, as dictated by engineering theory, to start to bridge the conversational barrier.

It is also submitted that comprehension of the larger set of connected curriculum engineering processes of considered and action engineering would provide new bridges to the exciting world of the operating curriculum for theorist. Greater appreciation of engineering in curriculum systems may move theorists to more inclusively reach out to practitioners.

Ⅳ. Conclusions

This paper advances the thesis that an evident conversational barrier between educational practitioners and theorists regarding curriculum does exist and that this barrier is an outgrowth in differences in methodological approaches and experience and a probable lack of appreciation on the part of both parties for the complexity of the operations of the curriculum system in which practitioners labor. Using the *DASH* program as point of study, analysis suggested by engineering theory shows a diminishing influence of theoretic knowledge as a constructed curriculum passes from developer to trainer to teacher and administrator. This diminution can be traced to the knowledge support needed by different groups for practical inventions to carryout their work functions. The engineered inventions of developers are most influenced by theory from multiple disciplines, where teachers and administrators are markedly less influenced by theory and more reliant on training, experience, and lore. A curriculum such as *DASH* has many embedded theory constructs of which the teacher and administrator are only marginally aware. Recognizing the potential power of theoretic understanding in broadening the effectiveness of practitioners in their work, this analysis of curriculum engineering suggests that the theoretic grounding of well-developed curriculum offers a beginning bridging of the conversational barrier. Access to this bridging is a function of study, thus priority and time.

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