A SCIENCE PROJECT DIRECTOR REFLECTS ON CURRICULUM DEVELOPMENT AND DISSEMINATION

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The first generation of major science curriculum projects in the United States was begun in the mid-1950s and completed by the mid-1960s. As the first generation became the established programs of the schools, a new round of development began. These second-generation projects, started in the mid-1960s and going on to this day, were mainly directed to areas passed over in the first round. Such a one was the Foundational Approaches in Science Teaching (FAST) project, which was developed by the Curriculum Research and Development Group (CRDG) of the University of Hawaii. FAST undertook to provide curriculum materials for the neglected junior high school science program. As the project now nears completion, the reflections on the lessons of FAST offered here may be of interest to students of curriculum development trends and perhaps to those who embark on yet another round of development.

Background of FAST

FAST is a multidisciplinary, environmental science program which emphasizes foundational concepts of the biological, earth, and physical sciences and relates these to practical issues of human use of the environment. It is designed for use in grades 6 through 10. There are three sequential years of science in the program, labeled FAST 1, 2, and 3, to eliminate the stereotype of absolute grade level prescription. Some 65 percent of the students taking science in the public and private schools of Hawaii (about 12,000 students) use all or part of the FAST program.

The program is not a copy or a spin-off of earlier designs. Since its inception in 1967, much had been learned from the first-generation curricula that pointed to a new approach.

Three categories of differences set FAST off from its predecessors. First is its design and structure, which seek to capture within the classroom the community experience of the scientist.

Second is its style of development. FAST was completed in a single laboratory school setting where there was a constant interplay of theory and the reality of classroom trial. From 1967 to the present, the content of the program has been shaped and tested and reshaped in a continuous succession of laboratory school trials. The design, the ordering of experiments, the language, and the mathematics employed were all molded in this process. Materials were recrafted and retested from three to ten times before pilot testing.

Third, the field success of the program has rested in highly structured teacher training and intensive follow-up field support systems. A bit of history will clarify the discussion to come later.

By the summer of 1970, FAST 1 was ready for first pilot testing. Using a teacher-training grant from the National Science Foundation, 30 teachers, mostly from the Island of Oahu, were brought to the University of Hawaii and given six weeks of intensive training. The first training model included a complete hands-on trial of all experiments, and TV-monitored micro-teaching of experiments in the program. An extensive background lecture series was given in the areas of physics and ecology. During the course of the following year, bi-weekly feedback sessions were held to collect information for use in revision work. In addition, one staff member was assigned the task of acting as field liaison with the teachers, visiting classes on a weekly basis to detect program deficiencies and successes.

In 1971, as in the previous summer, a National Science Foundation Grant was used for FAST 2 teacher training. After grant money ran out, the project was forced to develop new dissemination techniques.

Austerity forced a trimming of our massive teacher-training model — fortunately, as it appears in retrospect. Over the next two summers, we successively pared the training from the
original six weeks to four, then to two weeks. Time economies were made by reducing the number of hands-on trials of experiments, by eliminating all micro-teaching in favor of role playing, and by dropping the content background lectures. The field visitation service, however, has been retained throughout the history of program dissemination. Much to our surprise, we found that we had been over-training our teachers, over-training in the sense that we had been providing them with more information than they could effectively assimilate in the course of a single summer, and more than was required to start the program successfully. This revelation reinforced a basic hypothesis that curricular change which accompanies development of new teaching skills is a long-term process requiring continued teacher involvement with people knowledgeable in a program.

Reflections on Development

With this background, we can contrast the FAST experience with early large-scale national curriculum development and dissemination efforts. Understanding the contrasts will in part explain how a major curriculum effort can be mounted on limited University resources without substantial inputs of funds from external sources.

Laboratory Development. The FAST project total developmental budget of $377,000 in a period of high inflation, contrasts markedly with the massive budgets of first-generation national science curriculum projects, which often ranged in the millions. A major factor in the cost of most first-generation programs was the large scope of initial piloting, since pilot testing served as the principal source of feedback for developmental revision. These projects sought a variety of test sites with large groups of teachers in diverse geographic areas. In contrast, FAST was able to employ a single laboratory school environment for intensive trial, feedback, and retrial for a full three years before piloting. Besides reducing the scope of testing, the laboratory setting had the advantage of putting the design staff in direct contact with students and teachers in the classroom.

Anonymity. For FAST, a major economy came in its relative anonymity. The early curriculum projects from their inception engaged in massive information dissemination efforts which were forced, it can be conjectured, by the educational concern of the time and their style of testing and dissemination. This activity was exceedingly draining of time and talent. FAST, being developed from University funds, was out of the spotlight and could concentrate most of its energies on development. This is not to say that there were no demands for accountability, but such demands were relatively easy to handle in the close community of the State Department of Education, the University, and the State Legislature.

FAST challenges the high-pressure curriculum "bandwagon" dissemination model and suggests that the real dissemination problems of curriculum are best solved through quality materials and services.

Longer Developmental Period. FAST's longer developmental period was another important factor in cost reduction. A short developmental period can be costly in that it requires many hands and minds all working simultaneously. Since simultaneous effort is essentially redundant, information flow is hampered, requiring a large staff of monitors and coordinators. A longer developmental period permits a much smaller staff, which eliminates much redundancy and the need for special coordinating personnel.

Stable Staff. Quick turnover in personnel was a common feature of many of the early projects in which writers produced their product during a summer and then left to teach or do research elsewhere. By placing the function of writing in the hands of a long-term staff, FAST was able to reduce information loss accompanying quick turnover. Most staff members worked together on the project for five or more years and knew the full history of problems and solutions. At its peak, FAST had but five developers.

Stringent Budget. Possibly the greatest inducement to cost-cutting was knowledge that the project was under budgetary restrictions. Painful and oppressive as a tight budget was, it did force
the staff to continually ask the question, "Is this expenditure necessary?" Usually the answer was "no."

Reflections on Dissemination

We learned much from the dissemination efforts of the first-generation national projects and built upon that experience. Dissemination of earlier projects was based on several assumptions. First, it was normally assumed that teacher training is desirable, if not necessary, in the initial implementation stages of projects. Our experience validates and extends this assumption to state that all who use a program should be trained in its use.

Second, the earlier projects generally assumed that a cadre of trained teachers with capacity to act as models and consultants to their untrained colleagues would remain in their schools and thereby maintain the vitality of the programs once they were installed. Experience has proved disappointing. Overlooked was the extreme mobility of science teachers of the 1960s. An informal survey of 40 secondary teachers in one district who were National Science Foundation trainees between 1960 and 1970 revealed that by 1970, 10 percent of the 40 had gone into administration, 15 percent had gone into higher education, 25 percent had retired, and 30 percent had left teaching. Only 20 percent remained in the classroom at the end of the period. Though the degree of mobility of the 1960-70 period was undoubtedly higher than in this decade, teaching remains a mobile profession.

Third, it was widely assumed that colleges and universities would automatically take up the training of teachers for the new programs in their preservice courses. However, many collegiate science educators held to the philosophy that they were preparing professionals whose careers would span the lifetime of many different programs. Therefore, discussion of project curricula most often became a part of a general survey of curriculum. As a result, fledgling science teachers had little background in any specific curriculum and more often than not floundered in their encounter with the first-generation courses. They often abandoned them, disenchanted and critical of the entire curriculum development movement.

Aware of this history, we had some clues on how to proceed with FAST's dissemination. First, only those teachers who have been trained in the use of FAST materials are authorized to teach FAST, and almost all teachers, principals and curriculum leaders agree with this policy. Distribution of materials is controlled by the project team at the University of Hawaii. There have been a few teachers who escaped training and obtained the materials as a classroom inheritance. When this has occurred, it has usually resulted in rapid abandonment of the program.

Second, we have trained a group of field teachers, or teaching cadre, who do the bulk of in-service training under University sponsorship, supervision, and pay. This capitalizes on the cadre concept and assures that time and financial support are provided for the activity. Learning to use a new program cannot be left to informal processes.

Third, we have accepted as a reality the collegiate philosophy that preservice training should continue to be general in scope. As a result, all new graduates take the regular FAST training given teachers in service.

Fourth, care has been taken to provide training continuously in the program. Even in Hawaii there is a yearly turnover of 15-20 persons per level of FAST, or between 10 and 15 percent of the teaching population. Teacher replacements must also undergo training, and the ongoing availability of initial training accounts in good part for the continuing vitality of the program.

Teacher Enthusiasm and Long-term, Continuous Involvement

Teacher Enthusiasm. Another body of dissemination knowledge involves a "teacher enthusiasm curve" which seems related to the long-term use and success of FAST and the other programs of CRDG. "Enthusiasm" here refers loosely to teachers' satisfaction with and continued voluntary use of the program. We have found a definite and presumed causal relationship to exist between the levels of teacher enthusiasm and the extent, timing, and nature of the training,
support and other involvement the teachers experience.

Figure 1 charts the teacher enthusiasm curves typical of five different groups of FAST teachers:

Pattern A Untrained teachers with no field support
Pattern B Trained teachers with no field support
Pattern C Trained teachers with field support only
Pattern D Trained teachers with field support and further program specific training
Pattern E Trained teachers with field support who became part of the Training Cadre

Teachers undergoing summer training for use of FAST materials typically reach a peak of initial enthusiasm at the end of the training period. The challenge of new content, the professional stimulation of colleagues, and the rising expectations opened up by new possibilities combine to raise enthusiasm. The pattern was predictable from the earlier national experience and was borne out in ours.

In the first months of school, the curve normally plummets as teachers face the sobering realities of the classroom and experience the anxieties of using new materials and tactics. Again, this is a predicted phenomenon even when teachers have been forewarned. However, the drop is sharper and lasts longer for those who do not receive field

Figure 1

Teacher "Enthusiasm" for Curriculum and Various Patterns of Teacher Involvement
support (Pattern B). Needless to mention, the teachers without training (substitute or replacement teachers and others who inherited the program materials) and without field support exhibit little initial enthusiasm, experience a sharper drop in the first months of school, and tend to leave the program within a year or two (Pattern A).

The period of depression ends for trained teachers as they develop confidence and expertise. Enthusiasm again begins to climb. The curve keeps rising through the second and third years of use. However, the recovery of the group without field support never matches that of the group receiving support. There is a discernible gap in the enthusiasm levels of these two groups (Patterns C and B).

Between the third and fifth years, the upward trend normally levels off for both the field-supported and the unsupported groups and reaches a plateau. The plateau seems to come about the fourth to fifth year for teachers visited by the field representative, earlier for the unsupported group. Then the curve begins to fall off unless further training is undertaken. Without the added stimulation, the downward trend for these two groups continues into their fifth and sixth years of teaching FAST. As of this writing the curve is still dropping (Patterns C and B).

The enthusiasm curve typically exhibits neither plateau nor downward trend in the third and fourth years for those teachers who receive additional training as members of the Teaching Cadre or through special instruction during these years. (The special instruction in this case included in-depth program-specific study of program philosophy, student evaluation procedures, class organization, discussion techniques, and special teaching strategies.) There also appears to be a further differentiation in the degree of rise in the curve between those who took the additional program-specific instruction and those who were selected to become trainers of other teachers and given intensive instruction for their training assignment (Patterns D and E). We attribute this difference to the trainer group's more intensive contact with the development staff and the recognition and status attached to their selection as teacher-trainers.

It is interesting to note that the integrity of the program suffers along with enthusiasm in direct proportion to the level of field support. Teachers without support have a tendency to bastardize the materials with little consideration of sequence or logic, often randomly adding exercises taken from materials used earlier in their professional careers. When the teacher receives follow-up support, there is a far greater tendency to use materials as developed or to modify them so as to retain the logic of the initial program.

From these observations we hypothesized the following:
1. That interest and enthusiasm for a program will begin to drop once teachers have mastered all they care to of the new content and new tactics.
2. That the enthusiasm curve is strongly associated with a teacher's own learning about a program.
3. That enthusiasm can be stimulated by further involvement in service to, and study of, a program.
4. That once program content is mastered, enthusiasm-stimulating studies may involve program techniques, methodology, learning problems, and philosophy.
5. That to be effective, study should be rooted in the structure of a program.

On these hypotheses we are now undertaking to develop further "program-specific" seminars for all teachers. This program is in its infancy, but the early indications are that it may establish the desired positive curve among teachers generally. From the standpoint of developing master teachers, this insight appears to have deep implications. Equally important, it may prove a means to prolong greatly the functioning life of a curriculum.

Personalization. Another finding, perhaps the most significant, is that many teachers begin to personalize the program after a period of systematic participation in FAST. This may be the step beyond enthusiasm — a step in which teachers, from their learning of FAST, have developed a competence and confidence in the
structured area of knowledge covered by the curriculum to such a degree that they feel free to begin to modify the program. The sharing of their modifications and alterations has constantly freshened the FAST program. In this process, the classroom teacher becomes a curriculum developer, often bringing to light new and important insights. The effects of personalization are sure to be felt more strongly over time.

Conclusion
FAST has demonstrated that substantial curricular efforts of consequence can be successfully mounted and maintained on limited budgets out of local or regional resources, utilizing a small and stable staff over longer periods of time, in the limited but flexible environment of a laboratory school setting. FAST has also demonstrated that a program of considerable complexity can be installed, its vitality maintained, and teacher enthusiasm for it sustained through setting up essential requirements and conditions for teacher support and training. Where resources for training and follow-up services are available, programs such as FAST have a high prognosis for successful, long-term operation.

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