

School Change and Improvement: The CRDG Experience

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We in the United States have spent millions to develop innovative programs with the intent of changing what we do in schools and improving students' achievement. Yet the curriculum in many schools looks much like the curriculum of 30 years ago, when I was in school. Why so little change? To answer the question, I first identify the major findings of research into disseminating and implementing innovative programs in schools. Then I describe our experience in managing change to reach more learners more effectively.

RESEARCH ON PROGRAM IMPLEMENTATION

Our experience in research, development and dissemination at the Curriculum Research & Development Group (CRDG) of the University of Hawai'i has shown clearly that for changes to take effect in educational settings, much more is needed than curriculum guides, materials and published research findings.

Before 1970, efforts to reform schooling focused primarily on adoption of new programs. Developers assumed that implementation followed an industrial model—that changing a curriculum meant deciding to use a new program, installing it with minimum staff development and assuming widespread, immediate use (Fullan, 1987). However, research (Fullan and Pomfret, 1977; Joyce and Showers, 1983; Pottenger, 1977; Young, 1993) has revealed that merely deciding to adopt a new program does not necessarily beget implementation and actual use in classes.

The 1970s: Analyzing Failure

Fullan (1987) described the 1970–1980 period as one of "documenting failure." The first research analyzing the problems of implementation appeared in 1971 (Sarason, 1971; Gross et al, 1971). Even the term "implementation" was little used before 1970.

Fullan pointed out that during this decade we learned what not to do: Don't neglect training; don't ignore local leaders and opinion setters; don't implement large, vague innovations; don't count on adopters to tell how individuals act in classrooms; don't trust that reported use means actual use and so on. The "industrial model" did not fit reality.

Then a "political view" began to emerge. It focused on activities and interactions within schools. Berman and McLaughlin (1975) coined the term "mutual adaptation" to describe the adjustments among teachers, schools and the innovations that were necessary for implementation to succeed.

From this phase Fullan (1987) identified four categories of factors that affect the degree of implementation:

- 1 characteristics of the innovation, such as complexity;
- 2 the implementation strategies used, such as teacher training, resource support, coaching and prompt feedback;
- 3 characteristics of the school, such as demographic features, the decision-making process and the organizational climate and
- 4 characteristics of the school system, especially such things as size, incentives and evaluation of teachers and students.

The 1980s: Analyzing Success

Since about 1978, research on program implementation has accentuated the positive—what works rather than what does not work (Crandall et al, 1983; Fullan, 1987; Huberman and Miles, 1984; Joyce and Showers, 1984). The perspective has also shifted to include the culture of the school along with its politics. Research focused on what innovations look like when they are implemented well, what teachers actually do in the complex world of the school and what developmental stages teachers go through with a new program (Hord and Huling-Austin, 1987; Hall 1979; Hall and Loucks, 1978).

Researchers have identified several factors as determinants of success: administrative support and commitment, ongoing coaching and feedback and follow-up services. They now see implementation as a long-term process of change that requires initiation, training, support and maintenance.

The 1990s: Leadership for Change

It has become clear that innovative programs, by themselves, have no long-term impact on teachers, students, or schools. We have now entered a phase of managing change.

The research of the last two decades revealed the need for designs and plans for systematic dissemination, implementation and institutionalization. Attention now focuses on training plans, follow-up strategies, monitoring

and feedback. Change and growth in teachers is seen as a long-term process, not as a quick fix in short-term training. We are beginning to see that meaningful change takes sustained effort over three to five years. Thereafter, programs require continuing maintenance as teachers personalize the curriculum and mature in their use of innovations.

We see now that any innovation that aims to change or improve school practice must take into account:

- 1 the nature of the knowledge and skills to be transmitted (the nature of the discipline),
- 2 the educational system (including the mores, politics, resources and the culture and climate of schools),
- 3 the nature of the learners and
- 4 the way to organize and deliver instruction.

Omitting any of these elements in planning for improvement will reduce the impact of an innovation.

THE PROBLEM OF TRANSFER

In-service training for teachers has long been seen as the avenue to improving schooling. But evidence shows that conventional in-service programs have had little effect. A major reason is that teachers often encounter difficulty in transferring training to their classrooms.

Joyce and Showers (1983) document possible reasons for lack of transfer: the need to expend great effort to learn new skills, feelings of awkwardness and frustration in practicing new strategies, anxieties inherent in taking the risks necessary to change behaviors and feelings of discomfort that can lead to avoidance. To overcome these barriers, training programs must include these elements:

- 1 forecasting and acknowledging the problem of transfer,
- 2 presenting the theoretical basis, rationale and description of the innovation,
- 3 modeling or demonstrating the required skills or strategies,
- 4 rehearsing new strategies under conditions of positive feedback in a protected environment and
- 5 coaching by peers, supervisors, or others during implementation.

Combining these methods of presentation yields a transfer rate between 75 percent and 90 percent (Joyce and Showers, 1983).

Garmston (1987) and Kent (1987) have shown that administrators too must aid the transfer process. Their leadership is needed in five arenas:

- 1 creating a climate in which teachers are expected to participate in worthwhile in-service programs;
- 2 ensuring that a support plan is in place to provide feedback to teachers during the change process;
- 3 providing resources for teachers to take part in in-service and support activities,
- 4 fostering a climate of collegiality, support and trust and
- 5 modeling desirable behaviors to support teachers in coaching one another to gain new skills.

Setting up arrangements for teachers to form a community in which they support one another is now regarded as essential if transfer is to succeed.

DEVELOPMENTALISM: HOW TEACHERS CHANGE

A related area of research on professional development has focused on the stages of concern that teachers go through as they mature into competent, master professionals using an innovation (Fuller, 1969; Hall, 1979; Hall and Loucks, 1978; Hord and Huling-Austin, 1987). Teachers' concerns pass through stages from self-related concerns through task-related concerns to concerns about impact on students.

In the first stage, self-oriented concerns dominate. Teachers have such questions as "What is it?" "What am I to teach?" "Can I do it?" "Do I know enough?" and "Do I have the skills?" To answer these questions, teachers must learn what the new program is, how they fit into it and what they will have to do to implement it. In the second stage, teachers begin to practice what they have learned. Concerns shift from the self to the task. Questions such as "How shall I organize for instruction?" "Will I ever get it organized?" and "How can I arrange to have students doing different things at different times?" begin to emerge. Teaching is mechanical, often replicating the way teachers were trained to use the program. In this stage, teachers begin to comprehend the innovation.

Finally, in the third stage as teachers begin to master the content and teaching techniques of the program, they begin to care more about the impact of instruction on students.

Teachers evaluate themselves as they question whether their instruction is working for each student. They ask, "Are there ways I can refine what I am doing so it will work better?" Now they are becoming masters of the program, refining it and adjusting it to their circumstances.

If a new program is to succeed, these stages of concern must be accounted for in designing and conducting in-service sessions and coaching activities.

Teachers as Learners

Teachers are busy people. Often isolated from one another, they may have few opportunities to learn about ideas they could use, let alone helpful research findings. If we intend to make change happen, we must think of teachers as learners, just as we think of students. Neither teachers nor students are empty vessels to be filled with knowledge.

Research on teachers' use of knowledge has shown that they do want to enlarge their repertoire of practical skills. They most trust ideas that fellow teachers speak knowledgeably about and vouch for from their own experience. They are inspired by ideas and innovations communicated with an idealistic flair.

Teachers assimilate new ideas by trying them out and looking for evidences of success with students, asking: "Do students pay attention?" "Does the class run smoothly?" "Does the new technique help me get through the work?" Teachers keep using practices that draw favorable responses from students. Others they view as impractical. They depend mostly on trial and error as the way to master application of new ideas in their classes.

Understanding and mastering innovative practices is difficult and time-consuming. One shot of in-service training accomplishes little. Staff-development programs must focus on teachers as problem-solvers who adapt innovations in ways that meet their needs in their classes. They need time to gain practical knowledge of which techniques to use in which situations (Turnbull, 1991).

If we are serious about helping teachers to adopt and adapt innovative practices, we must allow them time to consider why the new practices are better than conventional ones. They must see such practices working in real classrooms and experience them first-hand as learners. And they need continuous, long-term support and assistance in learning ways to put new approaches into practice (NCRTL, 1991).

Fullan (1987) points out that significant educational change consists of changes in beliefs, teaching styles, and materials that can come about only through a process of personal development in a social context. Such change comes as teachers have opportunities to exchange ideas, watch one another teach, analyze their own and colleagues'

practices, and collaborate in trying new materials and techniques and evaluating the results.

FACTORS INFLUENCING SUCCESSFUL IMPLEMENTATION

The research of the last two decades reveals six features of successful large-scale change projects. Three have to do with characteristics of the change process, three with characteristics of the project.

Quality and Practicality

Innovations are more likely to succeed when their technical quality and accuracy are already proven and when at least some benefits for students and teachers are readily apparent (Fullan, 1987). Quality depends on fit to students' developmental levels, evidences of effectiveness, and clear communication of students' and teachers' roles. Practicality covers such factors as whether the innovation addresses relevant needs of students or teachers, whether it fits well in the teacher's situation, and whether it includes concrete how-to-do-it information. Practicality calls for trade-offs between costs in time and effort and benefits in impact on students and classrooms. Quality programs that are perceived as practical have a high probability of successful implementation when resources are continually available. Without adequate resources and support, teachers tend to dismiss an innovation as impractical.

Program Complexity

Complexity is defined by 1) the number of elements of practice affected, 2) the degree of difference from existing practices and beliefs, and 3) the difficulty of learning the new practices. More complex programs are more difficult to implement but are more likely to yield non-trivial results (Huberman and Miles, 1984).

Understanding and mastery of a new program depend on clarity of communication about the innovation, time to work with and practice new techniques and opportunities for teachers to talk together about what they are doing. Clarity and understanding grow out of communal discourse within the school and with others knowledgeable about the innovation.

Quality In-Service and Support Efforts

The most powerful force in implementing change is steady on-site service while participants are learning to do something new. We know that one shot of pre-implementation training without follow-up fails because it does not permit the interactive, cumulative learning that adults need if they are to develop new skills, teaching

behaviors and conceptions of practice. Huberman and Miles (1984) documented the characteristics of successful change practices:

Large-scale, change-bearing innovations lived or died by the amount and quality of assistance that their users received once the change process was under way.... The forms of assistance were various. High-assistance sites set up external conferences, in-service training sessions, visits, committee structures and team meetings. They also furnished a lot of ongoing assistance in the form of materials, peer consultation, access to external consultants and rapid access to central office personnel.

Follow-up support works best when it takes a variety of forms accessible to teachers in different ways. Explanation of the innovation combined with demonstration, opportunity to practice new techniques in a low-risk, supportive environment and feedback on classroom use yield the best effects (Joyce and Showers, 1983).

Consensus on Need

Prospects for success of implementation when there is consensus on the need for change and there is innovation applicable to that need. Innovations are often adopted without widespread agreement on the need for change or the choice of solutions. Although acceptance and commitment by teachers are essential to implementing change, they can evolve as teachers work with an innovation if conditions are favorable. That is, if the innovation is of high quality and proven in practice, administrators support it and the plan supplies adequate support during the change process.

Planning for Implementation

Success in implementing change does not just happen; it requires careful planning. The plan should clearly delineate processes for assessing needs and readiness for change, for assuring that essential resources both financial and human are available, and for achieving consensus on goals, activities and time lines—in addition to staff development and support.

The plan should cover careful monitoring of the progress of implementation, balancing the quality and quantity of both technical assistance and sustained administrative support. Monitoring need not be conducted as formal research; it does require that participants in the change process communicate regularly with one another—and with outside consultants.

Research clearly shows that a quality program has effects beyond its use. It has an impact both on professional growth in using instructional strategies and on organizational growth in collaboration and capacity to solve problems.

Further, greater effects appear to correlate with more complex programs, with more extensive staff development, with teacher participation in decision-making and with local leadership in implementation.

Administrative Support

Change within schools requires leadership and management. One or more people must serve as leaders in articulating and reinforcing the vision of change, solving practical problems, getting resources and communicating with others to build support for change. The research evidence clearly points to the critical role of school administrators in implementing change (Crandall et al., 1983). Administrators must be knowledgeable about the innovation; provide access to resources, training and assistance; communicate that change is a priority and provide a positive, supportive climate that encourages change. Successful implementation of change requires a balance of pressure and support from administrators.

Administrators can do a variety of things to support change efforts, some of which are listed in Table 1.

Table 1
Types of administrative action that support successful implementation

- Assure availability of instructional materials, equipment and supplies.
- Arrange time for teachers to meet with one another.
- Create opportunities and encourage teachers to visit one another's classrooms.
- Provide for continuous staff development.
- Build leadership teams within the school to overcome isolation.
- Provide moral support, encouragement, interest and praise.
- Create an environment where risk-taking is encouraged is the norm. (It's all right to fail if we learn what does not work).
- Align the teacher evaluation system with the innovation.
- Do not try to evaluate impact early in implementation; wait until the second or later year.
- Assess concerns through listening, informal conversing and questioning.
- Attend to needs expressed by teachers; address needs at higher levels after teachers' lower-level needs are met.
- Continually communicate with others (parents, teachers, board members) about the innovation through letters, newsletters, anecdotes, displays of students' work, open house, news releases, etc.
- Avoid multiple initiatives or implementations.
- Focus on other efforts in the system that complement the innovation.

THE CURRICULUM RESEARCH & DEVELOPMENT GROUP

The Curriculum Research & Development Group (CRDG) is an organized research unit of the University of Hawai'i charged to improve instructional programs and practices in the state's schools. The University Laboratory School is the CRDG's site for experimental work on curriculum.

Traditional kinds of research—analytic, historical and

empirical studies, for example—are useful but insufficient for CRDG’s work, which demands the further steps of developing, disseminating and evaluating instructional programs. CRDG staff produce curricula that 1) represent their domains of knowledge (disciplines) authentically, 2) meet standards of content and pedagogy keyed to students’ development and 3) meet the tests of teachability and practicality. In short, the work of CRDG is to find ways to put research findings into practice in classrooms. A theoretically sound curriculum that does not meet the test of usability and acceptability in schools is judged only a partial success because CRDG expects its courses to change what happens in schools. Rather than just improved versions of old approaches, CRDG curricula are intended to produce “paradigm shifts” in ways of teaching and learning.

CRDG Science Programs

Typical of such shifts are 1) teaching students to use inquiry procedures rather than to memorize or “master” subject matter, 2) integrating subject areas within courses, and 3) helping teachers to change their teaching theories and approaches along with the content they teach.

These changes in instructional patterns typify CRDG’s *Foundational Approaches in Science Teaching (FAST)* program, which departs radically from conventional approaches to teaching science in middle-school grades. It has taken 25 years for its approach to catch on nationally; now over 3,000 schools in 36 states are committed to the program, and it is used in 10 foreign countries. *FAST* and two other CRDG science programs—*Developmental Approaches in Science, Health and Technology (DASH)* for grades K–6 and *Hawai’i Marine Science Studies (HMSS)* for grades 9–12—reflect the move away from traditional practices. Elements of this paradigm shift are shown in Table 2.

Table 2
Paradigm shift

Traditional Emphasis	New Emphasis
<ul style="list-style-type: none"> • Science for some • Reading and language first 	<ul style="list-style-type: none"> • Science for all • Inquiry and activity based learning accessible to readers and nonreaders alike
<ul style="list-style-type: none"> • Teacher as source of knowledge • Content-driven approach 	<ul style="list-style-type: none"> • Teacher as guide in learning • Constructivist approach building on prior knowledge
<ul style="list-style-type: none"> • Divorced from real world • Individualistic learning 	<ul style="list-style-type: none"> • Applicable in real world • Collaborative/cooperative/social learning
<ul style="list-style-type: none"> • Atomistic/disconnected event 	<ul style="list-style-type: none"> • Holistic/connected/integrated/thematic content
<ul style="list-style-type: none"> • Single exposure to concepts 	<ul style="list-style-type: none"> • New modes of inquiry, thinking skill, scientific habits of mind
<ul style="list-style-type: none"> • Testing 	<ul style="list-style-type: none"> • Multidimensional assessment

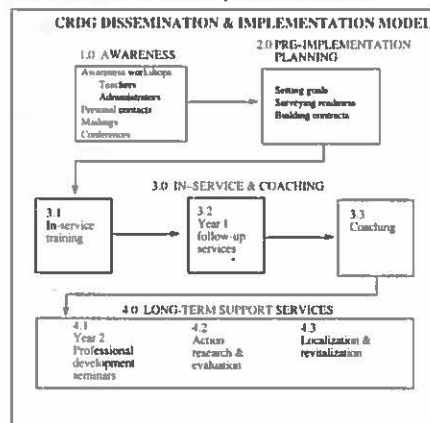
With the paradigm shift, the role of science teachers becomes more demanding. They no longer merely dispense information; rather, they guide learning. Inquiry teaching engages teacher and students in questioning observations about the natural and technological worlds. Students collaborate as co-learners; the teacher is their coach. Because teachers and students work together on investigations, teachers’ skills in questioning become crucial. Knowing what questions to ask is as important as knowing answers. Teachers must use activities that lead learners to construct their own interpretations and advance their own knowledge.

CRDG Dissemination and Implementation Model

Figure 3 shows the model devised by CRDG science staff for expanding the reach of CRDG curricula. The model draws on the collective experience of researchers in program implementation and teacher change and 20 years of successful in disseminating science programs.

Because CRDG science curricula are complex, the model is complex. The curricula are intended to replace existing science programs in schools; they require changes in teaching approaches, in behaviors of teachers and students, and in expectations of students; they require ten days of in-service sessions plus extensive follow-up support to assure success. The model has four phases: 1) awareness, 2) pre-implementation planning, 3) in-service training and coaching and 4) long-term support services. The process takes three to five years.

Figure 3
CRDG Dissemination and Implementation Model



Phase 1. Awareness: Getting Acquainted

In the awareness phase, we use a variety of strategies to alert educators to the new program: personal contacts, direct mailings to teachers and administrators, articles and advertisements in journals, exhibits and presentations at conferences, awareness workshops for teachers and administrators. Because no single contact or advertisement

normally captures genuine interest in a program, we must use these strategies repeatedly to convince educators that our program is authentic, reliable and consistent.

In what we call "the infection model," information about a program spreads by word of mouth. When teachers and administrators find a program that works well, they share their excitement and enthusiasm. Their message has a personal touch. Teachers invite principals and parents into their classes; principals invite superintendents and board members to see how students are learning.

In disseminating *FAST* and *DASH*, we have worked with the National Diffusion Network (NDN), an agency of the Office of Educational Research and Improvement, U.S. Department of Education. The NDN affords entry to schools through projects funded in each state. A state facilitator worked with schools to define needs and find a match among the programs that the NDN has validated as effective. In effect, the NDN had provided *FAST* and *DASH* with an advocate in each state.

The awareness phase ends either with rejection of a program as not meeting local needs or with a request for further information and assistance in planning for possible implementation.

Phase 2. Pre-Implementation Planning: Getting Ready

During the planning phase, CRDG staff members work with school staff to clarify the objectives of the program and the school, calculate costs of implementation and maintenance, work up a time line for in-service instruction and follow-up, and commit time to the effort. Ideally, those with roles in using the program participate in decisions. In this phase the goals are to build consensus on the need for change and commitment to the program and the implementation plan. When teachers and principals participate in goal-setting, implementation usually succeeds. Mandated adoptions require stronger moral and resource support during implementation.

For CRDG science programs, goal-setting ends with a written adoption agreement specifying the responsibilities of both parties and signed contracts for initial training. Written statements are important public evidence that both parties—CRDG and the adopting school or district—have made long-term commitments to each other.

Completing the first two phases takes much longer than we had predicted. It usually takes two to three years to move from initial contact to commitment. We found that adoption decisions are rarely made solely on the rational basis of program effectiveness; they almost always evolve from the trust established between persons during the awareness and pre-implementation phases. Presenting a cost-effective, research-based program with ample evidence of effectiveness with students and teachers is a necessary but insufficient condition for a decision to implement a program.

Trust between advocates and educators in the school or district is often the decisive factor.

Phase 3. In-Service and Coaching: Providing for Success

All CRDG science programs require intensive, program-specific in-service instruction before implementation. Teacher institutes combine hands-on experience as a learner in the program with extensive modeling and discussion of the program's inherent teaching strategies. The institutes also give teachers experience in practicing new strategies. In essence, they go through the entire program so that they know its activities and investigations well. Institutes are led by certified instructors who have taught the program successfully and have had preparation in teaching teachers. Each program has its own cadre of certified instructors to assist in the in-service and coaching phase of implementation.

Because we found that initial instruction alone does not assure success, we arrange for follow-up services and coaching during implementation. For each teacher institute, we identify a local coordinator—a science supervisor, a certified instructor, a regional center staff member, or other person charged with long-term maintenance of the program. Local coordinators receive resource guides and further support in use of the program to guide them in arranging follow-up activities.

An array of support services are provided beginning in the first year of use and continuing as long as necessary. Table 4 lists some of these follow-up services, along with some of the limitations inherent in each.

It is during the in-service and coaching phase of implementation that the research on teachers' concerns is most pertinent. We had to learn through experience to be patient, to listen and to design in-service programs and follow-up activities that respond to users' levels of concern.

For example, we now know that before and during initial training, teachers' concerns are in Stage 1, the stage of self-doubt. Our teacher institutes focus on these concerns by having the instructor model teaching strategies and lead discussions on what was done, how it was taught and what effect it had on learning. Instructors focus on the excitement and enthusiasm of the new activities. Knowing that teachers doubt their own ability, instructors urge them to risk trying new teaching strategies. They are supportive and empathic because they have been in the same position themselves. And because the instructors have recent classroom experience with the new program, they have credibility with teachers.

As teachers begin to implement a program, they shift to Stage 2, task-oriented concerns. Because pre-implementation institutes demonstrate how the program was intended to be taught, new teachers tend to mimic, somewhat mechanically, what they did during the sessions. One of the clearer

Table 4
Follow-up services in implementing CRDG science programs

Follow-up Type	Examples	Limitations
Direct mail	Certificates, newsletters, updates, advisories, adaptations, recognitions, parent letters, evaluation data.	Maintaining up-to-date records; one-way communication.
Phone contact	Administrative follow-up to see that materials have arrived; 800 hot line; teleconference to answer immediate classroom questions about investigations or teaching; service from developer on evaluation, proposals, parent concerns, etc.	Time-consuming; differences in time zones; cost; contacting teachers during the school day; availability of equipment such as speaker phone; released time for meetings.
Computer network	Communication from local coordinators, teachers and administrators; bulletin boards; sharing environmental data among students.	Cost; availability of equipment; lack of familiarity with the technology.
Certified trainers	Providing continual follow-up and support for own district and local area; continuous training of new staff.	Lack of communication to developer.
Implementation support program	A 1-3 year program supporting teachers in classrooms implementing CRDG programs. Monthly agendas include discussion of successes/problems, presentation of philosophy/pedagogy, activities based on presentations, review of participant-identified topics/activities; available for university credit.	Availability of staff; released time for participants; responding to individual and group needs; union rules; funding for staff and for university credit.
Site visitations	Classroom, by developer, local coordinator, or certified trainer; administrative, to build understanding and support for program; observation and feedback using additional training if necessary.	Cost of travel and personnel; time; released time for teachers, certified trainers; low contact ratio; availability of people.
Conferences	Drive-in conferences by region; group meetings at state science conferences; exhibit booth where users can meet one another and developer.	Getting time on conference agendas; coordinating and facilitating; released time for professional meetings.
Institutions of higher education	Provide research and credit for professional growth; local adaptations; provide for staff development and evaluation; provide subject area experts as needed.	Training of faculty; turnover of key personnel.

implications is that initial in-service institutes must focus on the most important and exemplary aspects of the new program.

During initial use, the role of on-site coordinators is crucial. They must make sure that equipment and supplies are at hand, that teachers observe one another teaching, that they meet to discuss their successes and problems, that follow-up in-service activities are available when needed, that communication with the project staff is responsive and that teachers get encouragement to carry on, even when the new teaching style feels awkward or frustrating.

This phase of teacher development and support services lasts for one to three years. During this time the full range of follow-up activities listed earlier are often used at one time or another.

Phase 4. Long-Term Support Services: Making It Ours

As teachers master the new science program, their concerns shift to its impact on students. In *FAST*, for example, teachers begin to adjust their teaching. Teaching through inquiry feels so comfortable that few teachers would choose to revert to old ways of teaching.

It is at this stage that we have successfully engaged

teachers in a series of professional development seminars to explore areas beyond the day-to-day use of the program. The focus in group meetings shifts from problems of implementation to such philosophical questions as "What is worth teaching?" and "What is the nature of science?" or to such research questions as "How can the research on learning styles [or cooperative learning or thinking skills] help us teach this program more effectively to more students?" It takes most teachers three to five years to reach this level of mastery. It is in Phase 4, when teachers are no longer struggling to understand the innovation but are refining and personalizing it, that evaluation of the program's impact is most appropriate.

THE STEP CONSORTIUM

CRDG's newest effort is a project funded by the U.S. Department of Education. Called Standards-based Teacher Education through Partnerships (*STEP*), the project brings the *DASH*, *FAST* and *HMSS* programs under one umbrella to provide standards-based staff development and prepare leaders in the science reform effort.

The project combines 1) effective programs with 2) pre-implementation staff development and 3) long-term support services. To carry out the project, we depend on the *STEP* consortium, a collaboration between universities and schools in their service regions. The members are Carnegie Mellon University, East Carolina University, Florida Atlantic University, Louisiana State University, University of North Alabama, Shippensburg University, Miami University, Michigan State University, University of Mississippi, Pacific Lutheran University, University of Missouri at St. Louis and the University of Hawai'i—all strategic locations for national dissemination.

Common Commitments and Assumptions

Consortium partners share a philosophy and a commitment to improving science instruction. These include the following assumptions:

- Collaboration and dialogue among universities and the schools they serve hold the best hope for improvement.
- A constructivist philosophy of learning, together with inquiry as an avenue to learning, best serves students and teachers in building their understanding of the world.
- Collaboration of curriculum developers, researchers and practitioners best shapes the

development of practical, useful and effective programs.

- The most effective instruction in pre-service and in-service programs combines the talents of university faculty and classroom teachers in modeling and reflecting on new instructional strategies.
- Assessment and research into implications of new approaches to curriculum require careful inquiry; such research should form a dynamic feedback loop in the development and revision process.
- Systematic support from program development through implementation is essential for change.

Functions of Consortium Partners

The functions of the consortium partners include activities described in Phases 1 through 4 of the CRDG Dissemination/Implementation Model. Specifically, partners provide

- awareness workshops for teachers and administrators about the available programs and services,
- pre-implementation planning with schools,
- in-service teacher institutes,
- in-service follow-up support for teachers,
- adaptation of programs for relevance and alignment with state or local guidelines,
- consultation services to local schools,
- research and evaluation of program impact,
- coordinating and customizing services to schools,
- assisting in seeking funding for implementing and maintaining programs,
- interacting with state science supervisors, other institutions, public and private funding agencies and so on.

THE IMPORTANCE OF FOLLOW-UP SUPPORT SERVICES

Pre-implementation teacher institutes and long-term follow-up services are what distinguish the CRDG model

from other attempts to improve science education. Why do we go to the trouble? Because it's worth it.

Our projects benefit from maintaining quality control over use of the innovation. During follow-up, we get a good sense of which schools are implementing our programs well. We can confidently refer other educators to these schools to witness the gain in students' learning. As professional developers, we want our work to be the best it can be and to have the best possible impact on teachers and students.

In follow-up we steadily assess the effectiveness of our training and materials. We collect information on modifications that teachers make, test them on a wider scale, and incorporate the best ones in our revisions. We use the data we collect to refine our work and update our institutes. We use feedback to assess our certified trainers, revise their training, or give them further training.

During the institutionalization and maintenance phase, follow-up activities help us to assess a program's impact on students and the progress of teachers and schools through developmental stages. This information helps us make judgments about program effectiveness.

What do adopting sites gain? Long-term services enable teachers to reach mastery levels in understanding and using our programs—a gain impossible when adoption was thought to equal implementation, when one-shot training was believed sufficient and when programs were dropped after five years in favor of the next innovation.

Teachers now have a place to go for help as they struggle with new content and teaching techniques. They grow professionally as they work through levels of concern about the new program. They become master teachers, confident in their approach and able to merge new strategies such as cooperative learning and cultivation of thinking skills into their expanding repertoires.

In the last 12 years that *FAST* has been disseminated nationally, we have maintained a retention rate of over 95 percent. *DASH*, which has been in dissemination for the last 7 years, has about the same rate.

ON SCALING UP FROM ORIGINATION SITE TO NATIONAL AND INTERNATIONAL IMPLEMENTATION

FAST and *DASH* are in use in schools in over 40 states and 10 foreign countries. Over 10,000 teachers have been trained in one of these programs. How has this success been achieved? We believe that the crucial elements are quality programs, competent pre-implementation teacher institutes and long-term support of teachers during implementation.

But in expanding from our small base in Hawai'i to national and international implementation, we have also relied on the help of others. Most noteworthy was the National Diffusion Network (NDN), which identified and

validated exemplary programs and funded their replication at a fraction of the cost of developing new programs.

In 1995, the NDN was terminated as a program of the U.S. Office of Education. With the demise of NDN, we have established networks of our own, such as the *STEP* consortium, and tapped funding sources. Collaboration between universities and schools has enabled us to continue to use the CRDG dissemination and implementation model nationally. We and our university partners are working with the other mathematics and science consortia established under the Eisenhower grants program. We have competed for and won Eisenhower funds for staff development and implementation at state and national levels. The Fund for Innovation in Education supports the *STEP* project and allows consortium partners to offer incentives to teachers and schools for beginning the change process.

We have been using computers in a project called the *Hawai'i Network for Education in Science and Technology (HI-NEST)*. Via the Internet and other carriers, *HI-NEST* provides direct links between *FAST* and *DASH* teachers, teachers and project staff and students sharing findings from their environmental investigations. Through *HI-NEST*, schools in Russia and Slovakia first learned of *FAST*. It is now the core of a new approach to science education in Russia, where five sites are working in school-university partnerships. In Slovakia, local teachers and university professors have joined to provide in-service institutes and support for teachers. Through collaboration, educators in Russia and Slovakia are getting new insights into science education and are incorporating them into the customizing of the *FAST* program and into their staff development efforts. We continue to support these teachers through the computer network.

What Did It Take to Do It?

As we reflect on what it took to achieve national and international impact, we can identify these elements:

- *A research-oriented organization committed to improving practice.* All of the other elements grew out of this seed.
- *Long-term commitment to the full range of educational change.* This commitment required us to take on the design, testing, revision and publication of materials, teacher training and support and evaluation.
- *Collaboration with the educational community at large.* This community has included teachers, schools, districts, other university partners, the NDN and so on.

- *A commitment to starting locally to build capacity and experience.* The University Laboratory School and Hawai'i provide our experiential base. We did not focus on national dissemination early on, and when we did, we recognized the need for localization and mutual adaptation.
- *Quality control.* Our commitment to staff development required CRDG to become its own publisher. No other publisher would commit to staff development as a condition of use of our programs. We have built a national network of over 200 certified trainers who provide in-service courses and give steady support. By retaining control of publishing, training and follow-up, we can make changes rapidly as we learn better ways to teach and learn.
- *National and international partners who can adapt programs to local conditions and provide training, support and research.* The national and international partners were selected on the basis of their commitment and ability to carry out this service.
- *Links to the international community for external validation of our work establishing its universality.* Through these links we have also gained insights that have enabled us to improve our programs, training and support services.
- *Critical mass and strong organization.* CRDG has been blessed with financial support from the State of Hawai'i that enables us to work at school improvement over the long term. We are less vulnerable to the ebb and flow of short-term grants that demand results that can be achieved only over the long term. We have been able to maintain flexibility in staffing, adding our own production and printing facility, an evaluation section, and most recently a staff dealing exclusively with dissemination and outreach. Such a critical mass is seldom available for short-term funded development projects.

SOME CLOSING COMMENTS

Research and development at CRDG is a lengthy process that includes researching, developing, testing, redesigning, retesting and refining. For major programs, the average development time is five to ten years. When we are satisfied that a program works well with target students and accomplishes its goals, it is ready for dissemination.

Our experience verifies the findings from research on

dissemination, implementation and institutionalization. The mere availability of innovative programs has little impact on changing teacher behavior or improving instruction. Little improvement is likely without careful attention to staff development and continual support. Projects that neglect these human factors will have little effect.

Our most important conclusions about what is needed for success in dissemination and implementation are these:

- Two factors determine the degree of implementation: the quality of the program and the quality and quantity of follow-up support.
- A variety of follow-up services is essential. Users need different services at different times in their development and professional growth. Not all sites require follow-up from the developer.
- Successful implementation is a process of individual development within the organizational constraints and the supports provided.
- Effective implementation requires opportunities for people to talk to one another. Comprehension and mastery come with time and with teachers talking with teachers about what they are doing.
- Changes in attitudes and beliefs follow changes in behavior (Fullan, 1987).
- Although complex projects are hard to comprehend and master, they are more likely to produce non-trivial results than small-scale projects.
- Successful implementation takes time—three to five years for most worthwhile efforts. Follow-up services should be provided all through the institutionalization phase, when schools take ownership of the program.

The CRDG dissemination and implementation model has proven itself for long-term implementation and institutionalization of CRDG's science programs. As we research and refine the model, we discover new and better ways to deliver the needed follow-up services. We believe that changing teachers' behaviors demands a commitment from both the developer and the schools to provide steadfast support from training through implementation to institutionalization.

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