Instructional Development Through A National Industry-Education Partnership

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Abstract. A Grade K-12 energy education program was developed, field tested, and installed in the schools with more than a million students in 1984 under an industry-education partnership involving several major energy companies and national education organizations. Nationwide field testing during development yielded mean pretest and posttest scores of 52 and 86 percent across the elementary and high school units. Data from 50,000 students using the program revealed similar overall test scores after its installation in regular classes. A set of ID practices that contributed to the success of the project are recommended for instructional developers.

More than a million American school children studied our country's energy situation during 1984 using a new energy education program developed through systematic, objectives-based instructional development (ID) procedures. Industry-education partnerships involving several major energy corporations and national education organizations were key elements in the program's development and its installation in the schools.

The Energy Source Education Program was developed and field tested over a three-and-one-half-year period from 1980 until late 1983 at a total cost of approximately $1 million. Financial support for its development was provided by 11 energy companies and trade associations, with major funding supplied by Atlantic Richfield Company (ARCO), San Diego Gas and Electric Company, and Westinghouse Electric Corporation. Participating educational organizations included American Federation of Teachers, Joint Council on Economic Education, National Council for the Social Studies, National Education Association, National Parent Teacher Association, and National Science Teachers Association.

Representatives of the education and industry groups formed an Advisory Council which met twice a year in Washington, D.C., to plan and review the subject-matter content and new materials for the program. The education and industry personnel played complementary roles. The educators reviewed the materials for instructional considerations and served as a support base with key educator groups. The industry representatives supplied information about their particular energy field and provided access to specialized consulting help as needed.

The company employed to develop the program was Educational Development Specialists, a Southern California firm experienced in energy education and in the development of industry-sponsored instructional programs for the schools. The project provided unique opportunities to apply and observe systematic ID procedures across the K-12 grade range in a large-scale cooperative industry-education effort.

The remainder of this article describes the Energy Source Education Program, including its development, field testing, and national installation in the schools. Also included is an "Advice to Developers" section, in which several ID practices that were effective in the project are recommended for general use.

Need For The Program

Historically, energy had been so cheap in America until the 1970s that it was simply taken for granted. But the 1973 Arab Oil Embargo and the Iranian Revolution in 1978 and 1979 changed all that. By the early 1980s energy costs absorbed 12 percent of our gross national product as compared to only one percent a decade earlier (Cook, 1982). The average American paid $18 at the local service station for a 15-gallon tankful of gas that had cost only $5.40 in 1972 (Monthly Energy Review, 1983). The United States paid foreign nations more than $80 billion a year—$1500 per average family—for imported oil alone (Energy and the Nation's Future, 1981). Headlines like "New Opec Pact," "Electric Rates Jump", and "Acid Rain Hits Northeast" had become all too familiar.

As energy took on greater economic and political importance, the lack of public knowledge about basic energy issues became evident. A government-sponsored national survey (Energy: Knowledge and Attitudes, 1978) revealed that young people of high school and college age were very poorly informed about important energy topics. More than 90 percent of the individuals in this survey wanted more information about energy and believed that energy should be a part of every school's curriculum. The need for better energy education in the schools was apparent.

The Energy Source Program

The Energy Source Program is a comprehensive energy education curriculum for kindergarten through high school. Seven instructional units comprise the total program: four spanning Grades K-6, two for the junior high school level, and one for high school. Each unit takes two-to-three weeks to complete at the pace of one class period per day, but may be extended for a longer period through recommended enrichment activities. The four elementary units and the high school unit were developed in their entirety during the three-year Energy Source Program. The two junior high school units were adapted with relatively minor modifications from units produced by the Energy Source Program developer working closely with a team of curriculum consultants and teachers from San Diego City and County Schools.

The program is designed to promote student attainment of an overall set of goals and a set of instructional objectives for each of the seven units. The goals relate to development of long-term values and attitudes that call for learners to believe that energy is important in our society, to stay informed and concerned about it, and to take an active interest in energy affairs. At the elementary levels, the instructional objectives deal primarily with learning important facts about such matters as energy safety, where and how we get energy, present and future sources, energy and the environment, and United States' and world energy supplies. High school students are expected to state several major energy issues of today, present arguments on both sides of each issue, and state and defend their own positions on the issues. These issues include acid rain, offshore drilling, energy price controls, radioactive waste disposal, and energy independence. Energy conservation is emphasized at all levels of the program.

Each of the seven units consists of a complete set of colorful instructional materials for use by the teacher and students. Included in a unit are:

1. One or more sound-filmstrip programs to introduce the content and stimulate student interest.
2. A student booklet for each student, containing information and practice related to the unit objectives. The booklets range in length from 16 pages for kindergarten to 84 pages for high school.
3. An activity booklet for use at home with parents for each level except high school.
4. A unit pretest and posttest for each level except kindergarten.
5. A record sheet, completed and returned to the program sponsor by the teacher, that lists the pretest and posttest scores by class, student reactions to the unit, teacher comments and suggestions for improvements, and information for reordering the program.
6. A teacher guide that describes the unit and gives lesson-by-lesson procedures for teaching it.

Several design characteristics were intentionally incorporated into the program. All units employ an objectives-instruction assessment approach and follow the competency-based model described by Sullivan and Higgins (1983). Practice on each objective was included in the student booklet and supplemented in activities directed by the teacher. All units were developed so that the teacher can present them effectively by using only the teacher guide and other program materials, with no additional study or outside preparation.

Field Testing

The elementary and high school units were field tested nationally as a part of their regular development cycles. The two junior high school units were field tested in the San Diego schools during their original development. Elementary and high school field testing was conducted in a total of eight separate geographic areas in six states: California, Colorado, Kentucky, Pennsylvania, Utah, and Wisconsin. In all, 151 teachers and approximately 5,000 students, ranging from 750 at the kindergarten level to about 1,500 in high school, participated in the tryouts of the four elementary units and the high school unit. According to teacher reports, slightly more than half of the classes were from middle-income areas, about one-third from low and low-middle income, and the remainder from high income areas.

The field test procedures were prepared in written form by the instructional developers and were distributed to local coordinators at the eight sites nationally. The coordinators included industry employees, a university professor, and school district personnel. Each coordinator contacted the schools and arranged the tryout in the local area according to the national field test procedures. Instruction during the field test was by the regular classroom teachers under normal classroom conditions. To reduce graphic design and printing costs, all print materials were field tested in black-and-white form, rather than in the color form in which they were produced for general use following the field test and final revisions.

To assess student achievement on the instructional objectives for each elementary and high school unit, except for kindergarten for which there was no formal assessment, the classroom teacher administered the pretest and posttest that is a standard part of the unit. The tests range in length from 12 to 30 items, depending on grade level. The pretest and posttest scores by grade level are shown in Table 1.

The table reveals that the average pretest and posttest scores across the four units were 52 percent and 86 percent respectively. The mean posttest score was above 80 percent for each of the four units, ranging from a low of 82 percent for the high school unit to a high of 92 percent for grades 1-2.

The data in Table 1 reflect the first and only field test for all units except for the one at the high school level. Whereas the

Table 1
Student Mean Percentage Scores by Grade Level

Grades	No. Classes	No. Students	Pretest Posttest Mean	Mean
1-2	30	757	66	92
3-4	30	836	43	85
5-6	30	1,057	55	85
9-12*	14	360	44	82
Totals	104	3,010	52	86

*Grade 9-12 figures are for the second high school field test only.

initial field test of each elementary unit yielded mean posttest scores above 80 percent as shown in the table, the first high school field test produced an average posttest score of only 62 percent. Consequently, several changes were made in the high school unit to incorporate more written and oral practice on the instructional objectives. Following these revisions, the second field test of the unit resulted in the mean posttest score of 82 percent shown in the table.

Student and teacher attitudes toward the units were assessed with brief attitude questionnaires administered by the teachers at the end of the field test. Attitudes were consistently positive. More than 90 percent of the elementary pupils reported that they liked their unit, that they would try to do more to save energy, and that they learned many important things about energy. Over 80 percent of the high school students responded positively to the questionnaire items "I liked this unit," "The content is important," "High school students should study the content," and "I learned a lot."

Among the field test teachers, more than 95 percent across the five levels reported that their students reacted positively to the program, that they were satisfied with student learning, that the energy content was objective and unbiased, and that they would teach the unit again.

Program Installation

Widespread installation of the Energy Source Program in the schools was a primary goal of its corporate sponsors from the beginning of the development process. When the first units were ready for general use in the schools, representatives of several development sponsors organized the Energy Source Educational Council, a national nonprofit agency whose mission is to guide and support business and industry in providing the program for American youth. The council publicizes the program to industry executives, educators, government officials, and the public. Council members also encourage energy-related corporations and private foundations to purchase the program and to work with school personnel to install it free of charge in the schools.

The efforts of the National Council and local sponsors resulted in more than $1 million being raised for installation of the Energy Source Program in 1984, the first year in which the complete K-12 program was available for distribution. The program was used during the year by 1.2 million students at a cost of approximately $1.00 per student. Twenty-five corporations and private foundations contributed form $10,000 to $150,000 each to sponsor program distribution, and more than 50 other organizations donated from $1,000 to $10,000.

Installation of the program in a school district typically occurs through the sponsorship of a single company or a consortium of companies active in the local area. The sponsors purchase the program for the schools, and they often install it with the help of current and/or retired employees participating in a company public-service volunteer program. After receiving appropriate training, these company representatives work in partnership with the district administration and teachers to orient them to Energy Source and to provide them with the materials.

A unique feature of Energy Source is that data on student learning from the program are routinely available after it is installed in the schools. The record sheets returned to sponsors by teachers after their classes complete the program contain the unit pretest and posttest scores for their students. For the 1983-84 school year, average test scores were calculated from 1675 record sheets representing more than 50,000 students from nine sites across the nation. The mean pretest and posttest scores were 54 percent and 84 percent respectively. These scores varied by only a few percentage points from the mean scores of 52 percent and 86 percent obtained during field testing of the program.

Advice to Developers

The Energy Source Program was a unique opportunity to apply instructional development procedures and observe their effects. Its unusual features included its magnitude, the industry-education partnership and the extent of industry involvement, the grade range of the instructional program, and the number of students using the completed program.

Application of basic ID procedures guides a project such as this one. But use of an ID model or standard development process by itself is not enough to produce a successful program. A number of other tactics are also important.

Seven instructional development practices that contributed to the success of the Energy Source Program, and that are also good practices in development projects generally, are listed and briefly described below. They might be labeled "Practical Hints for Developers" or perhaps "Things My ID Model Never Told Me." With one exception, they were chosen because they are important in the development process but receive little attention in ID models or the professional literature. The exception, "Try it out," is a step in all of the major models, but is also included below because the Energy Source project yielded particularly good data on its cost-effectiveness.

Do your homework.

Knowing the subject matter for your program may be the most important thing you can do as a developer, aside from using good ID procedures. Take the time to learn it well.

For most instructional programs, you need much greater depth of knowledge about the subject matter than you include in the program itself. The greater knowledge helps you to determine what content should be included and excluded, to organize the content into objectives, and to generalize appropriately across more detailed information when writing the program.

If your program will include a large amount of content, don't expect to get it all first-hand from subject-matter experts (SMEs). Read it yourself, and use the SMEs more as resource persons, sources for hard-to-find information, and reviewers. The SMEs can tell you good reading sources for most of the information you will need, but don't expect them to take the time themselves to supply all the information for you.

The "Do your homework" lesson was demonstrated graphically to an experienced developer on the Energy Source project. At the beginning of her initial meeting with a government liaison employee for a major oil company, who was to serve as an SME on government energy policy, the oil company official asked her if she had read a particular book which at that time was the leading book on U.S. energy policy. When she replied that she had not, he gave her the book and told her to read it and then reschedule the meeting. His action was justified. The developer should have done her homework before going to school—not afterward.

Avoid bias.

The last thing you or any well-intentioned client wants is for your program to be a legitimate candidate for a revised edition of Sheila Harty's *Hucksters in the Classroom* (1979), a well-known little book portraying industry bias in educational materials. Take as much care as possible to see that this does not happen.

There are several things you can do to attempt to avoid bias in your program. Learn the subject matter well enough yourself to recognize biased or inaccurate information when you see it—that is, do your homework again. Be careful not to unfairly advocate a particular point of view or self-serving position on an issue, even if you hold the point of view yourself. Have the material reviewed by SMEs who are likely to detect and call attention to bias and inaccuracies. On the attitude questionnaire for field-test teachers, ask them whether the content was objective and unbiased and have them note any instances of perceived bias.

Of course, it's important to recognize that to some extent bias is in the eye of the beholder. An amusing, if frustrating, incident occurred during SME reviews of the Energy Source high school unit when the very same short passage brought the following written remarks from a company executive and an environmentalist-author who reviewed the unit independently:

Energy Executive: "An anti-industry position like this is harmful to my company and the industry!"

Environmentalist: "This is totally unacceptable! It's loaded with pro-industry bias."

Call on the experts.

As important as doing your homework is, it won't eliminate your need for outside help. Make yourself familiar with subject-matter experts who can help you, and be considerate about your requests so that they are likely to respond when you really need them.

Content experts can provide needed information at a number of different times. By all means, build an expert review into your development project. Normally, the best time for it is prior to or concurrent with field testing. If the content is controversial or there are credible diverse points of view about it, select reviewers who either are unbiased or represent the different viewpoints. Often, SMEs can also quickly supply needed information that is difficult for you to obtain because of its specialized nature or recency and can provide a good second opinion when you are not fully confident about your treatment of a particular topic.

Calling on the experts and other key persons with a natural interest in your program can have public relations value as well as informational function. Their involvement in the development phase may build a proprietary interest and support base that later will cause them to willingly publicize the program and promote its use.

The Energy Source high school unit alone was reviewed during development by more than 40 industry personnel and educators. The development staff also maintained telephone contact as needed with a number of experts in different energy fields. Virtually all of the expert reviews and on-call assistance were on a voluntary, no cost basis.

Of course, the 40 reviews exceed the law of diminishing returns for the purpose of obtaining feedback alone, but the opportunity to review the materials was made available to individuals from all organizations on the Advising Council to foster their identification with the program as well as to obtain their comments. Reading the comments of so many reviewers, deciding on the changes to make, and incorporating them into the material was very time-consuming. Yet the reviews and other information supplied by content experts made a highly significant contribution to the final program.

Make it look good.

The quality and frequency of illustrations, photographs, charts, and other graphics content often influence potential users more than any other characteristic of a program. Good graphics also give a program a professional appearance and enhance its appeal for learners. So insist on high-quality graphics work. If your program does not look good, your elegant ID procedures may never see the light of day.

Looking good is only half the graphics battle, however. As the developer, you must ensure that the graphics content facilitates the desired learning. The typically obliges you to write rather precise specifications for the graphic designers and to work closely with them, rather than giving them a free hand. Unfortunately, turning the designers loose on their own too often results in works of art that are impressive to behold but that either distract students from the learning task at hand or are unrelated to it.

Much to our envy, my development colleagues and I found in the Energy Source project, as we have in previous ones, that the graphics and production costs are about the same as our development budget. We would like to get a bigger share of the funds and we think that we should, but as yet we have not figured out how to do it. Still, good graphics are so important that we are willing to pay the price to get them.

Try it out.

Field testing is a basic step in any self-respecting ID model. Yet only a small percentage of the instructional programs used in the schools actually have been field tested prior to their publication. When pre-publication tryouts are conducted, teacher reactions, not student learning, are often cited as the primary evaluation data.

The Energy Source Program serves as a good example of the value of field testing. For public relations and prospective marketing purposes, the units were field tested with far more students than were necessary for formative evaluation purposes only—an average of 30 classes per unit. The cost of field testing was approximately $125,000 out of the total project cost of $1 million. We can estimate conservatively that the sales life of the program is five years at an average of $1.2 million a year, the 1984 sales figure. That is a total of $7 million, $6 million in program sales plus $1 million in development costs. The $125,000 for field testing amounts to less than two percent of the total program expenditure of $7 million.

It is more difficult to calculate the value of the benefits from the field tests than it is to figure their costs. Yet, the revisions in the high school program alone between the first and second field tests resulted in an increase in student achievement from 62 percent on the first tryout to 82 percent on the second, a difference of 20 percentage points. In addition, feedback from the field-test teachers led to numerous changes that make each unit easier to use and improved the units in other ways as well. The field tests had the added informational benefit of revealing the level of student learning from each unit and the nature of teacher and student attitudes toward the units. Clearly, the benefits of improved student learning, greater ease of use, and information about achievement and attitudes from the field testing far outweigh the modest two percent expenditure on this aspect of the program.

Obviously, there are a number of reasons that cost-benefits analysis of field testing in the Energy Source project cannot be generalized freely to other development efforts. Nonetheless, the general result will be similar across projects. The costs of a welldesigned field test will consistently be modest relative to the benefits it yields.

Swallow your ego.

In ID projects, you want to have a number of people look at your program and give you feedback on it during the development phase. Rest assured that everyone is not always going to like everything you do, and they may not always be tactful about telling you so. So be prepared to take your share of criticism without firing back at your critics. If you appear too eager to defend yourself, you may give the impression that you don't really want comments or that you are unduly defensive.

Keep in mind that your goal is improvement of the program, and be willing to make it available to qualified people who can help you achieve that goal. If the substance or tone of some comments seem unwarranted, forget it or handle it directly and graciously with the reviewer. Try to get your ego gratification from the quality of the program, not from winning a battle of words.

Two remarks written by reviewers in pre-tryout versions of the Energy source text still stand out in my mind. One informed me that "People like you who write this kind of Socialist garbage undermine the fabric of American society." The other, which appeared twice in one review, was even more succinct and eloquent. It simply said, "Bullshit!"

Hopefully you won't attract any comments that are quite as extreme as these. Yet, even the extreme ones have some redeeming value. The more you get, the quicker you develop an immunity to them. Sometimes you really need it.

Stick by your ID guns.

It is your advantage in ID projects to have a close working relationship with the program sponsors and SMEs, one in which you are partners in a joint effort to develop the best possible program. The innumerable decisions to be made about the program itself generally deal primarily with either subject-matter content or instructional practices. The best division of responsibility is for the SMEs to have the final word on subject-matter issues and the ID personnel on instructional decisions.

It is almost inevitable that you will occasionally have honest disagreements about the program with its sponsors or with the SMEs. (Because of the nature of your working relationship, it is even more inevitable that you will have them among your own development staff.) As the ID specialist, you are responsible for the instructional integrity of the program. When disagreements about instruction occur, hear them out carefully and make your decision on the basis of your knowledge of sound ID practices and applied learning theory. Then stick by your guns. On instructional matters, the buck stops with you.

There's also the other side of the coin, of course. You must acknowledge the same final responsibility for SMEs on subject-matter issues that you have on instruction. Deciding whether an issue is a subject-matter one or an instructional one is not always easy. A good reason for learning the subject matter well yourself is to determine whether a proposed or typical way of organizing and presenting it is actually the best possible way for students to learn it. Decisions of this type are instructional ones, but they are often controversial. You must know the subject matter well in order to make them properly.

All of the writing for the Energy Source Program was done by the instructional developers and reviewed by representatives of the sponsor companies, other SMEs, and educators. When significant disagreements occurred, they were discussed in an effort to produce final materials that were acceptable to both groups. Final responsibility on issues was divided as described above between a small group of SMEs and the instructional developers. Not everyone was always happy with every decision, but the overall process worked well and produced mutual respect between the two groups.

Conclusion

The seven practices above share an important characteristic with the basic steps in standard ID models. Both cost money to implement. Homework, graphics, and expert help can be very expensive. Yet, like the basic ID steps, these seven practices must be taken into account in planning and carrying out any well-conceived development effort. Certainly they made the difference between success and failure for the Energy Source Program.

Author Note. The author directed the development of the Energy source program while serving as a consultant to the Educational Development Specialists of Lakewood, California.