Constraints to Curriculum Reform: Teachers and the Myths of Schooling

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Curriculum reform efforts usually have ignored the culture in which curriculum is embedded. Principal components of the culture are the knowledge of teachers and the myths of this culture. Images, metaphors, and metonymies are forms of teacher knowledge that influence the manner in which teachers define their roles and implement the curriculum. Unless endeavors are made to facilitate teacher learning through the construction of new images, metaphors, and metonymies, it is unlikely that curricular reform will proceed in the intended manner. Similarly, the myths that define the customs and taboos of a culture need to be considered by instructional designers if their curricular resources are to be used as intended. The myths of teacher as controller of students *and* objectivism *together might persuade teachers to adhere to the more traditional approach whereby knowledge is transferred to students in teacher-controlled activities.*

This article describes the ScienceVision *series, a hypermedia system developed in response to a clear need for additional resources to educate teachers concerning alternative myths and their use in relation to utilizing resources.*

☐ The relative lack of success of the curriculum revolution of the 1960s is frequently attributed to the failure of teachers to faithfully implement curricular resources as intended by developers (Gitlin, 1987). It was assumed that curriculum developers knew what had to be done and that teachers could be trained to implement the curriculum in the correct way. In some cases, curriculum packages were designed to be "teacher proof," that is, to facilitate student learning irrespective of the preparedness of the teacher. The assumption that a curriculum is independent of instruction might have contributed significantly to the failure of reform efforts.

In an endeavor to overcome this problem, curriculum theorists reconceptualized curriculum as a set of actions that occur to influence the learning of individuals within a particular culture. From this perspective, any attempt to change a curriculum ought to take into account the teacher, the students, and the culture in which learning is to occur (Grundy, 1987).

Within the culture of schools, teachers refer possible actions to referents (e.g., myths*) to

*Hinnells (1985) describes myths as follows: "Not only are myths expressions of man's reflections on the basic meaning of life, they are also charters by which he lives, and they can act as the rationale of a society. The established pattern of society is given its ultimate authority through mythical concepts. . . . Myths, then, provide charters for ethical and religious conduct; they express and codify beliefs. . . ." (p. 20–21).

make sense of what they think and do (Tobin, 1990a,b,c). Accordingly, teachers utilize curricular resources in ways that make sense to them, in the context of what is permitted and advocated within the culture of the schools in which they teach. If curriculum resources advocate practices that are consistent with the customs of a culture, there is a greater likelihood that teachers will adopt them with fidelity. However, if curriculum resources recommend practices that are considered taboo within the culture, there is less likelihood that teachers will use or incorporate them in the manner intended.

The thesis of this article is that instructional designers ought not attempt to produce materials that are teacher proof, nor fail to consider the knowledge of teachers and other aspects of the culture in which a curriculum is to be implemented. What happens in classrooms will be constrained by the curriculum resources utilized to enhance student learning; however, the use of curriculum resources is dependent upon characteristics of the culture, an important component of which is the knowledge of teachers. Instructional designers should reflect on what they believe learning and knowing to be and how knowledge is conceptualized in planned resources.

Discussed in the first part of this article are the myths underlying the curriculum, teacher knowledge and the curriculum, and constructivist perspectives of the curriculum. Presented in the second part of the article is the *ScienceVision* series, a multimedia curriculum resource designed to allow teachers considerable flexibility in modifying and using materials, while emphasizing student-centered, cooperative learning.

MYTHS UNDERLYING THE CURRICULUM

The teacher as controller of students is a myth that pervades classrooms. Accordingly, the roles of teachers and students have evolved over time by developing customs and taboos regarding the extent to which the teacher can control students in postulated situations. Referring thoughts and actions to the myth of teacher as controller of students has led to the highly controlled learning environments that characterize many classrooms. Teacher and student roles associated with activities such as classroom management, small group problem solving, and assessment have evolved so as to maintain the teacher's power in the classroom. In the 1960s and 1970s, curriculum resources that advocated greater student responsibility for learning were implemented in a context of the belief that the teacher should retain control of students. Not surprisingly, most teachers utilized such resources in a manner different from that intended by the designers. The alternative myth—that students should have control of their own learning—does not appear to have widespread acceptance. This might be due in part to the compatibility between the myth of teacher as controller and the myth of objectivism.

Lakoff (1987) explained that *objectivism* was believed to be the only correct way to describe experience. There was no recognition of the role of conceptual schemes in experiencing the universe or describing it. From an objectivist point of view, knowledge is seen as separate from knowing and humans can *acquire* knowledge in an objective manner through the use of the senses. Objectivist beliefs about knowledge, knowing, and learning are based on a model that regards the mind and body as separate and knowledge as an entity that exists "out there." An educational program based on objectivism emphasizes the learning of knowledge as truths to be reproduced on tests. Discovery and behaviorist approaches to learning are examples of objectivist-oriented theories of learning.

Putnam (1981) discredited objectivism with the proposal that sensory inputs were influenced by conceptual structures. Putnam noted that:

> Even our description of our own sensations, so dear as a starting point for knowledge to generations of epistemologists, is heavily affected (as are the sensations themselves for that matter) by a host of conceptual choices. The very inputs upon which our knowledge is based are conceptually contaminated. (p. 54)

One of the central questions for any educator to answer is whether or not knowledge has any relation to reality. Lakoff (1987) provided the following insights into this question.

> We are not outside of reality. We are part of it, *in* it. What is needed is not an externalist perspective, but an internalist perspective. It is a perspective that acknowledges that we are organisms functioning as part of reality and that it is impossible for us to ever stand outside it and take the stance of an observer with perfect knowledge, an observer with a God's eye point of view. But that does not mean that knowledge is impossible. We can know reality from the inside, on the basis of being a part of it. It is not the absolute perfect knowledge of the God's eye variety, but that kind of knowledge is logically impossible anyway. What *is* possible is knowledge of another kind: knowledge from a particular point of view, knowledge which includes the awareness that it is from a particular point of view, and knowledge which grants that other points of view can be legitimate. (p. 261)

Constructivism (von Glasersfeld, 1989) is a theory that assumes knowledge cannot exist outside the bodies of cognizing beings. Constructivism recognizes a reality that exists independently of cognizing beings—i.e., the universe would continue to exist in a physical sense if there were no longer persons to think about its existence. However, the experiences of cognizing beings are constructs that are shaped by what is known and understood by the individual.

Experience involves an interaction of the individual with events, objects, or phenomena in the universe, that is, the interaction of the senses with reality. The result of this interaction is an image of reality, a personal construction that fits the external reality but is not a match. The senses are not conduits to the external world through which truths are conducted into the body. Because the senses of humans are embodied, all experiences are subjective. Accordingly, knowledge is a construction of reality, one that is viable in the sense that it allows an individual to meet his or her goals in his or her environment. Knowledge that is not viable for an individual does not survive. Thus, knowledge is constructed and adapted as a result of successive experiences and reflections.

TEACHER KNOWLEDGE AND THE CURRICULUM

The main thesis of this article is that a curriculum cannot be considered in isolation from the culture in which it is to be implemented. An extremely important part of this culture is the teacher who will plan and implement the curriculum. The teacher's knowledge will inevitably constrain student learning. Consequently, in this section the ways that teachers represent what they know are examined. Knowledge is viewed from a constructivist perspective as the product of learning, consisting of beliefs and other propositions, images, metaphors, metonymies, and bodily actions.

A teacher's experience is sensory and is given meaning by reflection that involves the construction of images and, in some cases, the assignment of language to images, which can be thought of as dynamic reconstructions of experience (Clandinin, 1986; Paivio, 1974). Sanders and McCutcheon (1986) and Elbaz (1983) reported how teachers used images as they thought about teaching. Even more graphic was the example of a science teacher who envisioned himself as a swashbuckling captain of a ship, barking orders to his crew to keep them under tight control (Tobin, 1990b).

Metaphors can be used to make sense of concepts associated with science and the teaching of science (Johnson, 1987; Lakoff, 1987; Marshall, 1990; Munby & Russell, 1990; Tobin, 1990c). These metaphors are personal referents and are not necessarily shared by teachers generally. However, metaphors serve to organize sets of beliefs. For example, one teacher, Marsha, used the teacher-as-comedian metaphor* to make sense of her management

*Marsha described and named her own metaphors. The words used to depict particular metaphors in this discussion are Marsha's.

and facilitation of learning roles (Tobin & Ulerick, 1989). Marsha had numerous beliefs associated with her roles, and each belief was consistent with the teacher-as-comedian metaphor. Similarly, her beliefs about how students ought to think and behave were associated with the teacher-as-comedian metaphor. When Marsha was unable to control students' misbehavior or facilitate their learning, she had few alternative metaphors to guide her actions. She had to be either comedian or effort miser. As effort miser, she focused entirely on management, keeping students controlled and busy. Learning ceased to be a concern.

An important aspect of language and knowing is referred to by Lakoff (1987) as metonymy, which occurs when a person uses a part of a concept to give meaning to an entire concept. For example, Marsha, and most of her colleagues, defined teaching predominantly in terms of management, which in turn was defined in terms of control of students. Hence, solutions to teaching problems were sought in terms of management and control.

Another way to think of metonymy is to identify the central concepts used to give meaning to a concept. This way of framing metonymy recognizes that some ideas are central to conceptualization and others are peripheral to it. Marsha used three roles to conceptualize teaching: management and assessment, which were central, and facilitating learning, which was peripheral.

The most common metonymic models for learning include discovery, drill and practice, and memorizing. Metaphors for learning are often associated with ingesting a fluid—soaking up or absorbing knowledge into the mind, which is situated in the head. Accordingly, a teacher faced with the problem of how to use technology to enhance learning could make sense of the problem in terms of using computers to transfer knowledge into the heads of learners. Furthermore, when the task is to transfer knowledge from the memory of a computer to the memory of learners, the strategies of teachers and learners that seem most appropriate are bound to differ from those suggested by constructivism as being most appropriate for learning.

From a constructivist perspective, a curriculum designed by outsiders to be implemented by teachers is doomed. The best that can be done is to provide resources and a way of thinking about how teachers and their students learn. *ScienceVision* is one such resource. Teachers are encouraged to modify and use the materials in ways that make sense to them. That is not to say that *ScienceVision* comes without assistance to the teacher; teacher materials are provided, along with descriptions of how other teachers have used the products.

CONSTRUCTIVIST PERSPECTIVES OF CURRICULUM

Constructivism is a set of beliefs that can be used as referents for making sense of actions. Accordingly, there is not *one* constructivist way to teach or, for that matter, *one* constructivist curriculum. Any set of actions can be interpreted from a constructivist point of view. However, a curriculum can be planned with constructivism as a referent. In such a case, the focus of the curriculum would be on facilitating the learning of students. Consequently, a curriculum built upon constructivist beliefs is concerned with the social aspects of learning in which students make sense of experience in terms of extant knowledge.

A review of computer-based programs (including the latest videodiscs used in instruction) reveals that many of them incorporate a behaviorist, step-by-step methodology of instruction. Most current software exemplifies a "cookbook" approach to instruction whereby a learner begins at step one, answers a question, is presented another step, answers another question, and so on. The cookbook approach constrains student actions and makes it difficult to take full account of students' extant knowledge and interests and local sociopolitical factors that might be incorporated into the science curriculum. Rejection of the cookbook approach to software design resulted in *ScienceVision*.

SCIENCEVISION: A CASE STUDY

The Interactive Media Science's (IMS) *ScienceVision* project (Dawson, 1991) is an example of the most recent wave of curriculum reform efforts. Developed at Florida State University as a collaborative effort among the University, the National Science Foundation and Houghton Mifflin Co., Inc., *ScienceVision* is a hypermedia system comprised of a physical package of six two-sided interactive videodiscs, computer software, and print material. There are two discs in each of the disciplines of biology, earth/space science, and the physical sciences. The subject matter of the six discs deals with ecology (*EcoVision*), human body systems (*BioExplorer*), astronomy (*AstroVision*), geology (*TerraVision*), Newtonian physics (*ErgoVision*), organic and inorganic chemistry (*Chemical Pursuits*).

ScienceVision Goals

ScienceVision is designed to address seven basic goals:

1. Provide students with opportunities to experience and explore science in relation to their lives and to become comfortable and personally involved with its processes and ideas.
2. Provide students with opportunities to learn science while having experiences emphasizing imagination, adventure, relevance, and the joy of learning.
3. Provide a confidence-building experience.
4. Establish personal, societal, technological, and environmental relevance of science content.
5. Emphasize the notion that humans are the stewards of the earth.
6. Emphasize the notion that students can make a difference.
7. Foster a positive attitude toward science.

The Development Process

The *ScienceVision* goals were important guides for the development team. The Project Director (Principal Investigator) set the overall philosophy, rationale, and basic design for the project and was the primary contact with the university, the publisher, and the National Science Foundation. Day-to-day operations were handled by a Project Manager who monitored the adherence to the established policies.

Subteams were assembled for each of the three content areas, consisting of a middle school science teacher known for his or her teaching ability and knowledge of science, a writer, videographer, programmer, graphic designer, and illustrator. Support was provided to all three subteams by searchers who located reference material and obtained permissions, a producer, and a head programmer.

The project was housed and operated at the Center for Instructional Development and Services at Florida State University. The Center provided fiscal management and other support services to the project.

Three project teams designed a user interface, wrote scripts and programmed code with the goal of empowering students. The project teams did not subscribe to an inquiry approach (Schwab, 1963) because that model carefully defines the problem for students and prescribes steps leading to a solution. Conversely, the design had to do more than simply present a topic and leave procedures entirely up to students.

Roughly 18 months of preplanning and initial design was required to produce a model with sufficient flexibility for a student to truly explore a topic. The model needed to provide a degree of guided discovery and allow free inquiry (Carin & Sund, 1989). These features were embedded to reflect the belief that people do not tackle problems using a single mode. Instead, a variety of resources and tools were provided to permit and encourage student-centered learning strategies.

The topics included in *ScienceVision* are not usually studied in a middle school science classroom due to time required, danger or cost involved, or the impossibility of manipulating some variables. For example, *ScienceVision* enables students to observe the period of revolution of the moon around the earth when making changes in any combination of the mass of the earth, the mass of the moon, and the distance between the earth and the moon. By conducting research within the *ScienceVision* microworld, students see how science knowledge has been, and is being, constructed in a social setting.

Pedagogical Features

Focus on Science Processes

ScienceVision stresses science process over specific content. There are very few programs available where the world of "doing" science is simulated. In *ScienceVision,* students learn content by experiencing science as a process. While the situation of a mining site is centered around principles of ecology, science processes are being used. By selecting "hot spots" on the site screen, students *observe,* using their eyes and ears, differences among the various sites. These sites represent successive stages from cleared land to a mature forest.

Students use measuring and graphing skills in research activities such as "Project Green Thumb." They use a tool to take the pH of the soil in the mining site, where almost nothing is growing, compare it to the pH of the soils outside the site, where plants are growing well, and discover that the pH is lower in the mining site. When they "plant" corn under one or more (their choice) variables such as pH, they measure the height of a representative sample of corn grown under low-, medium-, and high-pH conditions, and discover that corn will not grow well at the mining site unless the soil is treated to raise the pH. (In the formative evaluation feedback, teachers have reported that students have tried to calculate how many boxes of baking soda they will have to buy to increase the pH of the soil.) In many instances, students end up doing a cost/benefit analysis of converting the mining site to farmland. There are ample opportunities for the students to infer, predict, formulate hypotheses, define variables, create models, and record, collect, interpret, and report data.

While *ScienceVision's* file tab format has elements of guided design, students have a great deal of latitude about what to study and how to go about their work. What is encouraged, within the limitations of the hardware, is free inquiry. The fact that the student investigator can get from one location directly to almost anywhere else means that a student can "mess about" in ways suggested by David Hawkins (1965).

Once *ScienceVision* students are familiar with the resources of the program, they can ask questions on their own. "What if" questions can be asked at any point in the six-disc series. For example, one of the discs teaches physical concepts by exploring the question of how to make a roller coaster more exciting. Students can ask questions such as, "What if I put a bigger motor on the chain on the first hill? Will that make the car go faster?" In demonstrations of this disc, people in the audience are asked to list questions they would ask about roller coasters if they had a chance. A very large percentage of the questions asked over the past year can be answered by "messing about" with the disc.

Prior Knowledge

ScienceVision does not assume specific, prior science knowledge, nor is there belief in an agreed-upon body of knowledge that must be learned. Rather than pretesting and providing a prescribed plan of action based on what students already know, the discs are designed to enable students to seek answers to questions raised in the courseware and to questions that arise while doing related activities. Rather than prescribing what is to be studied, *ScienceVision* presents students with a context designed to arouse their interest.

Student Centered

The structure of the *ScienceVision* materials attempts to take account of students' extant knowledge; allows students to pursue their personal interests while using a disc; advocates collaboration with others, negotiation, and consensus building; and recognizes the need for students to make personal sense of experience and utilize their own language to describe what they have learned. Social collaboration is an important ingredient of the electronic and print media that comprise the materials.

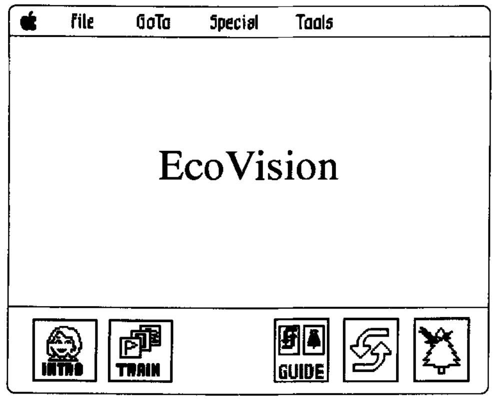
Cooperative Learning

The developers prefer students to work cooperatively so that negotiation can occur within and among groups. The discs contain suggestions for student roles and the need to assume different roles from time to time. Assistance to the teacher on how to set up cooperative learning groups is given in the Teacher Resource Guides. Students are encouraged to "mess about" and come up with their own questions and to negotiate meaning from their investigations. The responsibility for learning and making sense of what happens rests ultimately with individual learners. However, learners need time to experience, reflect on their experiences in relation to what they already know, and resolve any perturbations that arise. Accordingly, learners need time to clarify, elaborate, describe, compare, negotiate, and reach consensus on what specific experiences mean to them. *ScienceVision* encourages experimentation and recommends that students go "off-line" to reflect on the progress they have made toward solving problems.

A Typical Session

Perhaps the best way to get an understanding of how *ScienceVision* works is to observe a group of students using the *EcoVision* program. They start with the Main Menu screen shown in Figure 1* in front of them. Upon starting the program, the team of three students has an Agent's Log open, which is read aloud by one of the members. The Agent's Log is a workbook designed to hold field notes students collect as they investigate ecological problems. Each of the icons on the computer screen is identified, and a narrator suggests that students select the Training Room icon if they are unfamiliar with *ScienceVision*. By selecting the Training Room icon, students are taken to a sample Site Screen, where uses of each of the icons on the screen are described using both text and voice. Since all icons are standard for *ScienceVision*, students should need to use the Training Room icon only once.

FIGURE 1 ☐ Main Menu Screen



Once they understand how to move about the disc, students return to the Main Menu screen, where they can select the Intro Movie icon for an introductory movie describing the theme of the disc. The introductory movie introduces Michelle, the Director of EcoVision Headquarters, a fictitious organization that students concerned with the environment can contact for assistance. She describes four general categories of concern to EcoVision Headquarters: land reclamation, development on wetlands, waste management, and species preservation. By selecting the Guide icon, the students are provided a brief description of each of the sites where these topics can be investigated.

When the team is ready to study a site, they select the appropriate icon and go to the Site Screen (Figure 2) for the problem chosen. The

*All illustrations used in this article are from: Interactive Media Science Project (1992). *EcoVision User's Guide.* Boston: Houghton Mifflin.

FIGURE 2 ☐ Disturbed Lands Site Screen

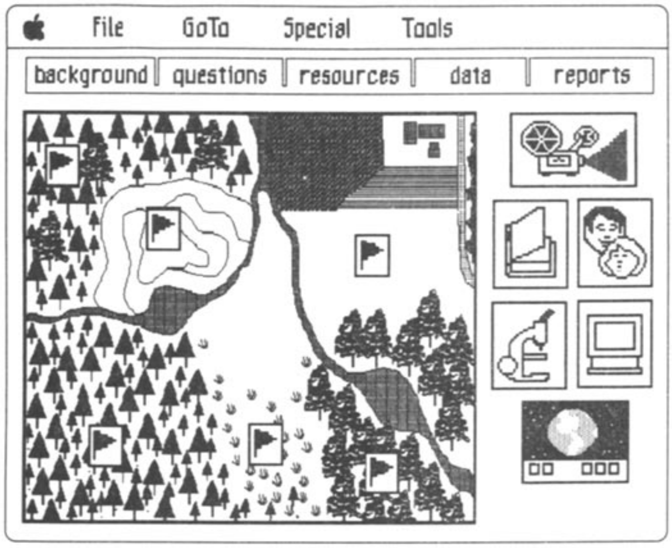
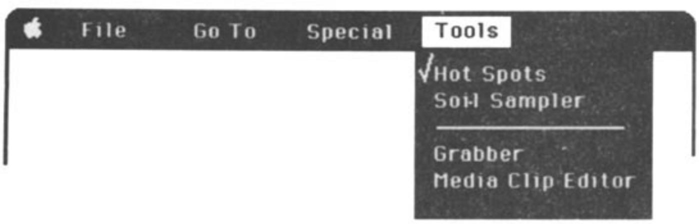


FIGURE 3 ☐ Tools File



team then begins work at the site. From this site (similar to the home card in a Hypercard stack), students can select from a rich array of resources. As students "need to know," they can access data from the disc to assist them to solve a problem. Terms used in the *ScienceVision* materials are defined in a "videopedia," one of the references under the Book icon. These entries are linked to an illustration, which is usually a slide but can be an animated segment or movie clip. Other resources available include data bases (Computer icon) containing information such as the number of fish in a pond, contemporary or historical persons who act as experts (Faces icon), and research activities (Microscope icon). The materials are designed in such a way that a student can link information resources directly.

At the top of the screen are file tabs for other useful resources which remain visible when any computer-generated screen is displayed. The File label has the normal file commands. The GoTo label has direct links to major sections of the disc. The Special label has commands for turning narration on and off. The Tools label (Figure 3) includes a variety of commands and features, such as Grabber and the Media Clip Editor for repurposing, Hot Spots for film clips (indicated by flags on the Site Screen) about a section of the site, and Soil Sampler for obtaining details about the soil conditions—depth, pH, nutrients, and moisture content.

FIGURE 4 ☐ Background File

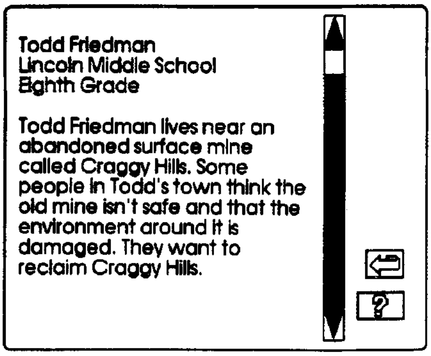
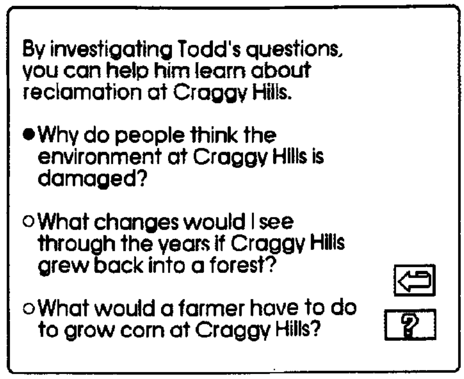


FIGURE 5 ☐ Key Questions File



The only recommended sequenced event at the Site Screen is the site movie where the site is introduced. In the movie, a student, Todd, is shown talking to Michelle about an abandoned mine taken over by the little town in which he lives. A debate is going on about whether the mine site should be returned to farming, allowed to return to its natural state, or left for dirt bikers to continue to use. Todd can see advantages to all of the options and wants help in making a decision, so he has turned to EcoVision Headquarters. Michelle informs Todd that there is a group of EcoVision agents interested in working on the problem, and that they will get back to him with their recommendations. Our student team then begins to investigate the mining site.

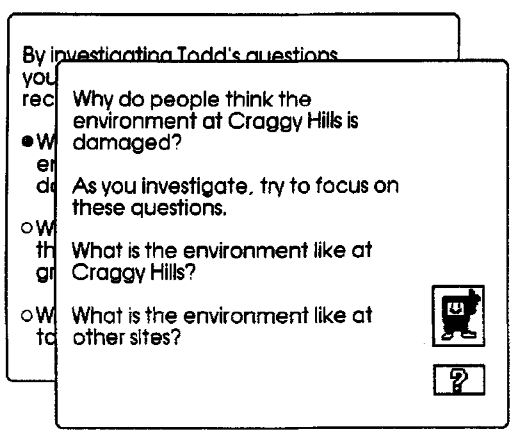
By selecting the file tabs at the top of the screen, students receive assistance in conducting an investigation. The arrangement of the tabs suggests a way of conducting an investigation: What is the problem (Background file)? What questions have been raised (Questions file)? What resources would be most useful to answer a particular question (Resources file)? Where do you record your data (Data file)? What forms might a report take (Reports file)?

The Background file (Figure 4) is a textual summary of what is covered in the site movie. It is used for a quick review by the team, or for reading by a team member who may have been absent when the site movie was viewed by the other team members.

When the Questions file is selected, a number of key questions the authors raised are presented (Figure 5). If a student double clicks one of the questions, focus questions are revealed (Figure 6). If the students can answer the focus questions, they should be able to answer the key question.

When the Resources file (Figure 7) is selected, the same three major questions for the site are shown. When the team selects a question here, they are provided a list of resources which are keyed directly to the question. This narrows the tasks somewhat from the vast array of resources available in the program, but still requires the students to decide which, if any, will be used. Similarly, if a student

FIGURE 6 ☐ Focus Questions File



selects the Data file, a menu (Figure 8) appears, telling the students where to record data in their Agent's Log.

When students select the Reports file (Figure 9), they are shown a list of alternatives for reporting what they have learned to Todd and to their teacher. They can select any of the items displayed to receive additional instructions (Figure 10) about what to do. The Media Clip is of special interest because students can capture, label, and sequence any of the video images on the discs to make a multimedia presentation of their research. They or the teacher can use this tool to repurpose the discs. For example, by using the Media Clip tool, students can access the Field Guides in the Reference section, select photos of reptiles from each of the biomes of the United States, and make a presentation about them.

FIGURE 7 ☐ Resources File

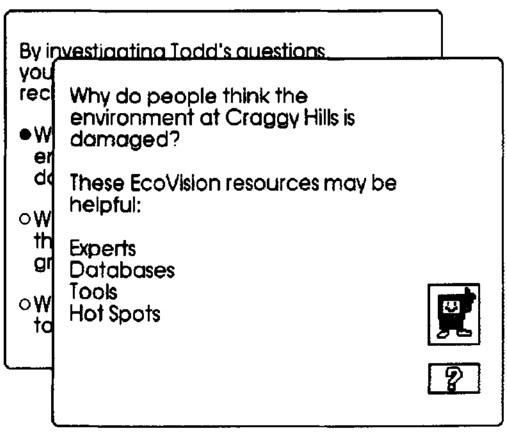


FIGURE 8 ☐ Data File

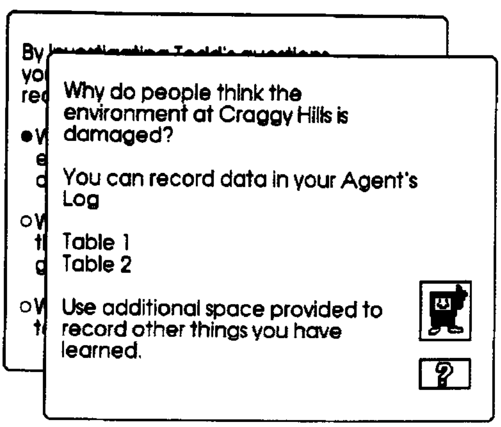


FIGURE 9 ☐ Reports File

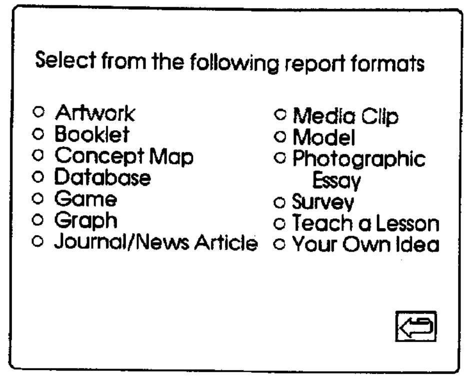
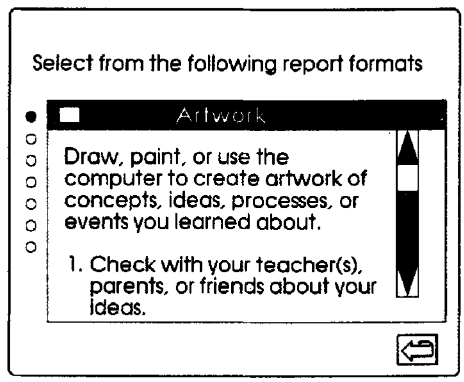


FIGURE 10 ☐ Instructions File



FIELD TEST HIGHLIGHTS

Complete field-test data have been collected and have been compiled in detail (see Bowen & Dawson, 1991). The following is a summary of the highlights of the evaluation. Data collected from the field test consisted of science content and process measures, an attitude survey, student interviews and annotated copies of Agent's Logs. Data were also collected from teachers in four areas:

1. integration of the *ScienceVision* materials into the curriculum;
2. management of the materials;
3. student use of the materials; and
4. innovative ways of using the materials.

Feedback from six school districts where *ScienceVision* has been evaluated indicates that teachers and students *do* change their beliefs about teaching and learning through the use of materials, and that students learn science effectively when using the *ScienceVision* program. *ScienceVision* students scored significantly better (alpha = .10) than control groups on both attitude and science achievement measures. They had little difficulty navigating around the lessons, they used multiple data points when solving problems, and they used what they learned outside the classroom. One notable example was evident in a group of students who, after using *EcoVision*, made their own tapes of local problems, coupled them with images from the *EcoVision* disc, and then made a multimedia presentation to County Commissioners regarding environmental problems in the county.

Teachers were enthusiastic about the program and reported that the materials were easily integrated and worked well in activity-based classes. Several teachers mentioned that students were successful with topics normally not taught in middle school science classes. Teachers did report two areas of concern: the management of the equipment and materials, and students missing other activities taking place in class. However, many teachers found ways to avoid these problems, and their ideas have been integrated into the revised editions of the program.

The field test resulted in many changes in the final products. The next task for the IMS team is to prepare related text and laboratory activities to supplement the videodisc/computer programs in order to have a complete program rather than a supplement to existing textbook-based science courses.

CONCLUSION

Despite the optimism of the *ScienceVision* authors and the promise of *ScienceVision*, it is unlikely that widespread changes in curriculum in general will occur unless programs are designed for teachers to understand constructivism and objectivism and consider their own classroom actions with respect to control, which involves asking questions about who should have control over the events that occur in their classrooms.

The struggle for control that characterizes so many classrooms results in a dysfunctional learning environment. Traditional attempts to solve the problems center on teachers having primary control and responsibility for many classroom events. However, solutions have not been forthcoming. In many classrooms, the learning environment appears to be worse than ever. Learners are given little autonomy and hence lose interest in the curriculum, and the struggle for control continues. School curricula traditionally have been built on objectivism. Accordingly, traditional practices—deliberative and routine—usually make assumptions about the nature of knowledge that constrain the roles of teachers and students to acquisition of knowledge as it exists in the "real" world.

Resources designed to assist teachers and students also have been developed on a framework of objectivism. However, as teachers learn how to use constructivism as a referent for actions, the curriculum takes on a different look as teacher and student roles evolve away from learning facts by rote toward providing learners opportunities to make sense of problems, building knowledge on what is already known in an environment where responsibility is given students for their own learning. A new breed of curriculum resources is needed by teachers and students, resources that provide learners with the autonomy to select activities that accord with their interests and prior experiences and build new learning on a foundation of extant knowledge. Such resources would not merely provide facts and figures, but would encourage the negotiation of meaning that is fundamental to learning in a manner that empowers the learner to meet his or her goals in a rapidly changing, increasingly complex world.

Our research suggests that the beliefs, metaphors, and metonymic models of teachers and students are associated with curricular actions. To change the curriculum, therefore, it is necessary for teachers and students to reconceptualize the manner in which they make sense of their respective roles. The implication of this assertion for instructional designers is that teacher education is an essential component of curriculum reform. Programs need to extend beyond *training* teachers to implement resources with fidelity. Instead, carefully designed programs should provide opportunities for teachers to become *educated* in the use of the resources to facilitate learning of students in their classrooms. The resources must be understood in relation to the curriculum within which learning occurs. □

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