Labs for Learning®: An Experiential-Based Action Model

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The challenges confronting today's classroom teachers are unprecedented. Teaching to major themes, integrating technology-based tools (e.g., telecommunications, databases, spreadsheets, CD-ROM-based simulations) supporting concept/process-based instruction and negotiated learning, and employing alternative assessment strategies have signaled both opportunities and concerns for educational practitioners nationwide. Exactly how can one expect to do all of these things in a manner that is consistent with a constructivist theory of learning but does not leave our instructional curriculum void of meaningful and relevant student experiences?

Several variables are already in place to aid educational practitioners through this change process. The advent of global telecommunications has created unlimited possibilities for spontaneous information searches, collaborative research projects, and data collection. The emergence of the Science, Technology, and Society (STS) movement coupled with the release of the *NCTM Standards* in 1989 and *Benchmarks for Science Literacy* in 1993 have provided an empirical as well as a philosophical foundation for restructuring efforts in science and mathematics instruction nationwide. The current focus on the constructivist learning approach and its emphasis on the learner's cognitive structures has brought added legitimacy to classroom practices that promote group learning, student activism, self-analysis, and issues resolution. Additionally, the appearance of many noteworthy instructional projects on the educational landscape including Labs for Learning have provided valuable curriculum models for educators to plan, implement, and evaluate their instructional curriculum consistent with the intellectual, social, and personal needs of the learner and the major concepts, processes, and themes embedded in the formal curriculum.[1]

This position paper traces the history of the STS movement within the context of the Labs for Learning approach, describes the salient characteristics of the Labs for Learning experiential-based action model, and discusses some of the requisites for its continued maintenance and expansion. Labs for Learning represents an instructional methodology that integrates science, mathematics, social studies, language arts, and technology through meaningful, relevant topics or themes. Science provides context for language arts and math, while contemporary topics (e.g., environmental pollution, world hunger) and themes (e.g., systems, change) provide the context for science.

The Labs for Learning methodology aligns closely with the Science, Technology, and Society (STS) movement popularized in the early 1980's. Science, Technology, and Society projects are designed for student exploration of the interdisciplinary nature and practical application of their classroom experiences. The underlying principle for all STS projects including Labs for Learning is the emphasis on issues investigations and student activism. Issues investigations stress student problem identification, exploration of alternative solutions, and the creation of action plans related to a problem or issue. Student activism refers to the learner process skills and strategies used by students as they organize, implement, and evaluate the success of their action plans.

History of STS

The primary impetus for STS was the result of several research studies in the late 1970's documenting the actual state of science teaching in the United States (Helgeson, Blosser, & Howe, 1977; Weiss, 1978; and the *Third Assessment of Science* by the National Assessment of Educational Progress, 1978). Some of these findings concluded that:

1. Ninety percent of all science teachers used textbooks for science instruction in excess of 90% of the time.
2. Textbooks did not address the personal needs of students, societal issues, or career awareness.
3. The textbook determined what was taught in the schools and variation from one textbook to another was less than 10%.
4. Instruction focused on textbook readings, teacher lectures, question and answer techniques, and verification-type laboratories.
5. Over 90% of the evaluation in science classes was based upon the recall of information.
6. Teachers viewed themselves as the determiners of information rather than facilitators. (Yager, 1993)

In the early 1980's, several national reports and position papers made specific recommendations to broaden the scope and relevancy of science and math instruction at the K-12 level (e.g., A Nation at Risk, 1983; Educating Americans for the Twenty-First Century, 1983). The National Science Board on Precollege Education stressed the importance of relevant science and technology education through its recommendation that the science curriculum "be organized around problem-solving skills, real life issues, and personal and community decision-making." (Educating Americans for the Twenty-First Century, 1983)

The STS movement was also supported by the national release of two monumental documents, *NCTM Standards* in 1989 and *Benchmarks for Science Literacy* in 1993. Both publications provided further impetus for increased emphasis on relevant mathematics and science in the classroom through the creation of national standards or benchmarks for the science/math curriculum. STS practices also provide a needed rationale for the expanding role of technology in the classroom. A 1990 report on STS by the Oregon Department of Education reiterated the importance of science and technology integration:

> Technology is a fundamental force in our modern society. Its importance to the school curriculum has been underscored by the reports and recommendations of the national panels and commissions which recognize that, while science and technology are not synonymous, they are closely related and interdependent, and that, while knowledge in science is not sufficient to the development of technological literacy, it is a necessary component. (Oregon DOE, 1990)

Many noteworthy STS-based instructional projects have appeared on the educational landscape as by-products of the STS movement including the Chemical Education for Public Understanding Program (The Regents of the University of California, 1989), Event-Based Science Project (Montgomery County Public Schools, MD, 1993), Radon Alert (New Jersey Department of Environmental Protection and Energy, 1993) and Labs for Learning (Learning Quest, Inc., 1993). Though the specific content may vary from one project to another, they all represent a new wave in instructional design that makes science and mathematics instruction current and a part of the real world.

Labs for Learning Methodology

Experiential learning dates back to the works and philosophy of John Dewey and encompasses those instructional practices that rely on real life experiences as the basis for learning. The fundamental characteristic of Dewey's educational philosophy involved the "... organic connection between education and personal experience." (Dewey, 1938) According to Dewey, the educator's task is to ensure the continuity of present experiences upon future experiences. In this context, quality learning experiences: (1) provide the learner with a sense of direction and purpose, (2) are encased in a well-defined context, and (3) include linkage between past and future experiences.

The Labs for Learning project employs an experiential-based action model to assist classroom teachers with organizing their instructional curriculum to promote technology integration, relevant mathematics and meaningful science — essential cornerstones of the STS movement. This model consists of five key stages including Focus, Current Conditions, Personal Involvement, Taking Action, and Feedback.

Focus

This first section sets the scene to create a holistic awareness and to motivate students about current, relevant issues related to the overall topic or theme using a variety of media and teaching strategies. Generating learner-based questions about the issue or problem and formulating a problem definition are essential elements of this section. Focus-related activities provide students with the motivation, rationale, and readiness to delve deeper into the topic and/or theme under investigation. Sample Focus strategies include students participating in surveys, observing surroundings for points of curiosity, asking questions, or noting unexpected phenomena.

Focus Questions

- ✓ Does a problem exist?
- ✓ What is the problem?
- ✓ How important is the problem?
- ✓ Does the problem affect me personally?

Sample Activities

- ✓ Newspaper Summaries
- ✓ Graphical Analysis
- ✓ Observations
- ✓ Demonstrations
- ✓ Surveys
- ✓ Literary Interpretations
- ✓ Discussions

Current Conditions

Once students develop an awareness of and a personal identification to the issue or problem, this section provides investigations and experiences to help students comprehend the magnitude of the problem and its relevancy to the overall topic or theme. Students thoughtfully interact with the pertinent science, mathematical, social studies, and language arts concepts and processes associated with the topic or theme through classroom experiments, field investigations, "I-Search" papers, surveys, data collection and analysis techniques, and simulations. Current Conditions activities provide students with the necessary experiences to understand the current status of and explore different perspectives about the problem associated with the topic or theme.

Current Conditions Questions

- ✓ How big is the problem?
- ✓ What does the problem look like?
- ✓ How do I know a problem exists?
- ✓ What do I need to know about the problem?

Sample Activities

- ✓ Experiments
- ✓ Surveys
- ✓ Debates
- ✓ Case Studies
- ✓ "I-Search" Papers
- ✓ Information Searches

Personal Involvement

Students at this level are given the organizational tools and analytical strategies that help them identify, structure, and modify solutions to the problem under investigation. Students now see how to use their knowledge in a practical and meaningful way. Personal Involvement activities include students reviewing and critiquing solutions, constructing and explaining models, or integrating a solution with existing knowledge and experiences. Personal Involvement events enable students to try different solutions for solving real problems. The solutions may range from an experiment to improve water quality to a community survey about starting a neighborhood composting program.

Personal Involvement Questions

- ✓ How can the problem be fixed?
- ✓ What are the most workable solutions?
- ✓ What can I do to solve the problem?

Sample Activities

- ✓ Experiments
- ✓ Trial and Error Studies
- ✓ Letters of Inquiry
- ✓ Surveys
- ✓ Field Investigations
- ✓ Model Building

Taking Action

This phase provides students with directions for putting their solutions into action and monitoring progress. Specific strategies including model action plans and organizational activities help students address the relevant issues on a local, regional, or national basis. Taking Action activities provide students with real world application of the concepts and processes embedded in the topic and/or theme.

Taking Action Questions

- ✓ Will my plan of action work?
- ✓ What does my action plan look like?
- ✓ Does my action plan address the problem?
- ✓ Can I do it?

Sample Activities

- ✓ Petitions
- ✓ Inventions
- ✓ Letters
- ✓ Fund-Raisers
- ✓ Volunteering
- ✓ Proposals

Feedback

Assessment, in the truest sense, gives students identifiable milestones to gauge progress toward the attainment of specific goals. The self-assessment portion of the Feedback phase helps students to reevaluate both the relevant issues at hand and their decisions to act individually or collectively. This step brings the five-phase experiential-based action model full-cycle.

In this assessment process, the teacher collects evidence and documents student success in written and oral communication, analytical and decision-making skills, student involvement and action toward solving authentic problems, and student understanding of the pertinent themes, concepts, and processes. Based on journal writing, communication among students, and development of resume-oriented portfolios, this assessment is both practical and meaningful in documenting student involvement and progress.

Feedback Questions

- ✓ How successful was my action plan?
- ✓ What concepts and processes did I apply?
- ✓ What content do I understand?

Sample Activities

- ✓ Open-ended Questions
- ✓ Problem Questions
- ✓ Performance Activities
- ✓ Portfolios
- ✓ Daily Journals
- ✓ Self Assessment
- ✓ Peer Review

Genesis of Labs for Learning

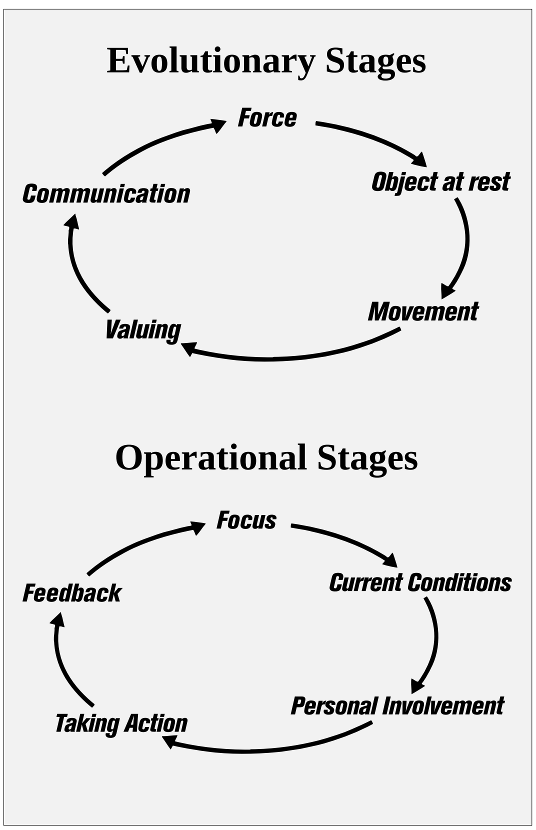
Though Labs for Learning can be categorized as a STS derivative, its evolutionary stages are entrenched in the physical and behavioral sciences. Figure 1 (page 5) compares these evolutionary stages with the operational stages of the Labs for Learning experiential-based action model.

By definition, force is a push or pull exerted on an object (Kilburn and Howell, 1981). When a force is applied to an object at rest, some type of movement (e.g., acceleration, displacement) results. In the context of Labs for Learning, this force represents powerful pedagogical events called Focus activities that motivate, challenge, and raise the general consciousness level of the learner about a significant problem or issue associated with the topic and/or theme. Since the amount of force is defined by the amount of acceleration given to a certain amount of inertial mass, the greater the force employed within any one pedagogical event (called a Focus activity), the greater movement or impact on the learner's awareness about and personal identification to the issue or problem associated with the topic/theme.

The object at rest or the inertial mass in this setting represents the content, learning activities, and teaching strategies associated with the problem or issue (i.e., Current Conditions) as well as the existing perceptions and knowledge within the learner's psychological world. The content (e.g., concepts, skills, and processes) may range from simple graphical analysis skills to conceptual understanding of Newton's Laws of Motion. The application of force to this inertial mass (i.e., Current Conditions) in the form of Focus events enables the learner to gain new perspective about the problem (e.g., air pollution, hazardous wastes, natural disasters) and a heightened interest in the concepts, processes, and skills related to it.

When a force is applied to an inertial mass, the resulting movement or change is analogous to the changes in students' perceptions and subsequent restructuring of existing cognitive structures or insights about a particular phenomenon. This movement represents the Personal Involvement stage of the Labs for Learning model because the emphasis is directed at student formation of new insights and the generation of solutions relating to the problem associated with the topic and/or theme.

Figure 1



The resulting displacement and change in the learner's perspective about the problem or issue leads to his selecting and, in a very real sense, valuing a particular course of action among competing options. The emphasis is directed at decision-making and evaluation. At this stage, referred to as Taking Action, it is the individual's psychological world interacting with his physical environment and the ensuing restructuring of existing notions and personal knowledge that lead to the creation and implementation of a particular course of action.

The final stage embraces the learner's interaction or communication with the society at large. Communication, in this context, provides feedback to the individual's restructuring of his psychological world related to his actions. In Labs for Learning, this stage represents Feedback and includes different forms of self-assessment, peer review, open-ended questioning strategies, and portfolio-based tasks.

Labs for Learning and Technology

Since the introduction of the Apple IIe computer in the early 1980's, the term "technology" has represented a broad range of interests and has been the subject of numerous interpretations. In school systems nationwide, technology has been the focus of curriculum renewal projects and school funding debates, and has served as the rallying cry for ushering many school districts into the 21st century.

Our fascination with technology stems, in a large degree, from its ambiguity within existing paradigms. Does technology represent things (e.g., computers, modems), words or ideas (e.g. progress, change) special forms of knowledge, or delivery systems (e.g., expert versus novice systems)? Each perspective on technology has its unique attributes and leads the individual to different conclusions and implementation strategies.

In Labs for Learning, technology is multidimensional. Spreadsheets, graphing applications, telecommunications, databases, CD-ROM-based simulations, probe interfaces, and related multimedia experiences are employed throughout the five-stage experiential-based action model to (1) promote student understanding of the pertinent concepts, skills, and processes, (2) assist the learner with finding solutions to an authentic problem, and (3) provide avenues for communication. Technology is also used as a means to an end (e.g., using telecommunications to survey community reaction to a proposed water conservation program) and as an end itself (e.g., the creation of a patent or new organizational strategy that addresses a pressing issue or problem).

Labs for Learning: A Balanced Curriculum

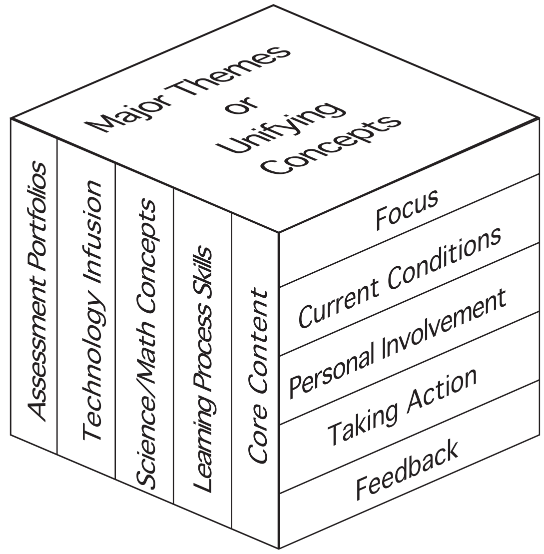
Through the Labs for Learning methodology, students discover and apply authentic uses of technology (e.g., spreadsheets, probes), as well as the important science, math, social studies, and language arts concepts and processes at each stage of the model. A well-conceived Labs for Learning instructional unit will also use a major theme or unifying concept as its organizing principle for assembling and shaping the specific investigations used therein.

Science for All Americans defines themes as "ideas that transcend disciplinary boundaries, and prove fruitful in explanation, in theory, in observation, and in design." In Labs for Learning, the intent is to provide meaningful context for students to conceptualize how these themes or "big ideas" help promote a better understanding of the integration of science, mathematics, language arts, social studies, and technology. Figure 2 illustrates the various dimensions of the Labs for Learning experiential-based action model and its relationship to a major theme or unifying concept. As illustrated in the diagram, each stage of the experiential-based action model contains significant core content, learning process skills, science/math concepts, technology application, and opportunities for student assessment relating to a major theme or unifying concept.

Labs for Learning motivates students to be proactive on current, relevant issues. Rather than passively listening and looking, students are actively involved in gathering information, analyzing data, and using their information to become responsible and socially-conscious citizens.

Labs for Learning provides the forum for civic awareness and participation. No more are science, language arts, mathematics, and social studies separated from the practical world of daily life; instead, students learn how the lessons of school translate directly into their everyday world. Every issue is one that affects the student, his or her friends, and family. The student learns to compare data sources, share information, and to critically review alternatives before decisions are made. In this manner, students learn how to refine their point of view, and if necessary, to change their perspective in light of new evidence.

Figure 2



Labs for Learning shows students how to make sense of national and international trends. In fact, it is the awareness or identification of trends that is a major goal of the Labs for Learning approach, while meaningful issues or themes related to these trends serve as the organizing threads that unite the entire curriculum. Labs for Learning is substantively different from other programs by its combination of technology, real data, thinking strategies, integrative curriculum, and a model for student action. All of these have been identified by industrial leaders, scientists, and educators as important in preparing students for the environmental, economic, social, and political challenges facing them in the future.

Future Outlook

The outlook for STS-related programs such as Labs for Learning appears promising. STS programs are underway in every state. The available empirical data tends to support STS as a viable instructional practice when compared to traditional science teaching (Mackinnu, 1991; McComas, 1989a, 1989b, 1989c, 1989d, 1989e; Meyers, 1988; Yager, 1989, 1990). (Yager, 1993) Since STS-related projects including Labs for Learning impact a broad spectrum of curriculum elements (e.g., types of learning activities, teaching strategies, methods of evaluation) at the instructional curriculum level, its Level of Use is, therefore, dependent on the teacher's self-efficacy, the readiness level of the classroom teacher, and the quality and frequency of interventions to support its implementation.[2]

The notion of self-efficacy and its impact on any change effort is well-documented (Ohlhausen, Myerson, and Sexton, 1992; Bandura and Wood, 1989; Guskey, 1988; and Berman and McLaughlin, 1977). Self-efficacy is a belief in one's ability to produce an effect or perform certain behaviors. Bandura and Wood (1989) define self-efficacy as one's capability to generate the necessary level of motivation, manifest the necessary cognitive resources, and accomplish the necessary course of action required to meet a given situation. According to Ohlhausen, Myerson, and Sexton (1992), "Individuals with high levels of self-efficacy are more likely to initiate new tasks and persist in light of roadblocks, frustrations, and difficulties." A classroom teacher's inclination to support and implement concept/process-based instruction, authentic uses of technology, and experiential learning–all characteristics of the Labs for Learning project–is directly linked to his self-efficacy profile.

Readiness references both the teacher's concerns about an innovation (e.g., Labs for Learning) and current level of instructional practices (see Figure 3, page 8). A teacher's concerns represent "... a composite description of the various motivations, perceptions, attitudes, and feelings experienced by a person in relation to an innovation. (Hall, 1978) The three developmental levels in Figure 3 describe the changes in instructional practices as one moves from a teacher-centered to a student-centered orientation characterized by the Labs for Learning experiential-based action model (Level 3).

Movement from one level to the next is dependent on the teacher's concerns about the innovation (e.g., current level of instructional practices). As the teacher's concerns move from self concerns (those related to the need for more information about the innovation as well as personal concerns about how the innovation will affect the individual) to impact concerns (concerns about the effect of the innovation on students), a corresponding desire or inclination to progress to the next level of the innovation will ensue. (Ohlhausen, Meyerson, and Sexton, 1992)

The need for frequent and high quality interventions to sustain any change effort is based on the notion that change is a general process and not a single event. (Ohlhausen, Myerson, and Sexton, 1992; Hall and Loucks, 1977) Aligning these interventions to the classroom teacher's concerns about the change process (e.g., progressing from Level 2 to Level 3) can increase the likelihood of a successful implementation.

A fourth variable impacting a teacher's implementation of an STS project including Labs for Learning relates to the level of complexity associated with the innovation. Though Labs for Learning entails a new conceptualization of one's instructional curriculum, the teacher can still employ existing learning materials and activities that have proven successful in the past. Since change is an incremental process, the Labs for Learning methodology enables the classroom teacher to retain existing investigations (e.g., surveys, experiments, demonstrations), but realign them in a manner that is personally relevant and purposeful to the student.

From a district perspective, Labs for Learning projects require little capital outlay for equipment and supplies. Using existing hardware (e.g., Apple, IBM, and/or Macintosh computers), science kits, labs, and available community resources (e.g., museums, government agencies, research centers, INTERNET), classroom teachers can transform dormant classrooms into dynamic centers of purposeful and experiential learning that intuitively move students from awareness to authentic action related to a real world problem or issue.

Figure 3

Levels of Instructional Practices

	Level 1	Level 2	Level 3
Learning Materials	Organized by the content; heavy reliance on textbook and sequential instructional materials	Emphasis on science kits; hands-on activities (e.g., AIMS, FOSS)	Determined by the problem areas under study; extensive and diversified resources
Learning Activities	Traditional verbal activities; problem solving activities	Emphasis on student's active role; problem solving activities with little or no context; verification labs via science kits and related hands-on experiences	Emphasis on student activism and issues investigations and resolutions; authentic hands-on inquiry related to a problem under investigation; focus on experiential learning
Teaching Strategy	Expository approach	Facilitator; resource person	Co-learner/facilitator
Evaluation	Traditional evaluation practices including multiple choice, short answer and true/false questions	Uses multiple assessment strategies including performance tasks and open-ended and problem-based questions	Multiple assessment strategies integrated authentically throughout unit and linked to the problem/theme/topic; use of portfolios, open-ended questions, self-analysis, and peer review
Technology	Drill & practice computer-based programs (e.g., traditional integrated learning systems-ILS), computer games; little connection between technology use and overall theme/topic	Technology integrated into isolated hands-on experiences (e.g., tabulating and graphing data to analyze a survey or experiment); information searches using telecommunications	Expanded view of technology as a process, product, and tool to find solutions to authentic problems, communicate results, and retrieve information (e.g., spreadsheets, graphs, probes, databases, CD-ROM-based simulations, telecommunications)

Notes

1. The term, formal curriculum, references a written set of intended outcomes for students that have been made by people other than the classroom teacher (e.g., state framework for science and mathematics). For a complete discussion of the formal curriculum and related levels of curriculum decision making, see Goodlad, Klein, and Tye, 1979.

2. The term, Level of Use (LoU), was first introduced by Hall & Locks as a means of describing the level of implementation for a given innovation. For a complete discussion of Level of Use, see Hall & Locks, 1977.

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