DOCUMENT RESUME

ED 309 746 IR 013 853

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TITLE Transforming Curriculum and Instruction with Technology.
PUB DATE Mar 89
NOTE 18p.; Paper 2 of the Symposium, Working in a New Paradigm: Technology Applications for Restructuring Schooling. Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, March 25-30, 1989).
PUB TYPE Viewpoints (120) -- Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; *Curriculum Development; Educational Innovation; *Educational Technology; Elementary Secondary Education; *Instructional Improvement; Learning Strategies; Metacognition; Process Education; Technological Literacy

ABSTRACT

The incorporation of new technologies into elementary and secondary education must be initiated through reconceptualization of curriculum and instruction; expecting the technology alone to catalyze the transformation is unreasonable and not substantiated by experience. The traditional curriculum improvement process is the best vehicle for bringing computers and related devices--videodiscs, CD-ROM, telecommunications--into the schools. Alliances between curriculum improvement teams and technology resource specialists can best accomplish this desired integration, using a curriculum-driven rather than a technology-driven approach. In nearly every area curriculum improvement follows similar patterns: (1) content/process curriculum balance; (2) integration of learning/study skills; (3) increased attention to thinking in problem-solving skills; and (4) an extended range of instructional strategies. The instructional unit plan is the device for supporting this integrated curriculum. Teachers develop integrated unit plans by blending six ingredients: (1) information and concepts; (2) process skills related to the discipline or subject; (3) thinking and reasoning skills; (4) learning and study skills; (5) technology application skills; and (6) communication skills. A form for an instructional unit plan outline is attached. (11 references) (GL)

Symposium:

Working in a New Paradigm: Technology Applications for Restructuring Schooling

Paper 2:

Transforming Curriculum and Instruction with Technology

AERA Annual Conference
San Francisco, 1989

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Transforming Curriculum and Instruction With Technology

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Closing the Gap

It is fashionable to speak of the potential of technology for catalyzing and supporting a transformation of curriculum and instruction. The needs for transformation are well established and well documented. They are summarized by Morton and Mojkowski (1989) in a companion paper for this symposium. The potential of the technology itself is likewise well established. Not only do the new information and communication technologies serve as extremely powerful productivity tools in supporting real world learning and work throughout society, there are examples, however isolated, of these tools being used as catalysts for a transformation of schooling.

If both the needs for curriculum and instruction transformation and the potential of the technology are well established and well documented both in schools and in society, what then are the barriers to a more complete and appropriate integration? In addition to the conceptual barriers outlined by Morton and Mojkowski (1989), the impediments are attributable to faulty and piecemeal strategies and tactics. The majority of educators and technology advocates have not yet employed a strategy for bringing about the transformation of curriculum and instruction using technology as both a catalyst and support. Without this strategy, technology applications, even whole "technology curriculums," have been developed on the periphery of mainstream curriculum improvement.

What is often not made clear is that the new information and learning technologies can substantially *support* a revitalized curriculum, but may have a more limited role in actually *initiating* the changes. Unless educators are willing to reconceptualize curriculum and instruction, they will probably need to be quite patient in expecting transformation to occur through the use of computers and other tools. There is ample evidence that the integration of computers and related devices - videodiscs, CD-ROM, telecommunications - into the schools can be accomplished

without appreciably altering curriculum and instruction. Indeed, many have argued that the vast majority of technology applications in elementary and secondary education are automating and perpetuating learning outcomes and teaching-learning practices that are themselves in desperate need of reform (Pea and Soloway, 1988; Perkins and Salomon, 1989; Nix, 1988). Despite the sparse but robust evidence that technology tools can contribute substantially to a revitalized curriculum, replication of these exemplary practices is meager.

This paper describes an approach to curriculum transformation in which applications of technology tools, principally computers, are used. The strategy for bringing about a transformation of curriculum and instruction requires a deliberate and dialectic process in which incremental modifications in curriculum and instruction are matched and supported with technology tool applications that, in turn, stimulate additional transformations in curriculum and instruction. The strategy is a deliberate attempt to bridge the gap between the potential and the actual, between the islands of innovation and the perpetual pilot programs conducted by a small core of voracious volunteers, and the vast majority of teachers who either do not use technology at all to support their teaching, or use it in such a way as to perpetuate traditional learning outcomes and pedagogy. Using an incremental approach to the accomplishment of the grand design, classroom teachers and technology resource specialists, through successive approximations, address the requirements of a transformed curriculum - learning outcomes and instructional strategies - and real-world applications of technology tools.

Basic Principles and Understandings

Our work in this area is guided by several operating principles:

- o The incorporation of new technologies into elementary and secondary education must be initiated through reconceptualizations of curriculum and instruction. Expecting the technology alone to catalyze the transformation is unreasonable and not substantiated by experience.
- o There is ample and growing evidence that a radically different curriculum and pedagogy are needed and available. Nearly every major subject matter

association has presented its plan for a transformation of learning outcomes and instructional strategies.

- The changes required in outcomes and pedagogy have substantial implications for the way that teaching and learning environments are organized (Sizer, 1984; Goodlad, 1984; Boyer, 1983; Klein, 1989).
- Our understanding of the change process in schools must guide our work in this area. We must move incrementally within a grand design (Crandall *et. al.*, 1987; Hord *et. al.*, 1987).
- As our knowledge base in the education sciences is extended both qualitatively and quantitatively, we must limit the range of individual autonomy in the use of technology and move toward strengthened professional agreements among teachers and administrators regarding best practice.
- Equity goals require that technology support systems allow teachers to employ tools differentially to accommodate varying capacities and needs.

Technology Integration: Strategy

One assumption of this paper is that there are substantial gains to be realized from technology embedded instruction, but that as a practical matter, faulty conceptualization and design impose a ceiling on the growth that can be expected. Our argument is that to raise the ceiling on our expectations for technology applications, we will first need to effect a transformation in learning outcomes and instruction as well as in the organization of schooling. To that end we have engaged teachers in the curriculum development process through the preparation of instructional unit plans that address the key characteristics cited above.

Our strategy has been to bring technology into districts and schools by way of the traditional curriculum improvement process. Specifically, we work as part of a curriculum improvement team in a specific subject area. We have found that nearly every school district has some form of committee working on curriculum improvement during the school year. We work as part of that team, identifying the major changes that need to take place and the specific implications these changes have for learning outcomes, instructional strategies, materials utilization and so forth. Through this process, we have deliberately forged alliances between curriculum improvement teams

and technology resource specialists. These specialists serve as staff to the committees, helping them to identify and integrate technology applications that advance the transformations in curriculum and instruction that the curriculum improvement team is or should be contemplating. In some districts the notion of a separate technology applications curriculum is actually abandoned, and specific technology competencies are integrated into the units.

In nearly every area curriculum improvement follows similar patterns:

1. *Content/process curriculum balance*

   In every major subject area, educators are seeking increased attention to the discipline specific procedural skills and knowledge that serve as the foundation for learning how to learn and that permit the student to demonstrate competence in the subject area. In many curriculum areas, the goal is to use the discipline specific process skills as the framework for the curriculum, rather than a selection of facts or instructional materials or topics. The result is a blend of instruction that helps students learn more efficiently how to learn and how to make sense of the rapidly expanding body of knowledge - in short, how to think, learn, and perform in each discipline or subject area.

2. *Integration of learning/study skills*

   The teaching by content area teachers of such skills as outlining and notetaking and locating and selecting information is increasingly being promoted. This integration is motivated by the recognition that learning how to learn is a general capability that can be customized to support every content area. The availability of technology tools in libraries, homes, schools and cultural education organizations will challenge educators to prepare students to access and manipulate information and to produce knowledge as independent learners.

3. *Increased attention to thinking in problem-solving skills.*

   While many generic approaches to teaching, thinking, and problem-solving skills have been developed, their incorporation into each of the subject areas has not been as rapid. Considerable work is being done on what Perkins and Salomon (1989) call

high road and low road transfer, that is, extending the learning of generic thinking and problem-solving skills into the content areas.

4. *Instructional strategies*

Improvements in teaching require extending the range of instructional strategies employed, particularly to address different learning styles and higher order thinking skills. The heavy reliance on lecture and simple information dissemination pedagogues needs to be replaced by a wider repertoire of teaching techniques, including demonstration, simulation, observation, brainstorming, discussions, and guided practice. Students need to take on increased responsibility for learning, while teachers need to operate as coaches and resource specialists.

The integrated curriculum is an underlying theme of most of the curriculum improvement research and practice. The rational is that by blending skills instruction with appropriate information, students will develop independent learning skills at the same time that they are mastering facts and concepts. New learning technologies, in exposing weaknesses in the existing curriculum, can serve as catalysts to precipitate precipitate curriculum modifications. We do need to keep our eyes on what existing and anticipating technologies can do for us, but the primary focus needs to be what the curriculum can become, on what students ought to know and be able to do to learn more productively and to live and work successfully in the 21st century.

We have found it helpful to provide both conceptual and programmatic guides to integration. Our approach employs the following:

- o clear specification of outcomes in a number of areas
- o careful selection of content
- o direct instruction and application of skills, both generic (i.e., learning-to-learn and thinking/problem-solving) and discipline-based (i.e., linked and customized for the subject area).
- o a focus on real world problems
- o teacher developed instructional units

Technology Integration: Tactics

Within the strategic approach, our tactic has been to advocate the use of a commonly accepted instructional planning tool - the unit plan. By building on a familiar concept, we are able to extend the typical conceptualization of instructional units to include attention to technology applications, with a special emphasis on tool applications that extend and support incremental transformations in teaching and learning, based on our improving knowledge base in the education sciences.

The unit plan is the linchpin in a three-part curriculum. The first part is the curriculum *framework*, a broad overview of the K-12 curriculum in a particular discipline or subject area. The second is the *instructional unit plan*, a detailed plan which addresses a major topic, set of concepts, or skills and which encompasses several lessons and sometimes as many as several weeks of instruction for a specific subject or discipline at a specific grade level. The third component is the daily or weekly *lesson plan* which guides the teacher in the implementation of the instructional units on a day-to-day basis.

The framework provides a "landscape" view for teachers and administrators of the K-12 curriculum. The framework responds to the following questions:

1. What are the major goals and objectives for the subject area?
2. How do the major oojectives addressed at each grade related to the K-12 sequence?
3. What major improvements is the district planning to make over the next few years in this curriculum area?
4. How will these improvements impact on the units and lessons teachers design and implement?
5. How will the curriculum improvement objectives established in this subject area impact on each school's improvement priorities?

The framework is focused on outcomes. It is the unit plans that provide the detail on instructional strategies and guide the integrative teaching of subject area knowledge and skills with cross-cutting generic skills. The unit and lesson plans are not only more detailed in their specification of outcomes, they are primarily concerned with delivery details, moving beyond overall strategies to specific teaching tactics and activities.

The unit plan is essentially a device for supporting integrative teaching, for blending the specific knowledge, skills and attitudes of a discipline with the more generic cross-cutting skills (thinking/reasoning, learning/study, problem-solving) that need to be developed in several disciplines. Lesson plans are the most specific guides for instruction. They focus on activities and techniques as opposed to broad learning outcomes. Lesson plans are the teachers' translations of the framework and unit plans into blueprints for day-to-day teaching.

The instructional unit plan is:

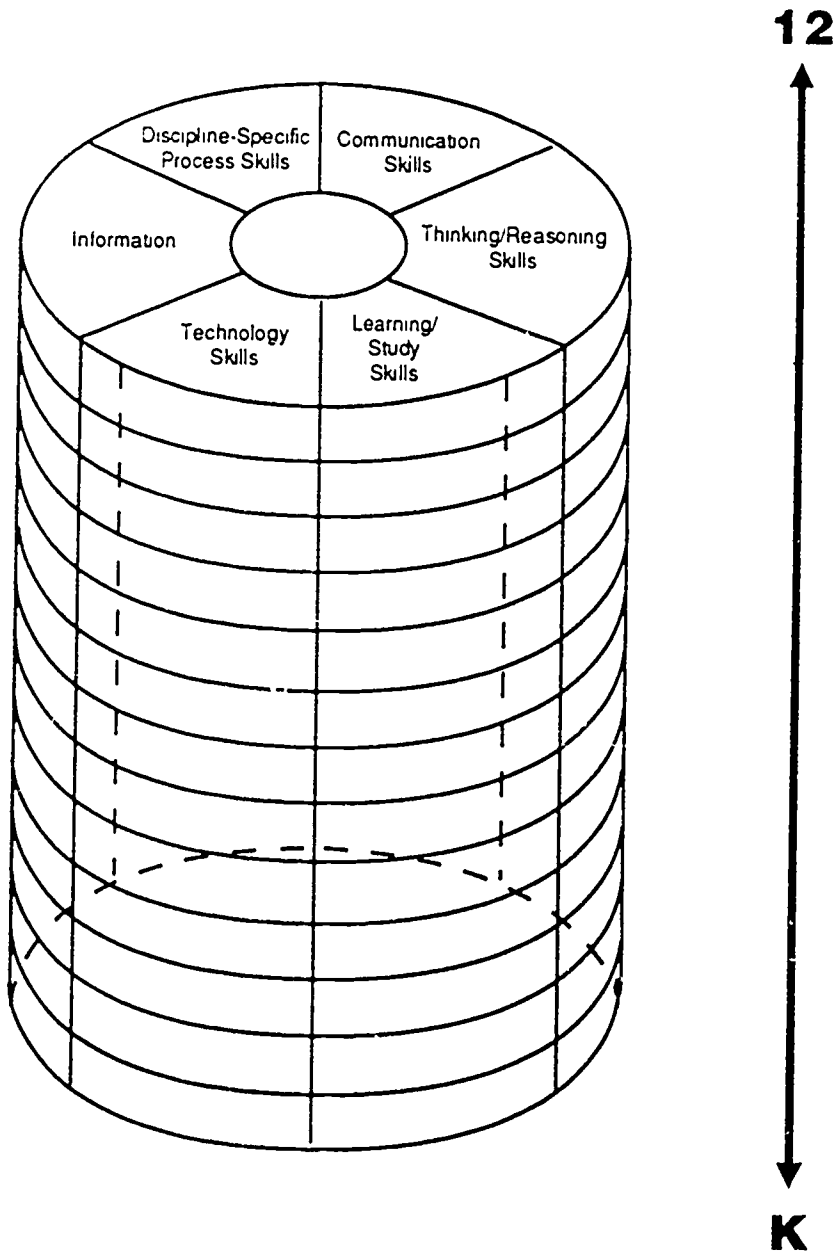
- o a design for teaching a unified segment or component of the curriculum;
- o the "bridge" that links daily instruction to the district's curriculum framework;
- o a road map for preparing daily lessons;
- o a means of accomplishing integrated teaching of skills and information;
- o a mechanism for sharing instructional plans among faculty;
- o a means of incorporating changes in instructional strategies; and
- o a means for integrating technology tool applications.

Developing instructional unit plans requires that a few prerequisite steps be accomplished.

1) *The overall purpose of the unit must be clear.* Typically the central purpose of a unit is to have students learn a specific skill or set of skills and related concepts that are judged to be essential to their development. This focus on a skill or set of related skills as the core of the unit may be a minor or major shift in perspective, depending on the grade level and subject area being addressed. For example, reading instruction in the elementary grades is focused almost entirely on skills development, while science instruction at the tenth grade is much more focused on information and concepts, with the process skills of science given less attention.
2) *There must be a clear specification of the "ingredients" to be used in the unit.* That is, each of the sets of skills and concepts must be well defined. There are at least six sets of "ingredients" that constitute the content of the curriculum (see Figure 1):
    a. information, concepts
    b. process skills related to the discipline or subject
    c. thinking/reasoning skills

Figure 1

An Integrated K-12 Scope and Sequence Model



d. learning/study skills
e. technology application skills
f. communication skills

There is some overlap between some of the bins; discipline/related process skills, for example, are closely related tc thinking/reasoning skills. It is possible to distinguish the latter as more generic, serving as a foundation for addressing any set of discipline/specific process skills.

3) *The skills or information in each bin must be organized according to what should be learned first, second, and so forth: the scope and sequence.* The scope and sequence of reading skills at the elementary grades is typically well delineated. The discipline-specific skills taught in secondary school science are usually considerably less well specified. Social studies skills at the late elementary grades fall somewhere in between these two extremes.

The importance of a clear and accurate scope and sequence becomes obvious when teachers start to develop an instructional unit plan for teaching a specific set of skills at a specific grade level. They need to be clear about what skills have been taught at previous grades and what skills will be taught at subsequent grades. They also need to be clear about how the skills will be introduced, expanded and applied across several grade levels. Thus, each bin needs to be filled with objectives, outcome statements, or descriptions of skills or competencies that teachers can select in developing their unit plans.

With these prerequisite steps accomplished, teachers can begin developing instructional unit plans. Teachers need to blend selected ingredients from each of the bins to form an integrated unit. This blending process is difficult because there are no hard and fast rules for selecting. Some guidelines derived from our experiences to date:

1) The central purpose and core of the unit should be a specific discipline-related process skill. For example, in language arts the skill might be revision, i.e., the process of "re-visioning" written communications and making appropriate modifications. In science, the core skill might be forming hypotheses; in social studies, collecting and organizing information from secondary sources.

This use of a skill as the core, or anchor, of a unit might be a shift from typical approaches to instructional planning, where the central focus may be a topic, such as weather, the Civil War, or Silas Marner. (Review the chapter headings of almost any textbook; topics, not skills, are featured.) In an information-rich environment in which what we know about topics is changing so rapidly, a focus on skills is especially important. Students need to spend more time learning how to *think, learn, and perform* in each discipline or subject area.

2) Teachers will still need to select from the information bin; we cannot abandon the teaching of important concepts, definitions, rules and laws, formulas, and so forth. What will be necessary is to be more selective about what information they choose to cover. An increased attention to teaching skills will require that less time is available for covering content or disseminating information, at least initially.

With a focus on teaching the skills related to a specific discipline or subject, it is possible to conceive of an entire course or subject being centered on skills-based units. For example, in science the teachers might identify the scientific problem solving process as the core to be addressed. An introductory unit, done at the beginning of the year, might be used to introduce the overall process and the skills involved. Each subsequent unit could then focus in greater detail on a different step in the problem solving process. Teacher will still need to select other content: concepts, laws, rules, formulas, and information and facts to incorporate into the unit. Indeed, they may decide to follow the topic sequence in the textbook, particularly if there is are prerequisites required in each succeeding chapter. The creative challenge is to cover the content while teaching students the processes and skills whereby scientists identify and solve real problems.

Clearly, teaching such an integrated instructional unit focused on discipline-specific skills will require instructional materials in addition to those in the typical textbook. In some cases, the instructional unit plan may need to be supplemented with an addendum of teacher and student materials, including teacher and student directions, reading materials and worksheets.

One of the hazards of using instructional units as the basis for integrated teaching is that the units may fail to add up to a comprehensive and coherent course or grade-level syllabus. Here again, the selection process is critical; what teachers decide to cover in each unit--skills, information, topics, concepts, and so forth--must be guided by their knowledge of the total domain of material that is appropriate at a particular grade level. A focus on discipline-specific processes and skills can be the "glue" that helps to form a coherent program instead of a random collection of topics.

Initially, a focus on skills-based units may reduce the amount of information that can be covered. Research and experience indicate that a focus on processes and skills will make it easier for students to learn and retain information, thus reducing the time it takes to achieve mastery of information. There may be a need, however, to eliminate some information or reduce the time given to coverage of some topics. Since such a selection process is always taking place, teachers may need to make some decisions about reductions in time given to topics. These decisions should be made at the department level or at least among all of the teachers concerned with that subject or course. A generic unit plan outline is included as an appendix.

What does all of this look like in practice? The instructional units require that all of the elements in the integrated set of learning outcomes are addressed, as appropriate, in each of the units. In addition, units must address the following requirements:

1. Students must be viewed as knowledge producers as well as consumers.
2. Students must learn how to access and use a knowledge base outside of themselves and their immediately available instructional materials.
3. Learning activities must be problem oriented and project organized, focused on an integrated set of knowledge and skills outcomes.
4. Learning activities must require the application, as appropriate, of a variety of technology support tools, such as word processors, databases, and telecommunications.
5. Learning activities must promote and develop social interaction, including collaborative learning and peer coaching.
6. Learning activities must produce meaningful work.
7. The units must relate to a K-12 curriculum design or framework.

Typically, unit plan development work is accomplished after the curriculum framework is completed. Volunteer teachers agree to develop unit plans which incorporate the modifications made in the curriculum itself (that is, in the learning outcomes and instructional strategies that are the essence of the transformed curriculum). Teachers work in pairs to develop their units and a technology resource specialist works with each team to identify applications that are appropriate to the unit. The emphasis is on generic tool applications, such as word processing, database development, and graphics support.

Experiences to Date

The unit plan development process provides an ideal forum for staff development and a practical context in which questions about transformations in teaching and learning practices can be addressed. Within this context it is easier to select technology applications that move beyond simplistic drill and practice and tutorial software. Incorporating appropriate technology applications into the instructional units is not a casual process, however. The resource specialists must be deliberate in their identification of opportunities for technology integration.

The process of instructional unit development avoids a common syndrome we have observed in schools: curriculum improvement committees working independently from technology resource specialists. It is not uncommon to find a technology curriculum that is peripheral to the content area curriculums which it purports to serve. Indeed, we have observed many exemplary applications to technology that exist at the periphery of mainstream curriculum improvement efforts. The lack of alliances between the two efforts results in piecemeal and episodic integration efforts.

Although our applications of this strategy have been limited to this point, we have gathered some insights that may guide future approaches. We suggest that such questions as these might form an agenda for exploring further a strategy and a process that is part of the traditional curriculum improvement process, but is essentially subversive to what typically are the outcomes of that process.

1. What role does (can) the teacher play in such a learning environment?
2. How is evaluation nested within the learning process?
3. How does one assure that core learning outcomes are addressed and mastered in a project oriented design?
4. What are the variety of ways in which the students use and respond to the various technology tools?
5. How does the curriculum development process, particularly the development of unit plans, get modified by the availability of technology tools?

Summary

Let me summarize our learnings from this experience.

1. There is a desperate need for focus. With the limited amount of resources, not only technology resources but people and time resources, it will be impossible to show any substantial impact without a greater focus on school improvement priorities.
2. There needs to be a stronger investment mentality guiding our efforts. Most everyone involved is looking for some kind of short-term immediate gain.
3. There is a heavy overlap in integration of curriculum improvement and staff development.
4. We need to move beyond volunteerism is order to address the requirements.
5. We need to reduce our attention to traditional CAI systems and to more deliberately evaluate those that are in place.
6. We need to promote changes in the ways that teachers and students conceptualize the use of technology.

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Instructional Unit Plan Outline

SUBJECT/COURSE: GRADE/LEVEL:

TOPIC:

PURPOSE/RATIONALE:

OBJECTIVES:

INFORMATION/CONCEPTS:

SKILLS–DISCIPLINE-RELATED:

SKILLS–THINKING/REASONING/PROBLEM-SOLVING:

LEARNING/STUDY SKILLS:

PREREQUISITES:

INFORMATION/CONCEPTS:

SKILLS:

Instructional Unit Plan Outline (Cont.)

INSTRUCTIONAL STRATEGIES

CLASSROOM ORGANIZATION/GROUPING:

ORGANIZATION OF CONTENT

TEACHING ACTIVITIES:

STUDENT ACTIVITIES:

MATERIALS & EQUIPMENT:

MONITORING & EVALUATION:

SCHEDULE: