Empowered Learning: Fostering Thinking Across the Curriculum

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> Most people will finish their formal education between the ages of 18 and 22. Today's young adults are expected to have the longest average life span in the history of the world, with most living into their 70s and many living into their 80s and 90s. We can only guess what life will be like in the years 2050 or beyond. One likely prediction is that many of today's young adults will be working at jobs that currently don't exist and dealing with technologies that dwarf the imagination of present-day science fiction writers. What do they need to learn during their first two decades of life that will prepare them for their remaining years? (Halpern, 1997, 3)

As society changes, the skills that citizens need to negotiate the complexities of life also change. Bransford (1999) states that in the early 1900s, a person who had acquired simple reading, writing, and calculating skills was considered literate. Today, however, the public education system expects all students to achieve higher levels of proficiency in reading critically, writing persuasively, thinking and reasoning logically, and solving complex problems.

There is certainly no dearth of ideas about what constitutes learning that is essential for the Information Age. The North Central Regional Educational Laboratory, for example, identifies the following literacies to "improve the intellectual capital" of the 21st century citizenry: basic language proficiency; knowledge of scientific thinking; competence in the use of computer applications; ability to decipher, interpret, and express ideas through visual media; global appreciation of the cultural diversity of peoples and cultures; and proficiency in locating, evaluating and using information (NCREL, n.d.).

For the last two decades, schools across the nation have been engaged in standards-based reform in an attempt to conceptualize and to clarify what should be taught in our schools. This has resulted in a plethora of standards for curriculum and learning developed at the national, state, district, and even school levels.

Although these various standards have yielded a rich set of alternatives for schools to design dynamic curricula, reform scholars contend that they have also resulted in a fragmented profusion that often confuses educators and the public (Newmann, 1996; Perkins, 1992; Sternberg, 1992). Wiske maintains that teachers surrounded by "curriculum materials, standardized test mandates, daily schedules, and years of experience that reinforce traditional transmission-based instruction," are understandably bewildered (1998, 3). What ultimately results in

the name of reform is nothing more than “irregular waves of change [and] episodic projects” (Fullan, 1993, 49). Ironically, we are victims of the information glut we often associate with the Digital Age. As one teacher wondered aloud at a meeting I recently attended, “We have over 400 standards for ten content areas in our state! Where do we start?”

Indeed, where do we start? For library media specialists, this question has special urgency. In many schools, we are perceived as providers of ancillary (and dispensable) services and gatekeepers of underused collections (DeGroff, 1997; Wolcott, Lawless, & Hobbs, 1999). In many districts and states, lack of funds and qualified personnel have resulted in schools without functioning library media centers. Rather than viewing this state of affairs as a “bad thing,” Johnson maintains that “our vulnerability demands that we as a profession need to continually find ways to strengthen our programs and roles” (2002, 21).

In reform efforts on all school campuses, library media specialists must see beyond the rhetoric of nurturing lifelong learning and begin asking ourselves deeper questions about what that learning really looks like and how we help to achieve it.

Although all standards include information literacy, the connection with the library media program is “implied rather than stated” (Kearney, 2000, 87). The pervasive yet transparent nature of information literacy standards makes it imperative that we review our own state standards and proactively identify those standards that correlate with information literacy.

Within this context of reform and change, *Information Power* (AASL & AECT, 1998) challenges library media specialists to reinvent our roles as teachers and as instructional partners. Certain assumptions are crucial in analyzing and acting on these roles. They are:

- Learning is more than the *what* of discrete disciplinary content; it embraces the *how* and *why* of learning.

- There are commonalties across disciplines in terms of the processes and dispositions that motivate and drive the *how* and *why* of learning.

- The entire school community helps students master these processes and acquire dispositions that enable them to become responsible decision-makers and resourceful problem solvers.

- Library media specialists are potentially powerful catalysts and team members in this learning community.

This article revisits the following essential questions as it addresses how library media specialists contribute to these learning communities:

- What is worth learning or knowing?

- How do students demonstrate this learning?

- How do we create environments that cultivate thoughtful learning?

Both theoretical explanations and practical examples are presented below. Past scholarship and records of effective practice are readily acknowledged throughout the piece.

What is worth learning or knowing?

Hester (1994) contends that the quality of learning is determined by the quality of the processes of thinking used in learning. Thinking, in this context, is essentially a problem solving process. He refers to creating "learning-ful" environments where students and adults come together and find meaning through their collective experiences (Hester, 1994, 4). His description of such environments overlaps with definitions of "thoughtful" learning communities posited by other educators (Barell, 1995; Fullan, 1993; Beyer, 1992).

The following characteristics of productive centers of learning emerge from these various descriptions:

- Schools must perceive themselves as learning organizations where all stakeholders work at changing norms and habits to make meaningful learning real for students. They must build a shared vision and define student outcomes that bring life to that vision.

- The school vision should embrace the notion of empowerment; i.e., students are not controlled by the environment but are able to impact upon it through innovation and invention.

- The outcomes focus on a foundation of thinking. Thinking is defined as a cognitive process that connects bits and pieces of experience with other bits and pieces to establish relationships, to move from the simple to the complex. This process grows and develops in learners so that they are capable of doing new things, not simply repeating what others have done (Hester, 1994).

- The concept of "thoughtfulness" is essential in a foundation of thinking (Tishman, Perkins & Jay, 1995; Barell, 1995). This involves not just the intellectual or cognitive operations but the feelings and attitudes that students have toward themselves as thinkers.

Glatthorn and Jailall (2000) further elaborate that curriculum based on the above premises exhibits depth rather than superficial coverage, emphasizes solving

problems rather than simply acquiring factual knowledge, centers on contextualized problems rather than skills taught in isolation, and selectively integrates disciplinary content rather than maintaining a separation of subjects.

While different theorists have presented their own models and taxonomies of thinking (Marzano, 2001; Halpern, 1997; Barell, 1995; Hester, 1994; Ennis, 1992; Beyer, 1992), certain thinking processes are reflected in all of them. They include:

- Perception and recognition of problems, of new data, and of patterns emerging from the data.
- Storage and retrieval of new data.
- Organization and transformation of data, identifying relationships between things.
- Reasoning, problem solving, deductive and inductive inference.
- Metacognition, assessment and monitoring for self-improvement.

Figure 1 expands on the process by identifying some of the strategies essential for thinking (Nahl-Jacobovits & Jacobovits, 1993; Beyer, 1992; Ennis, 1992).

Figure 1. Thinking process and related strategies

Thinking Process	Examples of Strategies
Perception and recognition of problem or issue	• Recognize a problem. • Recall prior related experience. • Define the goal. • Define terms important for context studied. • Generate appropriate questions. • Analyze alternatives. • Devise solution plan. • Plan experiment.
Storage and retrieval of data	• Determine sources for relevant data. 1. Devise strategies to locate data. 1. Define key terms and elements for search. • Judge credibility of sources.
Organization and transformation of data	• Organize data in multiple formats. • Interpret data. • Distinguish between fact and opinion. • Distinguish relevant from irrelevant information. • Determine accuracy. • Determine credibility.

	• Detect bias and distortion. • Recognize logical inconsistencies. • Recognize multiple perspectives. • Identify conclusions.
Reasoning and use of information	• Reason inductively and deductively. • Develop and defend a position on an issue. • Analyze. • Synthesize. • Apply. • Evaluate. • Communicate in variety of formats.
Metacognition	• Validate concepts learned in terms of conclusions and solutions. • Validate process in terms of efficiency and effectiveness. • Validate self-efficacy in terms of feelings and attitudes.

Implications for practice: How do we enhance this learning?

Library media specialists are strategically positioned to work with entire school populations and to examine curriculum from a big picture perspective. We are not immersed in single content areas; instead, we have the advantage of working with classes in multiple disciplines. We have the opportunity to reflect with teachers on the essential ideas and modes of inquiry in the various subjects taught.

Based on the premise that a foundation in thinking permeates the disciplines, library media specialists are key team members in identifying the relationships existing between thinking skills and dispositions and the processes embedded in the disciplines and in information literacy (Stripling, 1995).

What might these skills look like in various disciplines? Here are several examples culled from my own classroom observations and from more formal analyses conducted by other scholars (Wiske, 1998; Spitzer, Eisenberg & Lowe, 1998; Dalbotten, 1997):

- In language arts--literary appreciation and analysis requires strategic use of language including being able to predict, validate, and synthesize. It also encourages analysis from multiple points of view and perspectives, and the ability to identify bias and stereotyping. Students are immersed in both literary and nonliterary modes of information. Active engagement is crucial.

- In social studies--historical analysis involves formulating questions, obtaining data from sources, testing these sources for their accuracy and authority, and detecting and evaluating propaganda and distortion. Students develop

comparative and causal analyses and construct sound historical arguments. They use resources ranging from primary documents and artifacts to virtual field studies found on the Internet.

- In mathematics--problem solving in mathematics challenges students to formulate problems, consider alternative strategies to solve them, and apply a strategy and verify the results. To accomplish these aspects of problem solving, they must be able to collect, organize and describe data; construct, read and interpret displays of data; and formulate and solve problems that involve data collection and analysis. Mathematical inquiry provokes students to make sense of ideas in relation to one another and to the everyday world. The focus is on conceptual understanding, multiple representations and connections.

- In science—scientific inquiry necessitates that students understand key questions and concepts that guide scientific investigations. They must be able to formulate testable hypotheses, design and conduct the investigations, formulate and revise explanations and models using logic and evidence; and communicate and defend their findings. Students use a wide range of tools and make choices among alternatives. Carefully planned experiments can proceed in a predictable fashion or yield startling data that lead to new questions and investigations. The process is not random; it follows a purposeful sequence of testing, data collection and analysis, and drawing of conclusions.

- In information literacy--information searching and use assumes that problems and issues investigated require student engagement with information in different formats and for different purposes. Students must be able to articulate the focus of their information search, generate questions that probe the problem, consider alternative strategies to locate and retrieve data and to evaluate their value and relevance. Students also need to explore organizational schemes that help them store and use their information, and to hone their expertise with different communication formats.

Whether learners are performing a scientific experiment or a historical investigation, they are questioning, conjecturing, and searching for relationships to problems and issues. Figure 2 captures the cross-disciplinary nature of the thinking process.

Figure 2. Thinking across several content areas

Thinking	Literature	History	Mathematics	Science
Perception and recognition of problem or issue	• Identify and articulate issue or theme. • Predict outcomes. • Tap prior	• Identify and articulate historical issue. • Tap prior experience.	• Formulate mathematical problem. 2. Tap prior experience.	2. Identify and articulate scientific probl • Tap prior experience.

	experience. • Generate questions relevant to theme.	• Formulate historical questions.		• Generate testa hypothesis.
Storage, retrieval of data	• Consider approaches to analysis. • Collect evidence.	• Seek and evaluate data.	• Apply variety of strategies to solve problem. • Collect, organize, describe data.	• Design investigation, experiment. • Collect, organi describe data.
Organization and transformation of data	• Evaluate evidence. • Identify bias, stereotype.	• Compare and analyze evidence.	• Verify, interpret results.	• Conduct investigation. • Document resu
Reasoning, use of information	• Infer. • Analyze. • Synthesize. • Assume different points of view. • Present results.	• Construct explanation, argument. • Develop cause/effect relationships. • Present results.	• Present results. • Support solution. • Generalize solution.	• Communicate, defend results. • Analyze alternative explanations, models. • Present results
Metacognition	• Reflect on knowledge gained process used, attitudes, feelings.			

Although self-improvement and reflection are most directly captured in the metacognition strand in Figure 2, the notion of thoughtfulness actually permeates the entire learning experience. That is, as students practice the skills of thinking, they must also recognize the attitudes they are developing toward themselves as learners. Questions such as “How did I know I was doing it correctly or well?” and “How confident am I in doing this again?” go beyond the cognitive operations and acknowledge the importance of affective responses.

Working together with teaching colleagues to examine curriculum from the perspective of thinking processes, also means that we as library media specialists must look deeply into the content of our own information literacy instruction. While various excellent information literacy models exist, the challenge for library media specialists is to reexamine the skills we have traditionally taught and to evaluate them in the context of developing thinking.

In this self-assessment, many of us may discover that we have focused largely on tasks at the mechanical levels of performance rather than at levels requiring manipulation of information and ideas. Examples of these traditional tasks include:

- Using an online catalog.

- Identifying the physical components of a resource (e.g., parts of a book).
- Locating materials within a specific library.
- Using an organizational scheme to take notes.
- Creating a bibliography.

While the above skills are necessary components of information searching and information organization they deal largely with the technical aspects of completing research assignments. In addition to teaching these skills, we need to devise learning experiences that help students attack some of the deeper aspects of their investigations. Here are examples using the thinking strands previously identified:

- Perception and recognition: generating questions that go beyond the memory and recall levels are essential for imaginative and rigorous examination of an issue or a topic. Library media specialists can help students hone their question-making skills. Ciardello (1998) suggests that questions may be convergent ones requiring explanation and statement of relationships. Or they may be divergent and challenge students to predict, infer and reconstruct. They may also be evaluative in nature and provoke value judgments that must be defended.

- Storage and retrieval: determining the relevance of information is a crucial part of the problem solving process yet many students blindly accept every web site they harvest from the Internet or copy entire articles from encyclopedias. Library media specialists can focus on strategies that help young researchers distinguish relevant from irrelevant information. For example, students test their own understanding of the problems or issues being studied by restating them. They work with their instructors to develop criteria or clues for determining relevant information and select data and practice determining their relevance based on the criteria.

- Organization and transformation: selecting the most appropriate means of organizing data goes beyond teaching students how to create a set of note cards or how to develop a topical outline. Library media specialists can help students determine the most effective means of assembling data by analyzing the targeted learning outcome. For example, if students are expected to identify and defend a stand on an environmental issue, a pro and con visual organizer such as a T-chart with side-by-side columns for presenting arguments from two perspectives would be highly effective. If students are synthesizing information on the cultural features of several countries, a matrix or a grid would visually capture that information.

- Reasoning and utilization: achieving a targeted learning outcome requires that students create tangible evidence in some form. While papers and tests have been the conventional modes to measure proficiency, students are also presenting their findings in a range of nontraditional forms including video

documentaries, dramatic and artistic interpretations, and multimedia slide shows. While much of this activity might be completed in the classroom or at home, the library media specialist might assist with the crucial establishment of assessment criteria that help students shape and refine their works in progress. The assessment formats may differ (e.g., rubrics, checklists, journals), however, the criteria themselves should address the fundamental reasoning process. Stripling (1988, 140) poses the following types of questions that drive sound assessment: Is my main idea clearly communicated? Is my evidence appropriate, accurate, clear, and thorough enough to support the conclusions? Is my evidence presented in the proper order?

- Metacognition: reflecting on how one acquires knowledge is also referred to as thinking about thinking. The metacognitive process involves setting goals and monitoring the achievement of those goals. Students not only engage in making decisions and solving problems, but they also stand back and oversee their thinking as they work on solutions (Tishman, Perkins & Jay, 1995). The library media specialist contributes to this form of mental management by building critical points of reflection into various phases of the information searching process. Stripling (1998), for example, has developed useful questions that students might ask themselves beginning at the topic selection phase and culminating in the presentation of the final product. To cite two examples:

    - Question formulation stage: Do the questions provide a foundation for my research? Do they go beyond simple, factual questions to interpretive or evaluative ones? Do my questions cover the important aspects of my statement of purpose? Do I have unnecessary questions? (74)

    - Information retrieval stage: Are my sources usable and adequate? Have I found an acceptable number and variety of sources? Is each source reliable? Have I found a balance of points of view? (101)

How do students demonstrate this learning?

In a curriculum built on thinking and problem solving, students cannot be passive vessels waiting to be filled. Presseisen states that schools as cultures fostering deeper and more creative levels of thinking demand a “new role” of students involving what it means “to think [as] a scientist, a historian, a writer…” (1992, 9).

Effective thinkers are disposed to explore, to question, to probe new areas, to seek clarity, and to be open to different perspectives. Such dispositions take time to develop. In *Understanding By Design*, Wiggins and McTighe introduce “six facets of understanding” that delineate the competencies and dispositions of students who “really understand” (1998, 66-67). These behaviors include the

abilities to explain, to interpret, to apply, to view issues and ideas in perspective, to demonstrate empathy, and to reveal self-knowledge. Tishman and team (1995) have identified similar dispositions for good thinking. Figure 3 summarizes some of the salient features of thinking behaviors mentioned in these models.

Figure 3. Student thinking dispositions

Student Dispositions	Indicators of Student Behavior
Student is curious.	• Generates questions. • Poses problems. • Demonstrates desire to probe further.
Student can explain and demonstrate insight.	• Identifies central ideas and events. • Makes reasoned predictions. • Qualifies opinions. • Justifies views with sound evidence. • Reveals a personalized grasp of issue or problem.
Student can interpret information.	• Demonstrates clarity and precision in reasoning. • Offers meaningful account of complex situations and issues.
Student can apply knowledge.	• Employs knowledge in diverse contexts. • Applies knowledge in a novel way.
Student sees things from multiple perspectives.	• Explores alternative points of view. • Critiques a situation or event from different points of view. • Infers assumptions underlying an idea or theory. • Recognizes bias.
Student demonstrates empathy.	• Projects self into another's situation. • Appreciates a different point of view. • Demonstrates tolerance for other points of view. • Practices active listening.
Student reveals self-knowledge.	• Recognizes own prejudices and strengths. • Questions own convictions. • Accurately assesses and regulates own behavior. • Is open minded about feedback and criticism.

In short, students are not only problem-solvers but problem-posers. They develop a sense of ownership for the knowledge they are acquiring and are responsible for their own and others' learning. The skills they demonstrate go far

beyond recitation and regurgitation. Students listen and question, visualize and connect, examine and challenge. They collaborate and support others. They are teachers as well as learners.

Implications for practice: How do we facilitate this learning?

Children are natural thinkers; however, "the subtlety, nuance and sharpness of reasoning powers and ability do not just happen" (Hester, 1994, 79). Stiggins points out that "the human mind does not come with a user's guide. Part of our job is to provide that guidance" (1997, 284).

The strategies and tools described below are not intended to be inclusive; however, they are research-based and classroom-tested practices. They give the reader some notion of the pedagogy that fosters critical thinking. Library media specialists and teachers as partners in instructional delivery must jointly incorporate some of these practices in the library media center and in the classroom.

- Perception and recognition: analogies help learners compare something familiar to something unfamiliar. Concept maps generated by either student or teacher also result in improved academic achievement (Cawelti, 1999). According to Tishman (1994), using language cues that support patterns of thinking help students to organize and communicate their own thinking more precisely and intelligently. For example, instead of using the ambiguous phrase "what do you think" about ideas presented, asking students to "compare," "clarify," or "justify" their ideas guides students in managing their own thinking more clearly.

- Question formulation: the process of generating questions is fundamental to critical thinking. It is the basis of the ongoing internal dialogue that is the core of intellectual analysis. Strategies suggested (Loertscher & Woolls, 2002; Dantonio, 2001; Mallery, 2000; Gross, 1999; King, 1994; Heiman, 1985) include:

    - Generate questions from reading or materials. Ask students to turn text headings and subheadings into questions.

    - Create mock exam questions. Have students make up questions that may actually be used in future tests.

    - Improve question quality by establishing criteria for good and poor questions and providing examples for critiquing.

    - Provide questioning stems and identify specific thinking skills induced by the different ones. For example, a question that begins with "what

would happen if" induces prediction and hypothesizing. "How does this affect" prompts a cause and effect analysis.

- Interpretation and evaluation of information: focused instruction in distinguishing between fact and opinion benefits all types of students ranging from gifted to those with learning disabilities (Hughes, 2000). Several studies have emphasized the importance of allowing for extended practice in data interpretation (Baumert, Evans & Geiser, 1998; Brown & Campione, 1992). One strategy recommended for strengthening data interpretation is reciprocal teaching in which a teacher and a group of students take turns leading a discussion about the material read. The learning leader begins the discussion by asking a question and ends by summarizing the exchange. If there are disagreements, the group reexamines the material. Everyone gets to serve as leader. One of the studies (Baumert, Evans & Geiser, 1998) reported that reciprocal teaching also resulted in increased learning transfer from one class setting to others.

- Organization of information: graphic organizers are spatial arrays that require learners to show how they construct their new knowledge. Researchers using various graphical displays in a number of studies with youngsters at different grade levels have reported significant student gains in summarizing and making sense of information through use of graphs, concept maps, etc. (Sinatra, 2000; Millet, 2000; Shaw, Mayer & Hegarty, 1999).

- Metacognition: having students reflect on how they execute specific operations raises their thinking to a level of consciousness that allows teachers and learners at various grades to diagnose problems and make improvements in future applications. Activities suggested in various studies (Harada, 2002; Cawelti, 1999; Beyer, 1992) include:

    - Categorizing with multiple criteria engages students in discussing actions or choices by placing them into at least two categories (e.g., useful/not useful).

    - Paraphrasing what is heard involves students in articulating one another's plans and actions.

    - Engaging in "I think" writing requires that students write a short piece describing how they are thinking about a task after having completed it.

    - Maintaining journals helps students record how they derive their answers and how they accomplish their tasks.

Scaffolding is a critical strategy that cuts across curriculum and facets of the thinking process (Beyer, 1997; Rosenshine & Guenther, 1992). Described as a temporary support provided by either the teacher or another student, this form of

guided assistance helps learners bridge the gap between their current abilities and their projected goals. The specific procedures involved are:

- Model the procedure or process.

- Practice thinking aloud as choices are made. In writing a summary, for example, one would articulate how a topic was selected and the steps in generating a summary.

- Anticipate student difficulties. This involves figuring out in advance the obstacles students might face and discussing them together.

- Provide for guided practice that incorporates constructive feedback.

- Use checklists or other forms of assessment to have students examine their own work against established criteria.

- Engage in independent practice. As students reach this stage, the instructor gradually moves from a coaching role to that of a supportive listener.

Strategies for developing cooperative learning are also deemed essential since knowledge evolves through social negotiation (Mallery, 2000). Cooperative groups are important because they allow students to test their own understanding and to examine the understanding of others (Savery & Duffy, 1995). Examples of groupings include:

- Jigsaw where students read different parts of the same selection, share what they have read, ask questions of each other, and integrate their information.

- Reading buddies where upper grade students serve as teachers or readers for emergent readers.

- Problem solving in teams where students identify the problem, generate questions to help understand the problem, divide responsibilities to collect information, compare their findings, and agree on solutions based on evidence.

The practices described above reflect an important shift in the roles of student and instructor. Students are involved in selecting activities rather than having choices made solely by the teacher. The accountability for learning is shared with students rather than managed entirely by the teacher. Students as well as the teacher may be the experts on an issue or problem. They identify and pursue learning that connects with their personal interests, develop arguments, and discover new layers of questions as they probe for answers. In using a repertoire of strategies, students increase their skills of self-awareness, personal control,

and constructive self-evaluation (Cawelti, 1999; Zimmerman, Bonner & Kovach, 1996).

How do we create environments that cultivate thoughtful learning?

Newmann (1996) states that learning environments, which result in significant achievement, embody the following attributes:

- Construction of knowledge: students have guided practice in acquiring the skills and knowledge they will need in the adult world. This involves constructing rather than simply reproducing knowledge. Students "produce original conversation and writing, repair and build physical objects, perform artistically" (24).

- Disciplined inquiry: students develop an in-depth understanding of a problem rather than shallow exposure to isolated bits of information. While past knowledge is a fundamental component of learning, students are challenged to push beyond this knowledge "through criticism, testing, and development of new paradigms" (24).

- Value beyond school: student accomplishments have an impact that extends into the real world. Students wrestle with situations and issues connecting their learning with larger public problems or with personal experiences.

In short, substantive learning requires focusing on a smaller number of critical ideas, concepts, and themes that can be studied in depth. These areas of study can be revisited at different grade levels. They can also connect to ideas and processes across various fields of study. Within this context, information literacy skills instruction can have a significant impact on students' mastery of prescribed content (Todd, 1995).

Pappas and Tepe (2002) describe the following as critical features of inquiry focused learning:

- Students wrestle with big ideas through essential questions. All learning activities are anchored to a larger task or problem.

- Learning reflects a connection to the world we live in.

- Students and instructors assess accomplishment through student demonstration of new knowledge.

- Learners have choices. They must have ownership of the problem-solving process.

- Students interact with others to accomplish goals.

- Students test ideas against alternative views and alternative contexts.

- Students reflect on both the content learned and the process by which they learned it.

Problem-based learning embraces the tenets of inquiry learning (Lambros, 2002; Katz & Chard, 2000; Cawelti, 1999). It challenges students to engage in significant and meaningful intellectual work. Instead of memorizing textbook explanations or rules and their applications, students think through tough, complex situations with peers to arrive at conclusions. It mirrors the kind of problem solving people do in life.

Key elements of problem-based learning include (Barell, 1995):

- Identify the situation or problem.
  - What do we think we know about it?
  - What do we need to find out?
  - What is interesting or intriguing about this situation? Why?
  - What do I personally want to find out more about?

- Determine how and where we can get the information.
  - Which sources will provide the information we need?
  - How might we locate these sources?
  - Which strategies will help us find the information most efficiently?

- Collect and discuss initial evidence.
  - What is the information telling us?
  - Are the sources reliable?
  - Is there bias?
  - Is the information firsthand or from a secondary source?
  - Is it objective?
  - Do we need to reconsider our original questions and goals?

- Continually monitor progress.
  - How well are we doing?
  - Do we need to revise our goals or strategies?

- Plan for use of information.
  - What conclusions have we reached?
  - What is the most appropriate way to communicate our findings?
  - How shall we organize the data?
  - How do we divide responsibilities and agree on deadlines?

- Reflect on efforts.
  - How well did we do?

What did we learn about the problem studied?
What did we learn about ourselves?
How well did we work with others?
What would we do differently next time? Why?

Implications for practice: How do teachers and library media specialists work together in building these environments?

The complex issue of collaboration with teachers is more extensively discussed elsewhere in this volume. At this point, I simply introduce the critical nature of the planning process with teachers. Kearney (2000) identifies the following steps:

- Understand and work with teachers' different planning styles.
- Allow teachers to take the lead in the planning process and accommodate different styles of planning.
- Agree on clearly stated learning outcomes from the onset.
- Develop the essential questions based on the problem or issue being studied.
- Decide on appropriate assessment criteria and assessment formats.
- Design the learning activities based on the targeted learning outcomes.
- Link resources. Students who engage in inquiry need access to quality resources and information. These sources extend beyond the library media center into the larger community. Public libraries, local museums, nature preserves, and experts on the Web are just the tip of the information iceberg (Pappas & Tepe, 2002).

In designing problem-based learning experiences with teachers, library media specialists have several important actions to consider.

First, as mentioned earlier in this article, library media specialists can help to identify the thinking processes inherent in the content standards and in information literacy. Although this may seem a formidable task, we can build on previous efforts. For example, various state education agencies (e.g., Wisconsin Department of Public Instruction, 1998; North Dakota Department of Public Instruction, 2002) have published online documents that merge information and technology literacy skills. Dalbotten (1997) has reported on inquiry skills and information literacy skills across various national content standards. There is also a sampling of national standards that are aligned with the information literacy standards in *Information Power* (AASL & AECT, 1998). On a grass roots level, a team of library media specialists in Indiana (Indiana Department of Education, 2002) has correlated the information literacy curriculum to their state content

standards for English, foreign languages, mathematics, and science. To avoid duplication of effort, therefore, it would be prudent to find out what our own state and district offices might already have in place.

Second, library media specialists can offer to write up the unit plans that result from the collaborative exchange. Current teacher certification and licensing initiatives focus on documented evidence of instructional competencies. An essential component is proof of curriculum planning and implementation. Within this context, teachers might welcome the opportunity to work with a colleague, who is willing to help document the work jointly accomplished. For the library media specialist this affords a valuable opportunity to integrate information literacy skills into the plan and to suggest assessment criteria that measure student performance at various stages of the project.

Third, library media specialists can work with teachers to extend the notion of learning communities so that it embraces a "global web of individuals and organizations connected by common interests and information needs" (AASL & AECT, 1998, 48). By doing this, we not only mine the richness of our library media collections but we provide links to human resources in our neighborhoods and to mentors and information sources elsewhere in the world. For busy classroom teachers, who have neither the time nor the searching expertise of the library media specialist, we would be proffering indispensable services that are integral to the learning experience.

What results from such collaborative practices? I conclude this segment with profiles of an elementary and a secondary problem-based unit (Figures 4 and 5). Although the written samples appear linear, their actual implementation requires a fluid back-and-forth approach as students tackle questions and problems at each stage of the process. The samples are based on actual projects implemented in Hawaii. The content area standards referenced are part of the *Hawaii Content and Performance Standards* (Hawaii Department of Education, 2002); the information literacy standards come from *Information Power* (AASL & AECT, 1998).

Figure 4a. Profile of a problem-based project - elementary

Issue or problem: Creating a school history.

The library media specialist discovered old photographs of the school dating back to its start fifty years ago. When she shared the photos with her sixth grade students, they immediately had a barrage of questions. They soon discovered that there was no written history of the school and decided to undertake the project of creating one.

Level/content focus: Elementary/social studies.
Duration of project: 6 weeks.

Standards addressed:

- Social studies: Uses tools and methods of historians to transform learning from memorizing historical data to "doing history." Employs chronology to understand change and/or continuity and cause and effect in history.

- Information literacy: Accesses information efficiently and effectively. Evaluates information critically. Uses information accurately. Strives for excellence in information seeking and knowledge generation. Participates effectively in groups to pursue and generate knowledge.

- Technology literacy: Uses technology tools to communicate, to collaborate, publish and interact with peers, experts and other audiences.

Essential questions:
- How does going to school 50 years ago compare with going to school today?
- Would I prefer being a student 50 years ago or being a student today? Why?

Final product: Web page of school's history.

Assessment criteria:
- Purpose is clearly articulated.
- Questions are directly addressed.
- Supporting information is relevant and accurate.
- Information is of sufficient depth, given the problem or question.
- Communication is effectively presented.

Assessment formats:
- Rating checklist based on assessment criteria.
- Student-kept journals throughout the project.

Problem-Solving Process	In Classroom	**In Library Media Center**
Identify the problem.	• Formulate problem. • Create a web of initial questions (e.g., What did students study? What did the school look like? What were the classrooms like?)	• Generate further questions after examining school yearbooks and photos.

Figure 4b. Profile of a problem-based project – elementary (continued)

Problem-Solving Process	In Classroom	**In Library Media Center**
Determine how and where to get information.	• Learn and practice interviewing skills.	• Brainstorm, list, and label possible information sources (e.g., archival photos, school records and bulletins, former students, retired teachers). • Learn about primary sources and practice extracting information from them.
Collect and discuss initial evidence.	3. Form investigative teams to gather information. 3. Compare and contrast	• Practice think aloud technique and record steps used in search and

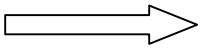
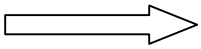
	information from different sources. • Question each other's reasoning. • Use concept mapping to organize collected information.	retrieval process. • Evaluate relevance of information. • Identify missing or inadequate information. • Problem solve ways to acquire the missing information.
Monitor progress.	• Reflect on following: What have we done thus? How well have we done? What problems are we encountering? How are we solving them? What help do we need?	
Organize and plan for use of information.	• Agree on best mode of presenting the information collected. • Devise an action plan to complete work; assign responsibilities.	• Receive additional input on action plan from library media specialist.
Prepare and present findings.	• Draft content for web page. • Critique drafts with peers and teacher. • Revise work. • Post web page; seek feedback from users.	• Learn basics of simple web page design. • Critique drafts with peers and library media specialist. • Revise work.
Reflect on efforts.	• Apply scoring criteria throughout project. • Compose journal entries throughout the project.	

Figure 5a. Profile of a problem-based project – secondary

Issue or problem: Confronting beach erosion.

Hawaii's shorelines are currently receding at an average of 1.25 feet a year. Over the last 100 years, the island state has lost as much as 30% of its shoreline through beach erosion. Students in a 10th grade earth science class, who spend their weekends swimming and surfing off the Oahu shoreline, were appalled by these statistics and wanted to do something about the situation.

Level/content focus: Secondary/environmental science.
Duration of project: 2 months.

Standards addressed:
- Science: Explains the effect of large and small disturbances on systems in the natural world. Identifies and explains current issues based on evidence found in available information.

Collects, organizes, and analyzes information from reliable sources to identify alternative solutions.

- Language arts: Generates questions, identifies issues, and investigates answers using a range of sources. Evaluates and synthesizes information from research and integrates information with own ideas. Publishes in a variety of ways.

- Information literacy: Accesses information efficiently and effectively. Evaluates information critically. Uses information accurately. Strives for excellence in information seeking and knowledge generation. Participates effectively in groups to pursue and generate knowledge.

Essential questions:
- What are the factors, natural and man-made, that cause coastal erosion and beach loss?
- What is the current status of beach use, beach access, and beach health in our community?
- What are the environmental, social and economic consequences of coastal erosion in our state?
- What can we do to stem this erosion?

Final product: Presentations for community boards.

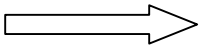
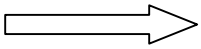
Assessment criteria:
- Purpose is clearly articulated.
- Questions are directly addressed.
- Supporting information is relevant and accurate.
- Information is of sufficient depth, given the problem or question.
- Communication is effectively presented.

Assessment formats:
- Rubrics for written work and oral/visual presentations based on assessment criteria.
- Student-kept journals throughout the project.

Problem-Solving Process	In Classroom	**In Library Media Center**
Identify the problem.	• Guest speaker stimulates questions about beach erosion. • Formulate problem to be investigated.	• Browse through print and Internet sources on the issue of local beach erosion. • Initiate questions related to problem.

Figure 5b. Profile of problem-based project – secondary (continued)

Problem-Solving Process	In Classroom	**In Library Media Center**
Determine how and where to get information.	• Plan for field studies to two beach sites. • Collaborate via email with University scientist on how beach erosion is measured.	• Brainstorm, list, and label possible information sources (e.g., newspapers, magazines, reports and studies, experts). • Map possible search strategies.
Collect and discuss initial	4. Form investigative teams	• Record steps used in

evidence.	to gather information. 4. Conduct measurement activities on field studies. • Keep scientific journal to record observations. • Compare and contrast findings.	search and retrieval of print, online information. • Evaluate relevance of information. • Identify missing or inadequate information. • Problem solve ways to acquire the missing information.
Monitor progress.	• Reflect on following: What have we done thus? How well have we done? What problems are we encountering? How are we solving them? What help do we need?	
Organize and plan for use of information.	• Draw conclusions. • Agree on best mode of presenting the information collected. • Devise an action plan to complete work; assign responsibilities.	• Receive additional input on action plan from library media specialist.
Prepare and present findings.	• Draft content of presentations. • Critique drafts with peers and teacher. • Revise work and rehearse. • Present to community boards.	• Learn presentation enhancement techniques (e.g., PowerPoint slides, display boards, charts). • Critique drafts with peers and library media specialist. • Revise work.
Reflect on efforts.	• Apply scoring criteria throughout project. • Compose journal entries throughout the project.	

Conclusion

Learning is about forming communities in which students are responsible for their own and others' learning. Senge (1990) maintains that learning is also turning the mirror toward ourselves as professionals and examining our personal assumptions about teaching, risk sharing them with others, and engaging in thoughtful conversations that ultimately reshape our practice.

To make a difference, we must learn how to teach for thinking, acquire thinking skills for ourselves, model thinking throughout the learning community, and provide opportunities for students to engage in the act.

We need to make a lifelong commitment to inquiry. Although the ability to think critically has always been important, it is imperative for the citizens of the 21st century. The decisions that our students make as individuals and as a society on issues, which range from preserving and sustaining our environment to combating the atrocities of racism and terrorism, will affect all future generations. The information to make responsible choices is at their fingertips. However, if young people cannot think intelligently and sensitively about the myriad issues confronting them, then they are in danger of having all of the answers, but still not understanding what these solutions mean.

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