

Library Skills, Information Skills, and Information Literacy: Implications for Teaching and Learning

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One intent of national-level reports such as the Secretary's Commission on Secondary Skills and America 2000 is to foster approaches to the education of our children that go beyond factual information to conceptual learning; beyond isolated rules to principles for application; and beyond textbook problems with known, predictable solutions to real problems with solutions that are unique to students and their interpretations of their resources and environments. Discussions of higher-order learning are not new. Bloom's taxonomy includes analysis and synthesis skills. Bruner describes "problem finding," and Gagné distinguishes problem-solving and cognitive strategies as categories of learned capability, while constructivist thinking includes authentic, situated problem solving. Although abundant theoretical viewpoints exist, guidelines are still developing for designing teaching/learning strategies that ensure higher-order outcomes in information literacy. This paper will (a) review characteristics of learning outcomes and environments that define higher-order learning in information literacy, and (b) describe some guidelines from two branches of cognitive psychology for designing information literacy instruction. The paper closes with an appraisal of research trends and current practice in the teaching of information literacy.

Schools used to have libraries with librarians. The general roles of the librarian were to manage a collection of print materials, promote reading and a love of good literature, and teach children how to find things in the library. Some librarians also kept track of filmstrips, slides, 16-mm films, audio tapes, records, and the various accompanying projectors and players (although larger schools frequently had a person called an audiovisual specialist who was responsible for maintaining, scheduling, and circulating non-print materials and equipment). Teaching children to find information was limited to the card catalog for the print collection, a guide for periodicals, and standard print reference sources such as dictionaries, atlases, almanacs, thesauri, encyclopedias, and various books of people, quotations, and places. Teaching children to find information in the library was circumscribed by the forms of information available, primarily requiring use of card catalogs, indexes, guide words, and alphabetical and numerical sequence to about the third character.

Then rapid change began. In approximately a five-year period leading out of the 1970s and into the 1980s, we saw video disc and half inch videocassette appear; audio cassette began to replace records; school libraries, school librarians, and audiovisual specialists were replaced by media

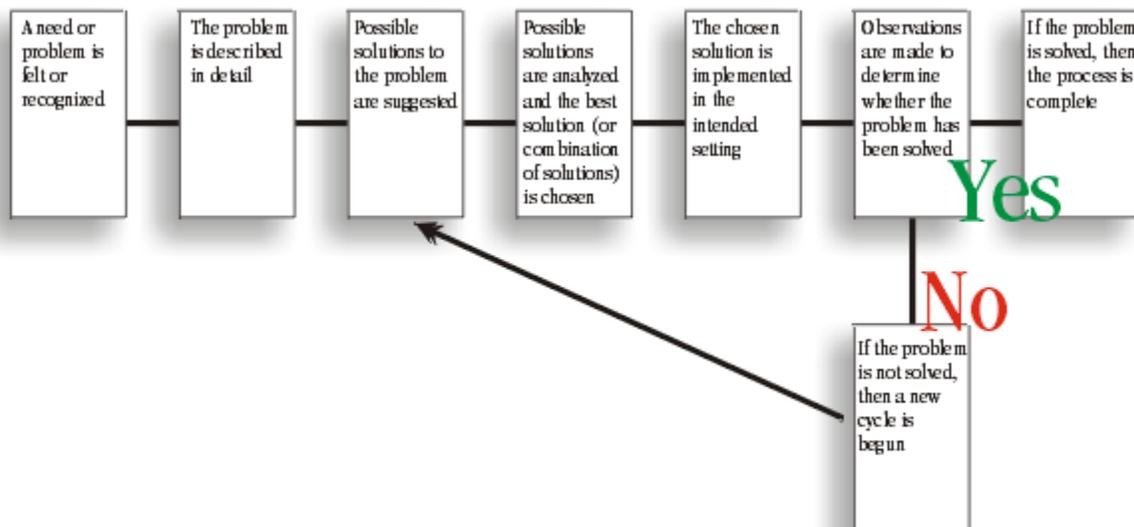
centers and media specialists; and micro computers showed up on desktops. The Information Age was beginning to touch schools, and as formats and sources of information proliferated, the question in media centers changed from “How do I find information in a limited number of resources?” to “How do I choose information that is most appropriate for my needs from a seemingly unlimited number of resources?” Clearly, the focus on tool skills that were specific to a particular information resource shifted to a focus on problem-solving skills generalized across many information resources.

Problem Solving

Logical, sequential strategies for problem solving have been taught for years in virtually all disciplines. Although strategies may differ in detail, a common scheme might contain the elements depicted in figure 1. The elegance of such a process is that it has utility for many types of problems. Once a process is learned and applied in one situation, the resulting mental strategy can be generalized and used in any number of situations. For example, one can think through the steps in figure 1 and imagine how they can be applied to these three sample problems:

- The use of water during the dry season exceeds the rate at which the aquifer is recharged
- Kids from the junior high school are smoking across the street in front of the elementary school, and
- The life of children my age in the migrant labor camps of central Florida is unfamiliar to me

Figure 1. A Typical Problem-Solving Strategy



What is it about this set of three problems that leads us to characterize them as instances requiring problem-solving capability? Though from different subject areas, the three examples have some distinct characteristics in common:

- Problem-solving tasks are what psychologists call ill-structured (Spiro, Feltovich, Jacobson, and Coulson 1992). That means that there is no single best solution inherent in the problem situation. Consider the case of using dividers and the scale on a map to work out a time-rate-and-distance problem, or using the drawing tools in PowerPoint to create a schematic representation of an electrical circuit. Both of these tasks would take some time, and a student would be using a variety of information, concepts, and rules to arrive at a correct answer. Both are worthwhile skills that could have many productive applications; but for the purposes of this paper, neither task is an example of problem solving, because both tasks have correct solutions that can be predicted before the task is even begun.
- Such tasks require a great deal of knowledge (in Bloom's definition of the term [Bloom, Englehart, Furst, Hill, and Krathwohl 1956]) that is organized into very complex mental data structures called schemata (Rumelhart and Ortony 1977). Students need a certain level of knowledge about subject areas in which they are working; and to function in a media center, they may need to know such things as general operating rules and procedures, the names and locations of resources, the function of bookmarks in Netscape, some sources that are good for specific reference tasks, and the position of the printer switch for using the dot matrix printer.
- Problem-solving tasks are also complex, requiring students to bring many tool skills with them to the task, and perhaps to learn new tool skills in the process of problem solving. Tool skills include a variety of intellectual skills, attitudes, and motor skills. In a media center students need to use computers and software applications, employ Boolean terms to broaden or narrow a search, use a digital camera, paraphrase an article, choose the most appropriate WWW search engine, find something of interest in the vertical file, etc.
- The tasks require a strategy, a collection of tactics that can be grouped and used in developing a solution. It may require brainstorming, developing a rating scale for comparing alternative solutions, holding a debate, rooting out primary sources of information and evaluating their authority, formatting a Gantt chart, testing a hypothesis, etc.
- Finally, problem-solving tasks require that knowledge, tool skills, and solution strategies be orchestrated into an effective process, recognizing that problems are dynamic, changing as we work on them and learn more about them. To solve problems effectively we must constantly check and re-check assumptions, apply different sets of knowledge and tool skills, change or modify our solution strategies, and mentally monitor the problem-solving process to make adjustments and keep it on track as we progress toward a solution. This is variously referred to as using cognitive strategies (Gagné, 1985) and metacognition (Brown, Campione, and Day 1981) or just plain "learning how to learn."

Two additional properties of problem-solving activity run throughout the literature on school restructuring and future schools. We read constantly that schools should be teaching children to think rather than memorize and repeat, and that thinking skills should transfer to the real world so that our children become independent, productive members of adult society. Problem solving as described above is the essence of thinking "skill," and if schools can provide the appropriate variety and frequency of problem-solving engagement, then transfer (in keeping with individual student's capabilities) will be assured. Figure 2 is a graphical representation of the foregoing description of problem solving.

Figure 2. Problem Solving and Life Skills

Information Problem Solving Models

Many disciplines develop specific problem-solving strategies so that practitioners need not infer from a generalized model to a context of particular interest. This is the case regarding information problem solving. A body of literature on information problem solving in school settings began to gather momentum in the 1980s with definitional discussions. The literature expanded into model building, and now, in the 1990s, has moved into qualitative (and some quantitative) investigations of the efficacy of models; strategies for optimizing applications of models; interactions among selected aspects of models, curriculum content, information resources, students, media specialists, and teachers, and; the application of appropriate theories from communications, information science, and cognitive psychology. It is not my purpose to review this literature here. The authors and their lines of research can be tracked through the last 10 to 12 years of *School Library Media Quarterly* and *School Library Media Annual*, but as a point of reference for those who may not be familiar with this literature, a representative information problem solving model, The Big Six Skills Approach (Eisenberg and Berkowitz 1990, 22–24), is included in appendix A.

My purpose in mentioning this literature is to emphasize that serious efforts have gone into building and testing models of information problem solving, and to point out that these models depict processes that share the features and characteristics of problem solving that I have described earlier in this paper. Granted, the models focus on strategies for solving information problems, but the models retain that critical property of transfer; that is, once a student has sufficiently broad experience with an appropriate range of problem environments in school, then the student will be equipped with mental strategies that can be applied in future levels of schooling and in many kinds of life situations.

Teaching Problem Solving

The purpose of theorizing, building models, and conducting research in problem-solving processes is, of course, to inform our practice of teaching. Table 1 is included here to focus some of the previous discussion of problem solving on the question of teaching, and to provide an organizational pattern for the rest of this paper.

Table 1. Teaching Problem-Solving Skills in the School Media Center Context

TYPES OF SKILLS	COMPONENT OF PROBLEM SOLVING (FROM FIGURE 2)	TEACHER'S ROLE	STUDENT OUTCOMES	PSYCHOLOGICAL FOUNDATION
Library Skills	Knowledge and tool skills	Teaching sets of tools for accessing, manipulating, creating, and reporting information in a variety of formats	Students find information from multiple sources and use it in preparing reports and presentations	Cognitive objectivism
Information Skills	Tactics and strategies	Teaching library skills and a process by which students can be guided in their solution of information problems	Students apply a generic solution strategy to a variety of information problems, and construct new meaning through the interaction between what they already know and the new information that they encounter	Cognitive objectivism and Cognitive constructivism
Information Literacy	Cognitive strategies (metacognition)	Creating learning environments (problem scenarios) and cooperative group structures in which the natural outgrowth of curiosity is the collaborative construction among students of effective information problem solving strategies (facilitated as needed with library skills, and techniques such as modeling, coaching, and scaffolding)	Students construct personal solution strategies for information problems, and generalize, test, and adapt those strategies in new problem situations	Cognitive constructivism

Please note one thing first about table 1. The terms *Library Skills*, *Information Skills*, and *Information Literacy* were chosen as convenient labels rather than with regard for their current usage in the field. Their inclusion in the table does not suggest that they are, or should be, operationally defined according to their usage here. A second note about table 1 is that the organization of the table is not intended to marginalize the value of library skills or information skills, as I am convinced that both are indispensable components of information literacy. A final caution: although facilitating discussion, the design of table 1 makes the entries in each column appear to be conceptually discrete, while the entries are really more continuous, blending from one row into the next.

Two Models from Cognitive Psychology

The focus of the paper now shifts to consideration of what two theoretical positions in learning psychology have to say about how we should design instruction for teaching problem solving. Cognitive psychologists believe that learning is an active mental process in which dynamic structures of meaning are created and modified as an individual interprets and acts on the environment. Cognitive psychologists also believe that there is value in trying to understand how the mental processes of learning work, so that we can design instruction in such a way as to support best what is happening in a student's mind during teaching and learning. The field of cognitive psychology has spawned a number of models for planning and carrying out the teaching/learning process. Two of these models from cognitive psychology are closely associated with the teaching role of school media specialists, and they are the two models that are featured in *Information Power* (AASL and AECT 1998). These two models are discussed in this paper because both provide valuable guidance for planning instruction, but at the same time, some of the practices prescribed within each model are antithetical to positions taken by advocates of the

other model. The first model for planning and carrying out the teaching/learning process is *instructional design* (sometimes used interchangeably with the term *instructional development*). Instructional design has been a prominent feature of the media specialist’s teaching and instructional consulting roles for more than twenty years (AASL and AECT 1975; Chisholm and Ely 1979; AASL and AECT 1988; Loertscher 1988; Turner 1993). Instructional design continues to hold a prominent position in the new standards for our profession outlined in *Information Power* (AASL and AECT 1988, 7, 65, 68, 70, 73). The second model for planning and carrying out the teaching/learning process is *constructivism*. Constructivism is a more recent emphasis in the literature about media specialists’ teaching and instructional consulting roles (Kuhlthau 1993; Vandergrift 1994; Stripling 1995; McGregor and Streitenberger 1998) and also holds a prominent position in *Information Power* (pp. 2, 59, 69, 70).

The discussion of instructional design and constructivism that follows will be organized using column 5 of table 1. In that table, instructional design is represented by the term *cognitive objectivism*. It is a term that was coined by a constructivist psychologist (Lakoff 1987) as a way of distinguishing different views within cognitive psychology. The discussion will begin by looking at cognitive objectivists’ views at the top of column 5, then skip to the bottom of column 5 to look at cognitive constructivists’ views, and then finish with an analysis of a middle ground combining objectivism and constructivism that is probably most representative of current thought.

Table 1. Teaching Problem-Solving Skills in the School Media Center Context: Psychological Foundations (Column 5)

PSYCHOLOGICAL FOUNDATION
Cognitive objectivism
Cognitive objectivism and Cognitive constructivism
Cognitive constructivism

Designing Instruction from the Cognitive Objectivist's Point of View

When referring to cognitive objectivism and instructional design, I am using narrowly defined terms that denote the assumptions, processes, and procedures described below. This technical use of the terms is not to be confused with a much more general use of instructional design to refer to anything that one might do in preparation for teaching a lesson. Although instructional design has recently been labeled *cognitive objectivism*, many instructional designers reject the label objectivist because they do not subscribe to all of the assumptions implied by the term (Merrill 1991). That said, I will go ahead and use the term here because it does denote the traditional instructional design view that the world has an “objective,” real structure that does exist regardless of how different individuals may internalize and interpret what they experience.

In a practical sense this means that knowledge and skills can be organized and categorized and that relationships can be identified within and among categories (Bloom, Englehart, Furst, Hill, and Krathwohl 1956; Gagné 1985; Dick and Carey 1996). Thus state departments of education can produce curriculum guides and scope and sequence documents; media specialists can list the skills that they plan to teach in the information curriculum for the year; and teaching sequences can be identified based on procedural, logical, and subordinate/superordinate relationships among skills.

Based on these assumptions, instructional designers work as follows:

1. Specify learning outcomes, usually in the form of goals and objectives
2. Analyze the skills required to reach the learning outcomes, identifying sequential relationships among the skills
3. Analyze the intended learners with regard to
 - o their mastery of skills that should have been learned prior to beginning the new instruction
 - o their predisposition for learning, including: attitudes, abilities, achievement levels, physiological or psychological limitations, family support structures, etc.
4. Specify instructional strategies (instructional events, materials, methods, and activities) based on learning outcomes, skills requirements, and what is known about the learners
5. Select and/or prepare instructional materials
6. Implement the instruction and evaluate the results
7. Revise the instruction if needed to improve effectiveness, acceptability, or efficiency

The fourth step, specifying instructional strategies, is also called lesson planning, and instructional designers typically stress inclusion of the types of instructional events listed in appendix B. The lesson plan represents the way in which instructional design has been conducted for approximately 25 years. It falls into the Library Skills category in table 1, being used to teach knowledge and tool skills. There is no real point of discussion here concerning the teaching of problem-solving skills, except to point out again that knowledge and tool skills are a necessary component of anyone's problem-solving repertoire. Now let's skip to the bottom row of table 1 and consider cognitive constructivists' views.

Table 1. Teaching Problem-Solving Skills in the School Media Center Context: Cognitive Constructivists' View (Bottom Row)

Information Literacy	Cognitive strategies (metacognition)	Creating learning environments (problem scenarios) and cooperative group structures in which the natural outgrowth of curiosity is the collaborative construction among students of effective information problem solving strategies (facilitated as needed with library skills, and techniques such as modeling, coaching, and scaffolding)	Students construct personal solution strategies for information problems, and generalize, test, and adapt those strategies in new problem situations	Cognitive constructivism
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Designing Instruction from the Cognitive Constructivist's Point of View

Jonassen (1992) describes a continuum of constructivist thinking, and places himself toward the radical end. Whereas objectivism assumes that reliable, structured knowledge about the world exists,

Constructivism, on the other hand, claims that reality is more in the mind of the knower, that the knower constructs a reality, or at least interprets it, based on his/her experiences. Constructivism is concerned with how we construct knowledge from our experiences, mental structures, and beliefs that are used to interpret objects and events. Our personal world is created by the mind, so in the constructivist's view, no one world is any more real than any other. There is no single reality or any objective entity. Constructivism holds that the mind is instrumental and essential in interpreting events, objects, and perspectives on the real world, and that those interpretations comprise a knowledge base that is personal and individualistic. The mind filters input from the world in making those interpretations. An important conclusion from constructivistic beliefs is that we all conceive of the external world somewhat differently, based on our unique set of experiences with that world and our beliefs about those experiences. (pp. 138–39)

A maxim from the field of general semantics sums up constructivism fairly well: “the same person cannot step into the same river twice.” The thought is that the reality of the river will have changed and so will the person experiencing the reality. Based on this thinking, one might conclude that the notion of constructivist instructional design is oxymoronic, a conflict in terms. If there is no objective reality and if students construct their own knowledge, then what is left for the instructional designer to do (Winn 1993)? If learning is internal and individual, and therefore unpredictable, then how can instructional designers determine what students need, prescribe instructional activities, and assess learning outcomes? Rest assured that instruction will happen, and that it will occupy space in a school and take up time, so if nothing else, the school will require that it be planned. But what form will such plans take? As a reminder, our focus is now on the bottom row of table 1, which places us into cognitive strategies for problem solving.

Before discussing design considerations for problem solving it will be useful to read through the scenario in appendix C, a description of a problem-solving task in mathematics. The scenario clearly meets many requirements of a problem-solving task per the above test. It requires

knowledge and tool skills, it is complex, and students must manage tactics and strategies to solve it. But is it ill defined; is there a correct answer inherent in the problem? If the number of jelly beans is the answer of interest, then this is a very defined problem and does not qualify as a problem-solving task. But if the teacher intends students to construct problem-solving strategies, then the outcome is ill-defined. Did the teacher in the scenario function as an instructional designer? Not in the traditional sense, but the teacher prepared instructional materials and followed a planned process in which student and teacher roles were carefully defined. A constructivist would say that the teacher had designed a *learning environment* (an engaging problem scenario), and that there are guidelines for such exercises.

Table 2 uses the framework of instructional events from appendix B to organize a set of guidelines for designing constructivist learning environments to support students' learning of problem-solving skills. This framework of instructional events also provides an opportunity for comparison and contrast between objectivist and constructivist points of view.

Table 2. Comparing Traditional Instructional Design with Constructivist Learning Environments

INSTRUCTIONAL EVENTS FROM OBJECTIVIST INSTRUCTIONAL DESIGN	GUIDELINES FOR DESIGNING CONSTRUCTIVIST LEARNING ENVIRONMENTS TO SUPPORT STUDENTS' DEVELOPMENT OF PROBLEM-SOLVING SKILLS
1. Provide a motivational introduction and focus students' attention on the important content that will be learned.	Foster motivation through "ownership" by giving students choices in the content they explore and control of the methods they use for exploration Situate the problem in a meaningful (authentic) context that is rich in the content of interest
2. Let students know what will be expected of them and remind students of relevant things they should already know.	Problem scenarios should emphasize constructing process over finding answers; for example, the aim is for students to think like mathematicians rather than to compute a correct answer Scenarios should require reflexive thought, looking back to incorporate foundational knowledge in construction of new knowledge
3. Present the new content and examples in ways that will enable students to learn and recall successfully.	Use cooperative learning so that students can negotiate the meaning of what they are learning Design problem scenarios of high complexity requiring use of multiple process strategies and knowledge and tool skills Encourage multiple perspectives and interpretations of the same knowledge Situate the problem in authentic contexts
4. Provide students with opportunities to practice their new skills.	Problem scenarios must be generative rather than prescriptive; that is, students construct their own, active investigation and knowledge acquisition rather than following steps in a prescribed process Encourage group participation for trying out and negotiating new knowledge and process
5. Provide students with information about how well they are doing in their practice.	Balance the potential frustration of aimless exploration with just enough facilitation to ensure progress (suggested facilitation techniques include modeling, scaffolding, coaching, and collaborating), but fade the facilitation as students become more skillful Facilitate group interaction as needed to ensure peer review of knowledge and process
6. Provide review and relate the new skills to real-world applications and to upcoming lessons.	Students should have opportunities to explore multiple, parallel problem scenarios where they will find application in a new scenario of information and processes that they have previously constructed
7. Provide tests, performance checklists, rating scales, attitude scales, or some other means of measuring mastery of the new skills in as authentic a setting as possible.	Suggest tools that students can use to monitor their own construction of knowledge and process; learning should be reflexive, encouraging review and critique of previous learning and newly constructed positions Standards for evaluation cannot be absolute, but must be referenced to the students unique goals, construction of knowledge, and past achievement The ultimate measure of success is transfer of learning to new, authentic environments

The table suggests that constructivists must certainly do a lot of instructional design to make instruction work. It also suggests that both constructivists and objectivists would seem to want to get a number of the same kinds of things done during teaching/learning, but would go about it in different ways. The guidelines in table 2 are a synthesis of ideas largely taken from Choi and Hannafin (1995), Savery and Duffy (1995), Kuhlthau (1993), and Stripling (1995). Now let us

turn our attention to the middle row of table 1, and consider a middle road of instructional design incorporating both objectivist and constructivist points of view.

Table 1. Teaching Problem-Solving Skills in the School Media Center Context: Combined View (Middle Row)

Information Skills	Tactics and strategies	Teaching library skills and a process by which students can be guided in their solution of information problems	Students apply a generic solution strategy to a variety of information problems, and construct new meaning through the interaction between what they already know and the new information that they encounter	Cognitive objectivism and Cognitive constructivism
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Designing Instruction from a Combination of Objectivist and Constructivist Points of View

Some of the conflicts between objectivists and constructivists are more over the theory behind why things are done in the teaching/learning process than over the actual things that are done. This is probably true in most instances where an emergent position is being advanced in opposition to a dominant position by proponents seeking theoretical acceptance. I have included appendix D as an example of what I would view as a combination of objectivist and constructivist lesson planning and management. This example is from Kuhlthau's (1993) description of a process approach to information problem solving. After reading through the scenario, you are invited to compare Kuhlthau's description of the teaching/learning process with the objectivist and constructivist views presented in table 2. I think that you will note that Kuhlthau's approach is at the same time more prescriptive than the constructivist view and more student-centered than the objectivist view. I think this is a result of the focus of the unit of instruction. My interpretation is that the goal of the unit was for students to learn to *use a given problem solving process* in their *construction of new knowledge* from a variety of resources. It appears that the approach to learning the problem-solving process is quite objectivist in its design, while the approach to learning from a variety of resources is quite constructivist. Had the focus of the unit of instruction been for students to *construct their own information problem-solving strategies*, then the design of the unit may have been quite different.

Research Trends and Current Practices in the Teaching of Information Literacy

Where is the field of school media with regard to teaching library skills, information skills, and information literacy? Figure 3 illustrates a continuum with indications of my estimation of where we are in practice and where we are in research/advocacy. "Library Skills" at the left end of the continuum are the knowledge and tool building blocks of problem solving that are probably taught most efficiently with traditional instructional design approaches to teaching and learning. On the other end of the continuum, "Information Literacy" is the cognitive strategies component of problem solving that is probably taught best using constructivist approaches to teaching and learning.

Figure 3. Status of Instruction in School Media Centers

TYPES OF SKILLS	COMPONENT OF PROBLEM SOLVING (FROM FIGURE 2)	TEACHER'S ROLE	STUDENT OUTCOMES	PSYCHOLOGICAL FOUNDATION
Library Skills	Knowledge and tool skills	Teaching sets of tools for accessing, manipulating, creating, and reporting information in a variety of formats	Students find information from multiple sources and use it in preparing reports and presentations	Cognitive objectivism
Information Skills	Tactics and strategies	Teaching library skills and a process by which students can be guided in their solution of information problems	Students apply a generic solution strategy to a variety of information problems, and construct new meaning through the interaction between what they already know and the new information that they encounter	Cognitive objectivism and Cognitive constructivism
Information Literacy	Cognitive strategies (metacognition)	Creating learning environments (problem scenarios) and cooperative group structures in which the natural outgrowth of curiosity is the collaborative construction among students of effective information problem solving strategies (facilitated as needed with library skills, and techniques such as modeling, coaching, and scaffolding)	Students construct personal solution strategies for information problems, and generalize, test, and adapt those strategies in new problem situations	Cognitive constructivism

My estimation of where we are in practice is based on the literature in our field, several years of LM_NET, and observations of media center programs in Florida, Ohio, and Arizona. With the constraints imposed on media specialists through staffing patterns, scheduling, and problems in breaking out of old perceptions of roles and responsibilities, it is difficult to bring together the cooperative arrangement among teachers, students, and media specialists that is required to implement a good information skills program. To that, add constraints imposed by state and district curriculum requirements, testing, and accountability standards, and for the media specialist to move toward a full-blown, constructivist, information literacy program becomes a task of enormous proportion. Even when states specify the desirability of information literacy, they typically prepare tests to measure it in ways that are at odds with constructivist theory. A dilemma for practitioners is that the most desirable benefits of a constructivist philosophy are realized at the far right end of the continuum in figure 3, but that is the very level of application that is the most difficult to employ in a typical school setting.

My estimation of where we are in research/advocacy is based on my comparison between a constructivist view and current writing in our field on information problem solving. I see a constructivist trend regarding children and their learning of information, but not regarding children and their construction of cognitive strategies for problem solving. The Big Six Skills Approach, Kuhlthau's process approach, and similar models for teaching information skills do contain some constructivist elements, particularly in the reflexive aspects of evaluating and "personalizing" the problem-solving process; however, current research/advocacy essentially mirrors the objectivist/constructivist combination found in *Information Power* (AASL and AECT 1998). Researchers interested in constructivist models for teaching and learning problem-solving skills face the dilemma that some of the most enticing lines of inquiry are also the most difficult to design, conduct, and interpret.

Several topical areas for discussion are suggested by the current status of practice and research/advocacy in our field. First, there may be some simple problems regarding the use of the term *constructivism* that could be resolved by efforts within our professional organizations to develop thoughtful, operational definitions with accompanying scenarios of how constructivist theory applies in our teaching of information literacy. Are our professional organizations really advocating a fully constructivist conception of teaching/learning, or is it more of a combination objectivist/constructivist approach? Discussion of this definitional question could raise a dilemma regarding theory and practice. Restating the constructivist position to accommodate the current combination of objectivist/constructivist methodologies would probably create some dissonance among theorists in our field; however, pushing the agenda toward a fully constructivist conception of teaching information literacy would probably create dissonance among practitioners in our field by driving the official position of the profession even further away from current practice. A second topical area for discussion concerns appropriate research methodologies for investigating applications of constructivist teaching strategies in the context of typical school media centers. Research in applications of models of information problem solving is well under way; perhaps this research could be expanded to include investigations of children's construction of their own strategies for information problem solving. Finally, in *Information Power* (AASL and AECT 1998) our professional organizations have added a constructivist theoretical foundation for the teaching/learning that occurs in school media centers. Perhaps broader discussion of theory should be encouraged among the membership, and alternative views of theoretical foundations should be entertained.

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Appendix A

The Big Six Skills Approach

1. **Task Definition:** (determining the purpose and need for information)
 - 1.1 Define the problem.
 - 1.2 Define the information requirements of the problem.
2. **Information Seeking Strategies:** (examining alternative approaches to acquiring the appropriate information to meet defined needs)
 - 2.1 Determine the range of possible resources.
 - 2.2 Evaluate the different possible resources to determine priorities.
3. **Location and Access:** (locating information sources and information within sources)
 - 3.1 Locate sources (intellectually and physically).
 - 3.2 Find information within resources.
4. **Use of Information:** (using a source to gain information)
 - 4.1 Engage (e.g., read, hear, view) the information in a source.
 - 4.2 Extract information from a source.
5. **Synthesis:** (integrating information drawn from a range of sources)
 - 5.1 Organize information from multiple sources.
 - 5.2 Present information.
6. **Evaluation:** (making judgments based on a set of criteria)
 - 6.1 Judge the product (effectiveness).
 - 6.2 Judge the information problem-solving process (efficiency).

Source: Eisenberg, M.B., and Berkowitz, R.E. (1988). *Information problem solving: The big six skills approach to Library & Information Skills Instruction*. Norwood, N.J.: Ablex.

Appendix B

Lesson Planner

Objective or Objectives: Students will work at a terminal in groups of three, and each student will complete a brief PowerPoint sequence that includes titles, bullets, sub titles, clipart, and a Microsoft draw object.

Notes: This is the first of 3 skill-building lessons in PowerPoint. Students will already have basic keyboard and mouse skills and familiarity with the Windows (or Mac) interface and basic word processing. Each student will be working on a report assigned by the classroom teacher.

INSTRUCTIONAL EVENTS	MEDIA AND MATERIALS	DESCRIPTION OF INSTRUCTIONAL METHODS, ACTIVITIES AND STUDENT GROUPINGS
1. Provide a motivational introduction and focus students' attention on the important content that will be learned.	-media specialist -computer w/LCD panel -beginning and advanced PPT projects from previous students	-demo for whole group -show some cool PPT presentations that students have produced as alternatives to pencil/paper reports -elicit ideas about different subjects that can be portrayed visually -point out that later in the semester they will be able to make their own WWW pages using PPT
2. Let students know what will be expected of them and remind students of relevant things they should already know.	-assignment sheet w/checklist -media specialist -computer w/LCD panel -beginning and advanced PPT projects from previous students	-put up the PPT interface and point out the interface conventions that they already know from word processing in their "Works" program -discuss the assignment sheet with some reminders about teamwork -highlight new skills in a couple of PPT sequences -mention that students will be checking their own work and point out checklist -preview the lesson guide in the flipbook
3. Present the new content and examples in ways that will enable students to learn and recall successfully.	-assignment sheet w/checklist -laminated flipbook -media specialist -computers	-try to group more experienced computer users with less experienced -hands on at the computers with students following step-by-step in the flipbook -circulate casually among groups to monitor and provide help
4. Provide students with opportunities to practice their new skills.	-same as in #3	-practice sequences built into flipbooks
5. Provide students with information about how well they are doing in their practice.	-same as in #3	-examples built into flipbook in form of screen prints -self-check and peer review with checklist -circulate among students answering questions and providing guidance as needed
6. Provide review and relate the new skills to real-world applications and to upcoming lessons.	-media specialist -computer w/LCD panel -beginning and advanced PPT projects from previous students	-summarize with a few PPT examples of what students' work should look like -brief demo of more advanced PPT shows that include transitions, builds, and imported graphics which will be covered in their next session
7. Provide tests, performance checklists, rating scales, attitude scales, or some other means of measuring mastery of the new skills in as authentic a setting as possible.	-students' classroom projects -rating scale that includes classroom teacher's criteria for students' reports	-review students projects after entire sequence of PPT lessons has been completed and students' classroom reports are completed -provide feedback on PPT presentation, focusing on how new skills and techniques were used to advantage in students' reports

Appendix C

A Scenario

The following scenario provides a window into a third-grade constructivist (in my mind) classroom. The teacher began the lesson with a Plexiglas box filled with jellybeans, which she had placed in layers separated by paper, suggesting that the children think of ways to figure out how many beans were in the box. The children were given unifix cubes to use as tools and were asked to record their solutions. After working in collaborative groups for awhile, they convened a “math congress” to discuss their ideas. A few children began by explaining that they were going to count the top layer, see how many layers there were, and then add them up. Another child suggested that the same strategy could be used to count the top layer if they counted the rows and looked at how many rows there were. Agreeing with this strategy, they began to count the beans in each row but then became confused whether some beans should be counted once or twice—once as a unit in the row, once to represent the number of the row. (This is a common confusion as children struggle to construct multiplication—entering with a unitary assimilatory structure they must grapple with a grouping structure in order to make sense of the task.) The teacher was noncommittal; instead she simply facilitated discussion. After much debate, they resolved that issue explaining and proving their reasoning to the rest of the group, which concurred. For the top layer they produced an answer of 6 rows with 8 beans in each. The teacher recorded 6×8 explaining that mathematicians write the expression with an X to show groups and to differentiate it from addition and subtraction. Some children argued that from where they were sitting they saw 8 rows of 6. They counted to make sure it was still 48 and discussion ensued over whether the total answer would always be the same when the digits were reversed (the commutative property). After proving to each other that it would, by building several rectangles and recognizing the reciprocal nature of the columns and rows, they began to count the layers and over the next several sessions proposed short-cut addition strategies (involving the distributive and associative properties of multiplication) such as adding up two layers three times. After each session the teacher had the children write in mathematics journals their individual ideas so that she had a clear idea where each child was, and she wrote back, in dialogue fashion, in each journal asking questions. From this one problem the teacher engaged the children in investigating multiplication, its properties, area, and volume.

I share this scenario for several reasons. First, it shows an example of how a constructivist approach can be used with young children. Second, the teacher used no fancy, expensive technology but was able to capitalize on learners’ initial conceptions and stretch them, letting learners put forth their own ideas and argue them within their learning community. Third, it suggests an avenue for assessment strategies. In a constructivist model it makes more sense (to me) to document learning, rather than to assess it. Portfolios of students’ writing, mathematics problem solving, or recordings of science investigations can be kept, as well as individual journals and clinical interviews. Patterns of growth can be recorded using a developmental structural analysis. If needed, triangulation measures, ethnographic case studies, and interrater reliability measures can be used to document classroom learning and classroom interactions. Post hoc assessment measures which are conducted out of meaningful learning contexts test only the testers’ question, and hence how learners take tests, rather than real learning.

Source: Fosnot, C. (1992). Constructing constructivism, pp. 173–74. In T. M. Duffy and D. H. Jonassen (Eds.), *Constructivism and the technology of instruction*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Appendix D

Library Media Programs Based on the Process Approach

The following is excerpted from Kuhlthau, C. C. (1993). Implementing a process approach to information skills: A study identifying indicators of success in library media programs. *School Library Media Quarterly*, 22 (1), pp. 12–13:

There are some general guidelines, however, for guiding students in the development of skills for seeking and using information in each stage of the information search process.¹ First and foremost, the process approach is initiated by open-ended problems, questions, or topics that need to be addressed by using a number of sources over a period of time. These open-ended issues arise directly from the curriculum to initiate problem-directed research, rather than artificially imposed research assignments that only peripherally relate to the context, content, and objectives of the course of study.

During initiation, an invitation to research is extended to students to prepare them for the creative process ahead. Some basic groundwork is laid to prepare students for the research process. An introduction such as a particularly gripping work of fiction, a vivid video portrayal, or an engaging speaker can capture the attention of students and enable them to form some basic constructs upon which to build. During this initial stage the students become aware of issues and questions worthy of further investigation and identify those issues that are of personal interest to them.

Brainstorming in the early stages draws out what students know and provides opportunities for generating, clarifying, and sharing ideas. Raising questions about their existing knowledge provides motivation for proceeding to find out more. An audience for their work beyond the teacher is established at the start. Brainstorming encourages collaborative learning at the very beginning of the process.

In the early stages, students concentrate on topics, ideas, and questions that need further investigation rather than getting enmeshed in the mechanics of the project. Mechanics are stated directly but in no way overshadow the central task of gaining a deeper understanding of a particular problem, issue, or topic. Keeping a journal is a useful strategy throughout the process and can serve a variety of purposes at different points. For example, at one point students use their journals to record thoughts on possible topics, plans for addressing the project, and prospective problems. Later in the process, they use their journals for detailed notetaking.

At the beginning, students are introduced to the concept of stages in the search process and become aware of what to expect in the ensuing project. The model of the information search process is used to illustrate the sequence of tasks, thoughts, actions, and feelings that are commonly experienced in each stage of the process. Students may refer to the model from time to time to determine where they are in the process.

After students have selected a topic or area for research, they are carefully guided and coached through the exploration stage. This is frequently the most difficult stage. Uncertainty prevails as students encounter information that is inconsistent and incompatible and does not match what they already know. Reading and reflecting in a receptive mood and in an unhurried environment

are conducive to formulating new understandings. Opportunities for discussing newly formulated constructs are offered through one-on-one conferences, small group interaction, and large group discussions. Journals are helpful for recording interesting ideas, connecting themes, and emerging questions developed from a number of sources instead of extensive copious notes from one source. This activity also deters students from the tendency to copy word-for-word or to plagiarize when presenting.

Students gain a clear understanding that their task during this time is to form a focused perspective of their topic or problem by reading, investigating, and thinking. A focused perspective provides direction for collecting information and is the turning point of the information search process. Once a focus is formed the search takes on a central theme or guiding idea that provides the basis for making judgments of what information to collect and what to disregard. Notetaking strategies shift at this point to recording detailed notes on information related to the focused perspective of the topic.

The final stage is organizing ideas for presentation. Students are guided in determining what will be paraphrased, summarized, and quoted and how to document the origin of the information used. Connections are made between and among the ideas and extensions of meaning are identified and explained. Presentations take many forms and are addressed to the collaborative learning group, not solely to the teacher.

An essential part of the process approach to information skills is assessing the process as well as the product at the end of the project. An opportunity to look back and take account of the entire process enables students to recognize that their experience has not been isolated to this one incident but is applicable to a wide range of situations. Journals provide an excellent means for students to review their process. By reflecting on their use of time, use of sources, and evidence of a focus in their presentation, they develop an awareness of their own information search process. “Processfolios” of student work representing the various stages of the project provide an excellent way to assess the process of learning.²

Endnotes

1. Carol C. Kuhlthau, *Teaching the Library Research Process*, 2d ed. (Metuchen, N.J.: Scarecrow, 1994).
2. Barbara Stripling, “Practicing Authentic Assessment in the School Library,” in *School Library Media Annual Vol. 11*, ed. Carol C. Kuhlthau, Mary Jane McNally, and Elspeth Goodin (Englewood, Colo.: Libraries Unlimited, 1993).

School Library Media Research (ISSN: 1523-4320) is the successor to *School Library Media Quarterly Online* and the predecessor to *School Library Research*, an official journal of the American Association of School Librarians. The purpose of *School Library Media Research* is to promote and publish high quality original research concerning the management, implementation, and evaluation of school library programs. The journal also emphasizes research on instructional theory, teaching methods, and critical issues relevant to the school library profession. Visit the [website](#) for more information.



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