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ABSTRACT

Constructivism is the theory that people learn by constructing meaning through interpretive interactions with the social environment. Constructivist perspectives are a growing influence among educators seeking to help students connect learning with life experiences, making constructivism highly relevant to vocational and career educators. This compilation is intended to guide practitioners in using constructivist principles in the following ways: describing its attributes as a philosophy and a model for practice; explaining assumptions, including its connection with authentic pedagogy, correlation with brain-based learning, and implications for a new teaching paradigm; illustrating applications in career and vocational education; and exploring how technologies such as the Internet facilitate constructivist learning. Each section includes definition of terms and questions to guide reflection and discussion. The largest section of the paper outlines 12 classroom activities that reflect constructivist principles. Activities for curriculum, instruction, and assessment practices are provided. Each activity contains the following sections: constructivist pedagogy, teaching strategy, learning activity scenario, evaluation criteria, operational steps, reflective practices, and evaluation method. Contains 93 references. (SK)

Applying Constructivism in Vocational and Career Education

Information Series No. 378

by
Bettina
Lankard
Brown

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CENTER ON EDUCATION AND TRAINING FOR EMPLOYMENT
COLLEGE OF EDUCATION
THE OHIO STATE UNIVERSITY

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Foreword

The Educational Resources Information Center Clearinghouse on Adult, Career, and Vocational Education (ERIC/ACVE) is 1 of 16 clearinghouses in a national information system that is funded by the Office of Educational Research and Improvement (OERI), U.S. Department of Education. This paper was developed to fulfill one of the functions of the clearinghouse—interpreting the literature in the ERIC database. This paper should be of interest to career and vocational-technical educators and graduate students.

ERIC/ACVE would like to thank Bettina Lankard Brown for her work in preparing this paper. Ms. Brown, a Program Associate at the Center on Education and Training for Employment, is the career education specialist for ERIC/ACVE. She has more than 25 years of experience in writing and designing curriculum products and instructional materials, including multimedia.

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Executive Summary

Constructivism is the theory that people learn by constructing meaning through interpretive interactions with the social environment. Constructivist perspectives are a growing influence among educators seeking to help students connect learning with life experiences, making constructivism highly relevant to vocational and career educators.

This compilation is intended to guide practitioners in using constructivist principles by—

- Describing its attributes as a philosophy and a model for practice
- Explaining assumptions, including its connection with authentic pedagogy, correlation with brain-based learning, and implications for a new teaching paradigm
- Illustrating applications in career and vocational education
- Exploring how technologies such as the Internet facilitate constructivist learning

Each section includes definition of terms and questions to guide reflection and discussion. The largest section of the paper outlines classroom activities that reflect constructivist principles. Activities for curriculum, instruction, and assessment practices are provided.

Information on constructivism in vocational and career education may be found in the ERIC database using the following descriptors: Career Education, Cognitive Psychology, *Constructivism (Learning), *Integrated Curriculum, *Learning Activities, *Learning Processes, Problem Solving, Teaching Methods, Vocational Education, and the identifiers Authentic Assessment and *Contextual Learning. Asterisks indicate terms that are particularly relevant.

Introduction

Purpose

Educational reform efforts have triggered an array of new theories, models, and practices that have resulted in a whole new vocabulary of educational terms. Although these terms may be easy to understand when clearly defined, the connections between the concepts they represent are often unclear. For example, what is the relationship between contextual learning and constructivism? Between problem-based learning and school-based learning? Between learner-centered instruction and disciplined inquiry? The answers to these questions are embedded in the contexts of new paradigms, pedagogies, and programs, all of which have some common characteristics and goals, but each of which represents a unique approach to educational development.

This document attempts to explain the relationship among a variety of educational assumptions, applications, and approaches, drawing upon constructivism as the overriding theory to guide learning. It discusses the philosophies of behaviorists and cognitive psychologists and their relationship to the constructivist theory of learning. It presents a rationale for constructivism as a prominent approach to teaching and learning. It examines a variety of classroom activities, work-related experiences, and information technologies that facilitate knowledge construction. By weaving together constructivist theory, characteristics, and practices, this publication offers a valuable resource to practitioners who desire to enhance their teaching practices to meet the demands of the 21st century.

Rationale

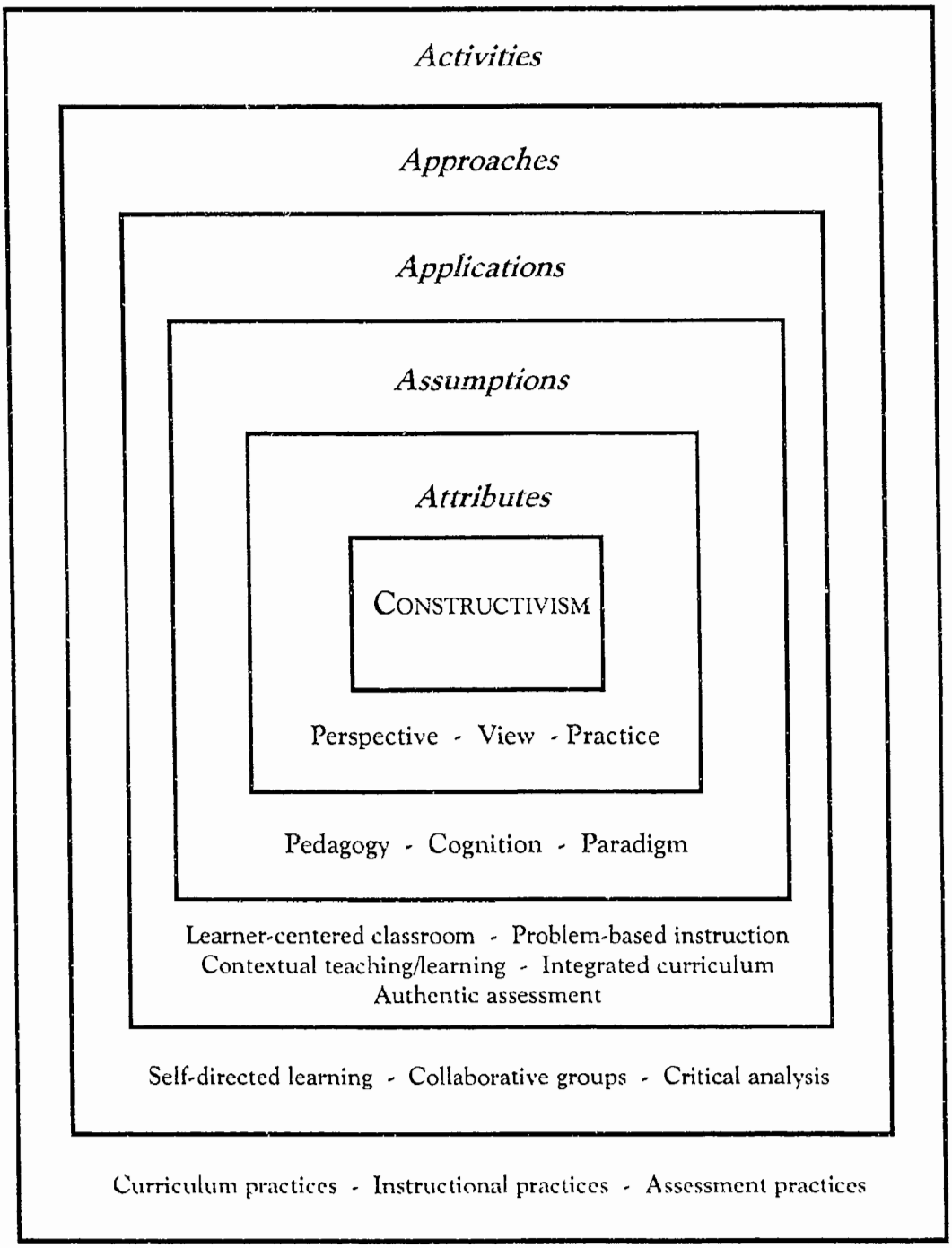
Today, a major concern of adult, career, and vocational educators is the educational preparation of the work force. In a workplace that is characterized by new management systems, production processes, and global competitiveness, employers are demanding that their workers have cognitive skills in critical thinking, problem solving, and conflict negotiation, as well as high-level technical and basic academic skills. Workers must be able to organize social and technological resources to acquire new knowledge, a "process

that requires knowing how to identify the limits of one's own knowledge, how to ask germane questions, how to penetrate poor documentation, and how to identify sources of information" (Berryman 1990, p. 8).

New ways of teaching and learning that place the learner in charge of his/her lifelong learning and involve the teacher as a learning facilitator are opening the doors to a new world of knowledge development and application in both academic and vocational education. Constructivism is seen by many educators as a guiding light for these efforts.

Intended as a guide for practitioners, this document highlights the unique features of constructivism and how they are related to learning in a variety of settings and with emerging new technologies. The descriptive information, along with a set of learning activities to facilitate the implementation of constructivist theory in the classroom, is particularly targeted to career and vocational-technical teachers and to students in teacher education programs. Each section of the guide explores one aspect of constructivism: attributes, assumptions, applications, approaches, and activities. The terms associated with each aspect are defined at the end of each section and highlighted in the schematic of the contents that appears on the next page.

Discussion points, phrased as questions, are presented at the end of each section. These questions offer topics to guide reflection and to provide opportunities for discussion and group interaction. Other topics relevant to students' interests and related to the content area may be solicited from the students to form the basis for additional activities.


Activities
Approaches
Applications
Assumptions
Attributes
CONSTRUCTIVISM
Perspective - View - Practice
Pedagogy - Cognition - Paradigm
Learner-centered classroom - Problem-based instruction
Contextual teaching/learning - Integrated curriculum
Authentic assessment
Self-directed learning - Collaborative groups - Critical analysis
Curriculum practices - Instructional practices - Assessment practices

What Is Constructivism? (*Attributes*)

An Historical Perspective

For the past 50 years, education has been dominated by approaches to teaching and learning that reflect the following assumptions (Feden 1994, p. 19):

- Learning is the process of accumulating bits of information and isolated skills.
- The teacher's primary responsibility is to transfer knowledge directly to students.
- The process of learning and teaching focuses primarily on the interactions between the teacher and individual students.

In this tradition, the teacher transmits information that the learner receives. Teaching practices focus on lecture as a means of conveying information and on the traditional paper/pencil, multiple choice types of assessment (Allenspach et al. 1996). Learning emphasis is on propositional knowledge—knowledge "that" (facts, assertions, concepts, and propositions). The objectivist philosophy, described by Jonassen (1991), reflects these assumptions for knowledge transfer. Objectivists believe that there is reliable knowledge about the world that teachers must transmit and that learners must replicate this knowledge in their thinking (Murphy 1997d).

Behaviorists also support this transmission theory, but focus on changes in behavior as well as mental state. Behaviorists contend that learning involves the changing or conditioning of observable behavior that occurs "as a result of selective reinforcement of an individual's response to events (stimuli) that occur in the environment" (ibid.). Learning emphasis is on procedural knowledge—knowing "how" (techniques, skills, and abilities). "Performance criteria, behavioral objectives, and the testing of students' learning through the use of competency-based programs and standardized testing all derive from proceduralism" (Manus 1996, p. 313).

Cognitive theorists, although recognizing the value of these learning mechanisms, stress the role of thinking in the learning process—the importance of knowing "why." They depict learning as a

process in which learners become active participants, drawing upon their personal experiences and their interaction with others to construct new understandings and knowledge. They regard the outcomes of successful learning as understanding, as well as knowledge and skillful performance. Interests, values, and attitudes are recognized as important parts of learning as they provide motivation for learning. "Dispositions determine whether an individual values a particular form of knowledge enough to be willing to participate in the effortful activity required to secure and then utilise that knowledge" (Billett 1996, pp. 143-144).

In traditional approaches to teaching and learning, textbooks and lecture provide the truth; there is little room for questioning, independent thought, or learner interaction (Murphy 1997d). Cognitive theorists believe that the role of the teacher is to provide learners with opportunities and incentives to learn, "holding that among other things—

- all learning, except for simple rote memorization, requires the learner to actively construct meaning;
- students' prior understandings and thoughts about a topic or concept before instruction exert a tremendous influence on what they learn during instruction;
- the teacher's primary goal is to generate a change in the learner's cognitive structure or way of viewing and organizing the world;
- learning in cooperation with others is an important source of motivation, support, modeling, and coaching" (Feden 1994, p. 19).

The constructivist theory of learning supports this cognitive pedagogy, proposing that humans have an innate sense of the world and that it is this domain that allows them to move from passive observers to active learners.

A Philosophical View

Constructivism is a theory about how people learn. Based on the work of developmental psychologists, constructivism contends that people construct meaning through their interpretive interactions with and experiences in their social environments. It presumes that prior knowledge and experiences play a significant role in learning and form the basis for subsequent actions. It focuses the learner's

attention on the "why" of learning and opens the door to critical thinking and intellectual development (Manus 1996).

Piaget, a Swiss psychologist, describes knowledge development from a holistic and cognitive perspective, emphasizing that there are many channels one uses to construct understanding, e.g., reading, listening, exploring, and experiencing. Vygotsky, a Russian psychologist, introduces the social and cultural influences on learning and emphasizes their role in the construction of knowledge. Vygotsky's (1978) social constructivism model stresses the importance of learning in context—constructing understanding through interactions with others in the social environments in which knowledge is to be applied.

Three primary propositions that characterize constructivism from a cognitive and social viewpoint are presented by Savery and Duffy (1995):

1. Cognition occurs as people share their understandings with each other and test the degree to which they are compatible.
2. The goal or purpose of investigation influences what is learned and what experiences the learner draws upon to construct new understandings.
3. Knowledge evolves through social negotiation, either independently or in collaborative groups. Alternative views and additional information enable learners to test the viability of understandings and to build new propositions that are compatible with those understandings.

A Model for Practice

Current research in teaching and learning supports the constructivist perspective, which has gained favor among educators. Evolving from the work of Piaget, Vygotsky, and others, constructivism reflects a paradigm shift from a teacher-centered pedagogy based on behaviorism to a learner-centered educational approach based on cognitive theory (Gagnon and Collay 1997).

"Behaviorist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement. Constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment. Four epistemological assumptions are at the heart of what we refer to as 'constructivist learning':

1. Knowledge is *physically* constructed by learners who are involved in active learning.
2. Knowledge is *symbolically* constructed by learners who are making their own representations of action.
3. Knowledge is *socially* constructed by learners who convey their meaning making to others.
4. Knowledge is *theoretically* constructed by learners who try to explain things they don't completely understand." (ibid.)

In constructivism, the focus of teaching is on the empowerment of the learner. The teacher's role is to engage learners in the discovery of knowledge and provide them opportunities to reflect upon and test theories through real-world applications of knowledge. The constructivist approach to teaching and learning moves learners away from the rote memorization of facts to metacognition and self-evaluation. It "promotes an 'examined life' and encourages the critical reflection of values, beliefs, and assumptions" (Hoskins 1995, p. 2).

In a workplace where businesses have become performance driven and jobs and tasks have become integrated, great emphasis is placed on collaboration, teamwork, and interpersonal communication skills. Work activities are socially shared; work is performed in "social systems in which what one person is able to do depends fundamentally on what others do . . . actions are intimately connected with things and events" (Berryman 1990, pp. 11-12).

Classroom activities, however, are not consistent with these realities. In the classroom, activities typically are individually performed and judged on the basis of each individual's performance. Activities are detached from meaningful context and from real-life situations and communities of practice. To prepare students for work in an increasingly participatory workplace, learning must be connected to the social environment in which it is to be applied.

Vocational educators have long recognized the importance of connecting school to work. Billett (1996) refers to this in his reflections on the importance of social origins of knowledge in the construction of vocational knowledge. He notes that knowledge and concepts of expert performance are situated in the circumstances in which they are acquired and that the goals for vocational practices are shaped by practices of the community in which the knowledge is used. Magnet schools, for example, have been organized for the explicit purpose of providing students with meaningful activities that reflect business, performing arts, science, and other activities of the real world (Berryman 1990).

Constructivist learning environments offer the potential for locating learning in the context of real-life situations and problems. They offer a rationale for curriculum integration that connects learning with the workplace. Learning is facilitated through the design of classroom activities that guide students to work collaboratively with others, set their own sequences and pace of work, and actively engage in problem solving, critical thinking, and negotiation. It is this domain that allows learners to move from passive observers to active learners who "construct knowledge by integrating new information and experiences into what they have previously come to understand, revising and reinterpreting old knowledge in order to reconcile it with the new" (Kerka 1997a, p. 1).

Terms

Behaviorist.....	equates successful learning with behavioral change; information is transmitted by the teacher, replicated by the learner
Cognitive theorist....	equates successful learning as understanding and skill performance; is learner centered
Constructivism.....	the theory that people learn by constructing meaning and through interpretative interactions with and experiences in the environment
Dispositions.....	interests, values, and attitudes
Epistemology.....	the division of philosophy that investigates the nature and origin of knowledge
Objectivist.....	equates successful learning with the acquisition of knowledge transmitted by the teacher; requires a change in learner's mental state
Procedural knowledge.....	techniques, skills, abilities (knowledge of *how to*)
Propositional knowledge.....	facts, assertion, concepts, propositions (knowledge *that*)

Questions for Reflection and Discussion

1. What is significant about the different philosophical approaches to teaching and learning, e.g., objectivism, behavioralism, and constructivism?

2. How are differences between the behaviorist philosophy and cognitive theory reflected in classroom teaching practices?

3. In what way could the knowledge constructed by one group be contested by another group?

4. How is truth determined from a constructivist viewpoint?

5. In what way does constructivism promote reflection?

6. What life experiences have contributed to your personal construction of knowledge about a topic or issue? What was the process of your learning?

What Is Unique about Constructivism? *(Assumptions)*

The constructivist theme that runs through current research on teaching and learning supports active learning and engagement in authentic activities that take place in the social culture of practice. Learning is guided by teachers whose roles are to facilitate learning and coach learners to question assumptions and arrive at new meanings. The constructivist approach to teaching and learning may be seen in teaching practices that reflect—

- Connection with *authentic pedagogy*, defined by Newmann, Marks, and Gamoran (1995) as instructional activities and assessments that are "rooted in a primary concern for high standards of intellectual quality" (p. 1);
- Correlation with *brain-based learning* principles, described by Caine and Caine (1990) as teaching to reflect the way the brain operates; and
- Connotations for *a new teaching paradigm* that requires a shift from traditional instructional practices, curriculum, and assessments.

Advantages and disadvantages of constructivism as viewed from these perspectives and a summary of the implications for implementing constructivism in schools follow.

Connection with Authentic Pedagogy

Constructivism implies that learning should be individually constructed through active and connected learning, strategies that are consistent with those of authentic pedagogy. However, not all constructivist teaching and learning practices are authentic. The following four questions serve as guides to a discussion of the correlation between constructivism and authentic pedagogy as reflected in teaching and learning practices. The answers to the questions are excerpted from an article by Newmann et al. (1995, pp. 1-4).

1. *Is High Quality Achievement the Goal of Learning?*

Educators and reformers often worry that today's students spend too much of their time simply absorbing—and then reproducing—information transmitted to them. They fear that students aren't learning how to make sense of what they are told and that there is little connection between activities in the classroom and the world beyond school. Students can earn credits, good grades and high test scores, they say, demonstrating a kind of mastery that frequently seems trivial, contrived or meaningless outside the school. The reformers call instead for "authentic" achievement, representing accomplishments that are significant, worthwhile, and meaningful.

To confront this problem, schools are adopting a wide variety of active-learning techniques. In many classrooms where lectures once prevailed, students now take part in small-group discussions and cooperative learning exercises. They conduct independent studies, or make greater use of computers, video recording systems, and other high-tech equipment. Their assignments take time out of the classroom to conduct community-based projects, such as oral histories, surveys, or service learning programs. Students exposed to such techniques often display greater enthusiasm and engagement. This heightened participation can lead some observers to conclude that higher-quality learning must be taking place.

But active learning alone offers no guarantee of high quality student achievement. If a small group's task is to solve routine math problems, for example, and one student produces the answers for others to copy, little or no serious academic work is accomplished. Or, if students survey community residents by simply asking short-answer questions written by a teacher and recording the answers, without reflecting on them, the opportunity to construct deeper meaning is lost. Educators must ensure that new approaches to learning are aimed toward high intellectual standards. Otherwise students' work, however "active," can remain shallow and intellectually weak.

2. *Do Learner Achievements Reflect Authentic Learning?*

Consider the types of mastery demonstrated by successful adults, such as scientists, musicians, business entrepreneurs, novelists, nurses and designers. What key characteristics of their work justify calling their accomplishments authentic? And how do these

accomplishments differ from the work that students complete in school? In answer to these questions, the following three criteria are offered:

Construction of Knowledge

The people mentioned face the challenge of constructing or producing meaning or knowledge, instead of merely reproducing meaning or knowledge created by others. Depending on their particular field, they may express this knowledge in different ways. For example, they may use words or symbols to write or speak about their findings. Or they might make things, such as furniture or a movie, or take part in performances for audiences, such as dance recitals or athletic contests.

Students taught within a conventional curriculum, on the other hand, are usually asked merely to identify the work that others have produced. They may be drilled on the differences between nouns and verbs, for example, or called upon to match authors with their works.

Disciplined Inquiry

For achievement to be authentic, it must be grounded in a field of knowledge, which usually includes facts, a specific vocabulary and a set of concepts and theories. Authentic performance in that field reflects an in-depth understanding of a particular problem or issue. That understanding is expressed through elaborate forms of communication that make use of written, visual and/or symbolic language to express ideas, nuances and details.

The conventional school curriculum, on the other hand, is more likely to require students to memorize isolated facts about a wide array of topics, and then use those facts to complete short-answer tests, which don't require deep understanding or elaborate communication.

Value beyond School

Authentic achievement has aesthetic, utilitarian, or personal value beyond merely documenting the competence of the learner. Successful adults engage in a wide variety of activities aimed at influencing an audience, producing a product or communicating ideas, from writing letters to developing blueprints to speaking a foreign language. Achievements of this sort have special value that is missing from tasks, such as spelling quizzes or typical final exams, which

are contrived only for the purpose of assessing knowledge. The oft-heard cry for "relevant" or "student-centered" curriculum, is, in many cases, a less-precise expression of this desire that student accomplishments should have value beyond measuring success in school.

According to our conception, the most authentic achievements must meet all three of these criteria. Students might, for example, tackle a calculus problem that requires construction of knowledge and disciplined inquiry; but, if the solution has no value except to prove that the students can solve calculus equations, its authenticity is diminished. Likewise, a student who writes a letter to the local newspaper editor commenting on welfare reform may be constructing knowledge to produce discourse with value beyond school. But if the student's analysis is shallow or based on significant errors, it doesn't qualify as disciplined inquiry.

Although our concept of authentic academic achievement demands that all three of these standards be met, this doesn't mean that all instruction and assessment activities must always fulfill all three standards. In some cases, repetitive practice or memory drills might help students build the knowledge and skills that can later serve as the basis for authentic performance. The point is not to abandon all traditional schoolwork, but to keep authentic achievement clearly in view as the ultimate goal.

3. *Do Teaching Practices Inspire Higher-Order Thinking?*

Although constructivism includes different points of view from those of authentic learning, both share certain assumptions. Learning takes place as students process, interpret, and negotiate the meaning of new information. This is heavily influenced by the student's prior knowledge, and by the values, expectations, rewards, and sanctions that shape the learning environment. Students' assimilation of new information depends heavily on whether that information helps them explain, or meaningfully extend, their past experience. Even an apparently simple task, such as learning the spelling of a word, involves this complex mental process.

With constructivism, teachers are called upon to nurture this process by leading students to engage in higher-order thinking, not just rote learning of superficial information. This means, in part, that teachers should offer students opportunities to process information through written and oral expression, as well as other avenues such as drawing, building, or dancing. Without expression, students efforts to make and negotiate meaning will be stifled.

Constructivism also calls for teachers to abandon the primary role of "dispenser of information and truth." Instead, a teacher should strive to be a coach, guide and mentor who inspires students to take on the work of learning. Teachers should engage students in a "cognitive apprenticeship," to be carried out in an atmosphere of mutual trust, collaboration, and high expectations.

4. Does Learning Result in In-Depth Understanding?

Our "construction of knowledge" criterion is consistent with the constructivist view of the student as a meaning-making person who continuously weighs new information against prior experience. But our vision goes further. Authentic performance occurs when the student reaches beyond imitation or reproduction of information and analyzes or interprets that information to solve a problem that can't be solved by information retrieval alone. We also add the criterion of disciplined inquiry, which requires a student to demonstrate in-depth understanding using substantial knowledge from an authoritative field. Constructivism on the other hand, doesn't necessarily require that a student's construction of knowledge conform to knowledge considered authoritative by others.

This view of Newmann et al. is also expressed by Blunden (1997), who highlights the perspective of those who believe that knowledge and skills exist in workplace practices and are not subject to negotiation. Instead of viewing knowledge as subjective, these educators contend that there are "givens which morally, prudentially, and educationally cannot be left for learners to construct or misconstruct for themselves" (p. 46). O'Carroll (1997), however, argues that the issue is not about what forms of knowledge are defendable, but rather how knowledge is constructed and what it means to the learner. In his view, understanding is the critical factor in knowledge construction. The constructivist's emphasis is not on learning outcomes, but about the ways people learn; and, therefore, about the process of learning that enables a learner to make connections between what is known and what is unknown.

Correlation with Brain-Based Learning Principles

Parnell (1996) contends that the greatest sin committed in many schools today is "the failure to help students use the magnificent power of the brain to make the connection between—

- Knowing and doing
- Academic and vocational education
- School and other life experiences
- Knowledge and application of knowledge
- One subject-matter discipline and another
- Subject matter content and the content of use" (p. 18).

"In the last few decades, brain research has shown that the need for developing connections is rooted in the basic function of the brain itself. When we teach for connectedness we are teaching in accordance with the way the human brain operates" (ibid., p. 19).

Caine and Caine (1990) have identified a number of principles associated with brain-based learning. These principles offer a basis for examining ways in which a constructivist approach to teaching and learning is congruent with the ways the brain functions. Five of these concepts are summarized as follows.

1. *The brain performs many functions at the same time.*

The brain simultaneously processes thoughts, feelings, visual images, and so forth. To teach in accordance with this concept of parallel processing, instructional strategies must be designed to effectively orchestrate the many dimensions of learning. Visual, tactile, emotional, and auditory learning preferences of each learner can be accommodated through the provision of multifaceted learning activities. Charts, posters, and other visuals can be used to support the learning process since the brain also absorbs information that is peripheral as well as central to its focus. Coaching practices should draw upon a variety of tools to stimulate brain functioning.

2. *The brain reflects the body's physiological and psychological state.*

Nutrition, exercise, eating habits, and other reflections of health influence the brain's ability to function and, hence, the individual's ability to learn. The same is true for emotions as they have a great influence on the brain's ability to recall information. Emotional stress, however, can hamper learning. Therefore, learning environments must be nonthreatening, supportive, and encourage mutual respect and acceptance. Caine and Caine (1990) note that "the brain learns optimally when appropriately challenged, but downshifts under perceived threat" (p. 70). It functions most optimally in a supportive environment in which learners and teachers are engaged collaboratively in the construction of knowledge.

3. *The brain searches for meaning.*

The brain resists having bits and fragments of insignificant information imposed upon it. It searches to create meaningful patterns by connecting relevant bits of information. Teachers can facilitate this process by allowing students to extract their own patterns, rather than asking them to repeat patterns imposed on them. Reflection can facilitate this search for meaningful patterns when it involves the learner in a pattern of thinking about what has been learned, how that learning has occurred, and why and how learning should continue. Journal writing is one strategy that draws upon the brain's search for meaning when it is designed to move the learner beyond the limits of observing and recording experiences and requires them to make meaning out of what is expressed (Kerka 1996b).

4. *The brain registers experiences automatically.*

Memory is another aspect of brain functioning that has implications for teaching and learning. The brain registers experiences automatically. Facts and skills, however, are registered differently, requiring repetition, rehearsal, and other strategies for memorization. Learning is facilitated when facts and skills are connected to experiences. For example, having students measure things in the classroom to arrange the physical space is an example of an activity to invoke spatial memory in the context of a real life experience. "Concentrating too heavily on the storage and recall of unconnected facts is a very inefficient use of the brain" (Caine and Caine 1990, p. 69).

5. *The brain remembers best when facts are embedded in ordinary experiences.*

Auerbach's (1989) "socio-contextual model" contends that the cultural and social practices are key considerations in the development of learning. This model is based on the proposition that people learn best when the learning is meaningful to them and situated in the context of their social environments. Learning evolves from the learner's desire to understand and construct new meanings (Billett 1996). Drawing upon cultural practices, family traditions, and other personal experiences of the learner can promote brain functioning. Constructivist-based learning is facilitated by the sharing of experiences between individuals.

For example, to enhance the English reading, writing, and speaking skills of literacy workshop participants, an instructor asked the

participants to share their food recipes with each others. "Some participants prepared dishes popular in their cultures; some shared memories of times when the dishes were served in their family homes; and some told about the countries from which their dishes originated. Such experiences locate learning in the context of the learner's real world, contributing to the construction of knowledge" (Brown 1998b, p. 1).

Connotation for a New Teaching Paradigm

Constructivism is an especially appealing learning theory for teachers who are trying to prepare students with skills that will enable them to succeed in a workplace that is characterized by diversity, competition, quality management practices, and teamwork. It supports the values of collaboration, personal autonomy, reflection, active engagement, individual determination of relevance, and pluralism (Savery and Duffy 1995). These practices of constructivism, however, require changes in teaching and learning. They call for teachers to modify their instruction, curriculum, and assessment practices, as well as their perspectives on what constitutes authentic learning.

Instruction

Teaching and learning from a constructivist orientation requires new ways of using time. As Parnell (1996) notes, time has traditionally been dictated by administrators and others rather than by the needs of teachers and students. Changes are needed to allow time for students to work together, perform in-depth investigations of issues, solve problems, and engage with the community to apply knowledge; and for teachers to respond to each student's individual construction of knowledge.

A reconfiguration of class time is often necessary to enable instructors to modify their teaching approaches and incorporate constructivist practices. In Milwaukee, Wisconsin, the South Division High School has adopted block scheduling for career clusters. This schedule accommodates time for team teaching, thematic projects, and staff meetings (Rahn 1996).

New ways of teaching and learning must reflect change in teacher and student roles. Constructivist teaching places the teacher in the role of coach, mentor, and guide. Learners become the creators of their own learning. As in cognitive apprenticeships, "experts

model the strategies and activities needed to solve problems, and learners approximate doing the activity while articulating their thought processes. Experts coach learners with appropriate scaffolds (physical aids and supporting materials), gradually decreasing assistance as through continued practice, learners internalize the process by constructing their own knowledge base and understanding (Farmer, Buckmaster, and LeGrand 1992)" (Kerka 1997a, p. 1). Scaffolding is an important concept for social constructivism in that it engages the teacher in moving the learner to the brink of his/her ability, thus advancing knowledge development.

In constructivist classrooms, the student plays a key role in directing learning. Learning occurs with teacher and learner both in the role of co-learners. As such, each has a voice in the learning process. Goals and objectives are established through negotiation, with each player having a voice in the process. With such an active role in the learning process, "students will also have to learn new ways to perform. They will have to learn how to think for themselves, not wait for the teacher to tell them what to think; to proceed with less focus and direction from the teacher, not to wait for explicit teacher directions; to express their own ideas clearly in their own words, not to answer restricted-response questions; to revisit and revise constructions, not to move immediately on to the next concept or idea" (Airasian and Walsh 1997, p. 448)

The instructional process must lead students to new understandings and knowledge construction. Teaching for understanding from a constructivist perspective must draw upon the learner's introspective and social construction of knowledge and engage him/her in reflective thought and action. In a constructivist classroom, the instructional process guides the learner toward an activity, experiment, or inquiry that is meaningful to him/her in pursuing new knowledge,. It is during the event—the activity, experiment, or inquiry—that the learner has an opportunity to think and reflect upon what is happening and what is being learned. During the sharing of new knowledge with peers, the learner is able to engage in social interaction and obtain feedback from others. With this new information, the learner can engage in the construction of new knowledge and redirect his/her thinking toward further investigation (Merriam and Caffarella 1999).

Curriculum

Curriculum must be designed to merge academic learning with its career and vocational application in the workplace. If constructivism implies that understanding is constructed through

interpretive interactions with others in the environment of practice, education cannot be limited to the school setting. Connections must be made between the school and community, and they should involve more than the mere placement of students in work experience programs. Planning and collaboration between academic and vocational teachers, representatives of business and industry, and community members are needed to design instructional programs that combine experiential, contextual, and social methods of learning. In Philadelphia, teams of teachers participate in teacher internships, exploring various industries by interviewing human resource personnel, job shadowing, and participating in team-building exercises. Afterward, the teachers discuss ways to integrate what they have learned through their workplace experiences into their curriculum (Rahn 1996). This prior knowledge and experience in the workplace gives teachers an opportunity to construct their own knowledge about workplace applications of learning and to use that knowledge as a model for enhancing student learning as well.

Curriculum should reflect design principles that facilitate knowledge construction. Murphy (1997a) summarizes the characteristics of learning environments as espoused by Jonassen (1991, 1994), Wilson and Cole (1991), Ernest (1995), and Honebein (1996). A summary of these characteristics of constructivist teaching and learning principles follows:

- Provide multiple perspectives and representations of reality.
- Have content and activities reflect the natural complexities of the real world.
- Focus on knowledge construction, not reproduction.
- Present tasks that are realistic, relevant, and authentic.
- Provide activities, opportunities, tools, and environments that encourage self-analysis, self-reflection, self-awareness, and metacognition.
- Foster reflective practice.
- Enable context- and content-dependent knowledge construction through social negotiation, collaboration, and experience.
- Emphasize problem-solving, higher-order thinking skills, and in-depth understandng.
- Highlight the complexities of knowledge construction by emphasizing conceptual interrelatedness and interdisciplinary learning.

Curriculum should draw upon all dimensions of learning--perceptual, cognitive, and affective. Recognition of the qualities that make learners unique -- their unique backgrounds, cultures, social

orientations, beliefs, and attitudes—must also include an awareness of individual learning preferences. Not all people are drawn to the same ways of learning. Brown (1998c) describes the characteristics associated with the dimensions of learning as follows (p. 1):

Perceptual dimension. This learning style dimension is influenced by physical and environmental elements. The physical elements are visual, auditory, tactile, and kinesthetic. Learning styles research shows that most people learn best through experiencing, doing, and involvement (kinesthetic learners), especially when reinforcement is offered through touching, manipulating, and handling (tactile senses).

Cognitive dimension. Cognitive styles of learning refer to ways people process information. It reflects Kolb's (1984) description of learning as a cyclical process by which one moves from concrete experiences, to reflective observations, to abstract conceptualization, and, finally, to active experimentation.

Affective dimension. The affective dimension of learning is reflected in the social interaction model described by Swanson (1995) and Griggs (1991). This model addresses how students interact in the classroom and deals with the elements of emotion, valuing, and behavior.

Each of these dimensions supports Kolb's (1984) notion that only a small percentage of students learn by thinking and watching; most people learn best by feeling and doing, through "interpersonal communication, sharing, mutual support, team processes, and positive reinforcement" (Hull 1993, p. 50). However, the inclusion of all four styles of learning—thinking, watching, experiencing, and doing—should be incorporated in instructional practices. Collaborative and cooperative learning are several ways to expose learners to alternative viewpoints and learning styles as a means of expanding thinking and learning.

Assessment

Assessment, from a constructivist viewpoint, must include attention to the measurement of learning that has value beyond the classroom and that is meaningful to the learner. Multiple choice tests, true/false exams, and other traditional forms of assessment measure items the school and textbooks define as important. They emphasize "knowing that," but do not assess a learner's ability to "know how" or to integrate "know thats" and "know hows" into their performance (Berryman 1990).

Authentic measures of learning require students to demonstrate through performance. The secrecy of test-taking is eliminated by providing up front the performance criteria by which learners will be assessed, as occurs in the workplace. Alternative forms of assessment, such as portfolios, journal writing, and peer reviews, are called authentic in that they assess meaningful performance that is valued in school and nonschool settings (ibid). Authentic assessments require adjustments in teacher practices, which pose certain challenges (Kerka 1995, p. 1):

> Authentic assessments require abandoning traditional notions about testing and evaluation and change teacher and student roles. They are time-consuming for teachers to prepare and implement, because they require clarity in goals, outcomes, criteria, and expectations and assurance that all stakeholders understand (Hayes et al. 1994). To ensure that evaluation standards are applied consistently, teachers and other raters need careful training (Borthwick 1995). Students need to be prepared for self-monitoring and reflection (Jones 1994). Some may be more comfortable with the traditional boundaries of grades and testing at set times.
>
> Authentic assessments are potentially more equitable in accommodating learning styles and acknowledging multiple ways of demonstrating competence. However, not all schools and districts may have access to some of the resources needed to develop them, and they impose demands that may challenge some students (Rudner and Boston 1994). Authentic assessments do not necessarily have to replace other forms of evaluation, but can be used to augment and broaden the picture of learner progress. Jones (1994), however, cautions that it is a mistake to use authentic assessment techniques if teachers are still relying on traditional methods of teaching, such as lectures and textbook readings.

Assessment practices should also be guided by standards and criteria of judgment to avoid an "anything goes" constructivism (Airasian and Walsh 1997). One of the challenges of constructivism is attempting to determine the relationship between truth and meaning, and whether or not some constructions are better than others. "Sole reliance on personal meaning to justify constructions leads to rampant relativism and potentially biased, self-servicing, and dishonest construction" (ibid., p. 448). However, in evaluating which constructions are acceptable, teachers run the risk of transmitting standards that they expect students to adopt, causing students to repeat what they know will earn them good

grades. Some of the challenges that this presents to the teachers are reflected in the following questions (ibid., p. 448):

- On what basis should students have to justify their constructions?
- Can the teacher who facilitates the constructions also be an objective evaluator?
- What constitutes a reasonable or acceptable student construction?
- Should the teacher try to avoid transmitting standards and criteria that end up influencing or controlling the nature of students' constructions? If so, how?
- Are evaluation standards and criteria independent of context or contextually bound?

Developing standards and criteria that allow variance in evaluation is an important aspect of teaching from a constructionist perspective. It presents a major challenge for teachers in that there are few external guidelines for achieving that balance (ibid.).

Assessments must offer opportunities for learning. To create assessment instruments that move the learner beyond recall and recognition, each assessment must be reframed so that (Marlowe and Page 1998, pp. 62-63)—

- it is, as much as possible, a continuous process that is part of instruction and not separate from it;
- it connects directly to learning and is introduced before or simultaneously with material;
- it requires students to do more than simply remember (e.g., requires students to develop mathematical formulas, produce exhibitions, write essays, create a sculpture, write poetry, create a musical score, develop and participate in debates, or create and conduct experiments); and
- student questions, at least in part, drive the process.

"The focus should be on learning, on how it is done, and on how it can be better, not on normative comparisons. Rahn (1996) suggests: 'Ask the students how they can show you when we finish . . . what they've understood, what they need help with, what questions they had answered, and what new questions they have . . . talk about how it could have been better, how my teaching could have improved, how your learning can improve next week, and then we move on'"(ibid., p. 63).

WHAT IS UNIQUE ABOUT CONSTRUCTIVISM?

Terms

Active learning	active participation in the learning process through group discussion, cooperative learning, independent studies, etc.
Applied academics . .	the inclusion of academic content in scientific and technical disciplines
Authentic assessments.	forms of assessment that measure learning that is meaningful to the learner and can be applied in real world situations outside the classroom walls
Authentic learning . .	the individual construction of knowledge, rather than the repetition of knowledge constructed by others
Authentic pedagogy .	instructional activities and assessments (teaching art) that requires students to achieve high standards of intellectual quality
Brain-based learning .	principles that define the way the brain functions and offer guidance to teaching in according with the brain process
Cognitive apprenticeship	an instructional model that draws upon authentic classroom activities and guided experiences that enable the development of mental skills through reflection, articulation, collaboration, and practice, and that are situated in authentic contexts
Disciplined inquiry . .	the investigation of issues that is grounded in a field of knowledge (e.g., facts, concepts, theories) and that results in-depth understanding
Learning dimensions	
Affective . . .	emotions, valuing, behaviors that are reflected in interactions with others
Cognitive . . .	thought processes that reflect thinking, watching, and experimenting
Perceptual . .	physical and environmental elements that reflect feeling and doing
Paradigm	model, practice, example

Questions for Reflection and Discussion

1. How can active learning exercises be expanded to reflect authentic learning?

2. In what ways could a teaching practice be modified to capitalize on the way the brain functions?

3. In what way could curriculum be modified to all dimensions of learning—perceptual, cognitive, and affective?

4. How can the cultural and political nature of learning be addressed through constructivist-based instructional practices?

5. Why is it difficult for teachers to provide standards and criteria that allow for variance in evaluations?

How Is Constructivism Being Applied in Career and Vocational Education? (*Applications*)

Traditionally, vocational education has prepared its students to be able to "do," to apply knowledge to practice. With a constructivist perspective, however, vocational educators must extend that emphasis to knowing under what circumstances and in what way knowledge is to be applied. This focus is congruent with the demands of today's society.

Workplace settings are now global in nature and are located anywhere, including the home. Work activities are customer focused and involve teamwork, cooperation, and collaboration among people who are diverse in culture, language, age, life experience, work history, knowledge, and skill level. For learners to be able to transfer knowledge to the complex and diverse environments in which it is to be applied, they must be able to learn in similar settings. Transferring knowledge from one situation to another is difficult, especially when the circumstances or conditions of practice in the transfer setting are remote (e.g., from the vocational classroom to the workplace) (Billett 1997). Thus, in keeping with a constructivist viewpoint, the essential role of vocational education is to "facilitate construction of knowledge through experiential, contextual, and social methods in real-world environments" (Lynch 1997, p. 27). "The end product is self-directed learners who make connections to workplaces and other environments based on personal and social experiences" (ibid.).

In vocational education, there are a variety of ways constructivism can be articulated. Some of these include the development of learning environments that incorporate *learner-centered teaching practices, problem-based learning, contextual teaching and learning experiences, integrated academic and vocational curriculum,* and *authentic assessments.* The following section describes how the common elements of constructivist theory can be incorporated into

these practices and also suggests strategies for their application in teaching and learning.

Learner-Centered Teaching Practices

In the traditional classroom, the focus in on teaching; in the constructivist-based classroom, the focus is on learning. This paradigm shift brings attention to the learner and to individual ways of learning. In the learner-centered classroom, learners work in collaboration with others, including the teacher; they and their teachers share the responsibility for learning, and everyone engages in teamwork. The teacher must be cognizant of different learning styles, cultural experiences, and learning needs of the learners, and of the different social environments from which learners come (McWhorter et al. 1996).

See related learning activities 1, 2, 4, 5, 8, and 9 following page 51.

The goal of learner-centered teaching is to empower the learner. A study of two sixth-grade classrooms in Hawaii revealed that students in the learner-centered classroom reaped decided benefits. They were more likely than their counterparts in the traditional classroom to feel positive about their ability to learn, about learning through a variety of experiences, and about taking the initiative to engage in reading (Maaka and Lipka 1997).

Learner-centered practices place the teacher in the role of facilitator, one who assists students in their knowledge and skill development by modeling (demonstrating), scaffolding (supporting), fading (gradually decreasing assistance) and coaching (suggesting, challenging) the learner. Kerka (1997a) summarizes the vocational teacher's role as follows:

> The vocational teacher's role is not to set tasks, but to organize experiences that allow learners to develop their own knowledge and understanding. Using the methods of cognitive apprenticeship, the teacher is a coach who provides guidance that gradually decreases as learners become more proficient, and who models, mediates, diagnoses, and scaffolds. The learning environment should reproduce the key aspects of communities of practice: authentic activities sequenced in complexity, multiple experiences and examples of knowledge application, access to experts, and a social context in which learners collaborate on knowledge construction.

Examples of constructivist practices include the following: (1) when students reach an impasse during an electronics lab, the teacher plays a logic game as a scaffold until students can articulate the logic of the electronic circuit for themselves (Rahn 1996); (2) an electronics student is matched with a repair shop where she accomplishes her school tasks through regular repairs assigned by the shop owner (Schell and Babich 1993); and (3) agriscience students are asked to learn why swine on a nearby farm are not reproducing successfully, a problem where more than one answer may be correct (ibid.). (p. 2)

Problem-Based Learning

Problem-based learning is considered to be "one of the best exemplars of a constructivist learning environment" (Savery and Duffy 1995, p. 31). It has a constructivist framework in that it supports the values of collaboration, personal autonomy, reflection, active involvement, and personal relevance. Learning activities and approaches that are rich implementations of problem-based learning include cases, simulations, progressive problem-solving, anchored instruction, and action research (Pierce and Jones 1998). Brown (1998e) summarizes the four critical features of problem-based learning identified by Stepien and Gallagher (1993) as follows:

See related learning activities 1, 2, 4, 5, and 6 following page 51.

1. *The problematic situation always opens the investigation.* It raises concepts and principles relevant to the subject matter content. It addresses real issues that connect to the students' personal world.
2. *The problem is ill structured.* It lacks critical information at the onset; it often changes as more information is found; it defies solution by a fixed formula or strategy; it requires careful consideration of the problem/solution fit; and it has no one "right" answer. It requires exploration to define and refine the questions and ideas surrounding the problem.
3. *Students are the problem solvers who generate solutions.* Students "own" the problem; they engage in observation, inquiry, and investigation of an hypothesis; they have major responsibility for shaping their own thinking and formulating solutions.
4. *Assessment is used as a structure for reflection.* Assessments focus on the complexity of both the reasoning process and the subject matter concepts. They must provide standards to act as

benchmarks for thinking, not directives for what must be thought.

In describing the teacher's role in implementing problem-based learning, Brown (1998e) emphasizes the importance of having good interpersonal and group dynamic skills. She highlights the need for teachers to adopt instructional strategies, resources, and activities that promote students' development of social as well as basic and thinking skills.

The social component of problem-based learning in the context of constructivism is discussed by Stage et al. (1998). These authors contend that "meaningful social exchanges between individuals are the primary sources of cognitive growth and the construction of knowledge" (p. 38). They explain that such teaching practices as problem-based learning require this type of interaction and interdependence among students.

Contextual Teaching and Learning Experiences

Contextual learning is a strategy for helping students to construct knowledge and meaning from new information through the complex interactions of teaching methods, content, situations, and timing (National School-to-Work Opportunities Office 1996). The term is widely used in the recent tech prep and school-to-work efforts. In contextual learning, "knowledge is socially shared, thinking is shaped by engagement with tools, learning is engaged with objects and events, and learning is situation specific" (Weinbaum and Rogers 1995, p. 5). Learning is connected to the family, community, and workplace as well as to in-school purposes. The emphasis is on application of knowledge and skills in the context of real-life experiences, problems, and events. Teaching emphasizes higher-order thinking, real-world application of knowledge, and the collection, analysis, and synthesis of information from multiple sources.

See related learning activities 1, 2, 4, 5, and 7 following page 51.

Pierce and Jones (1998) note that, at the low end of the contextual continuum, learners may use the tools or materials of a trade, but never experience the higher-level thinking processes required to solve ill-structured problems of the real world. The authors offer a continuum of activities defined by degrees of contextualization and problem-based learning elements. These activities are presented in Table 1. The activities and teaching approaches noted in Quadrant A on Table 1 reflect rich implementations of problem-based and

contextual learning. Two other quadrants on Table 1 list activities that are rated high for either contextual learning (Quadrant C) or problem-based learning (Quadrant B) and low for the other. Quadrant D on Table 1 lists activities having a low degree of both contextual and problem-based learning elements. Of advantage to the learner are activities with high problem-based and high contextual elements.

Table 1
Types of Learning Approaches

Quadrant B: Hi PBL and Lo C Cases Simulations Progressive Problem Solving Process Drama Anchored Instruction PBL Classroom Research Problems	**Quadrant A: Hi PBL and Hi C** Co-investigations, Co-development, and Co-learning Projects Expeditions Sustained Internships Action Research
Quadrant D: Lo PBL and Lo C Isolated Hands-On Activities Thematic Projects	**Quadrant C: Lo PBL and Hi C** Episodic Field Trips Service Learning Shadowing Procedural Learning Activity Simulation Kits

(Pierce and Jones 1998)

Four contextual teaching and learning practices are described next: *situated learning*, *cognitive apprenticeships*, *service learning*, and *work-based learning*. Each of these practices shares some of the assumptions of constructivism, although it is possible to have one without the other. Each acknowledges that knowledge and skills are best taught in contexts that reflect how they will be applied in real-life situations.

See related learning activities 1 and 5 following page 51.

Situated Learning

Situated learning involves the acquisition of knowledge and skills in the situations in which they will be used. Stein (1998) identifies four major tenets associated with situated learning: "(1) learning is grounded in the actions of everyday situations (cognition); (2) knowledge is acquired situationally and transfers only to similar

situations (context); (3) learning is the result of social process encompassing ways of thinking, perceiving, problem solving, and interacting in addition to declarative and procedural knowledge (participation); and (4) learning is not separated from the world of action but exists in robust, complex, social environments made up of actors, actions, and situations (community)" (p. 1).

The main elements of situated cognition—content, context, community, and participation—offer a number of opportunities to engage learners in meaningful learning. Cooperative and participatory teaching methods are prime ways of helping students acquire knowledge, as "knowledge is created or negotiated through the interactions of the learner with others and the environment. Subject matter emerges from the cues provided by the environment and from the dialogue among the learning community. The structure of the learning is implicit in the experience rather than in the subject matter structured by the instructor" (ibid.).

Cognitive Apprenticeships

See related learning activities 6 and 8 following page 51.

Cognitive apprenticeships use the "traditional concept of craft or trade apprenticeship as a prevailing metaphor for teaching authentic activities through guided experience by focusing on the teaching of symbolic mental skills" (Black and Schell 1995, p. 3). In addition to providing meaningful and authentic tasks, cognitive apprenticeships require reflection, articulation, collaboration, and multiple practice (Farquhar et al. 1996). In cognitive apprenticeships, learners are placed in authentic settings where they observe the work of others and practice, acquire, develop, and refine their skills using cognitive tools. Student teaching is an example of cognitive apprenticeship in that it enables learning to occur in an authentic setting where the learner can experience the cultural and interpersonal aspects of work in the profession (Lankard 1995). In this capacity, the student teacher (learner) observes the modeling behavior of the instructor, receives guidance in performing instructional activities, and gradually assumes more and more of the teaching responsibilities relinquished by the instructor.

Service Learning

See related learning activity 4 following page 51.

Service learning is a form of contextual learning in which real-world problems provide the basis for learning. It is a form of learning that involves learning by doing, an activity-based practice. It includes apprenticeships, experiential learning, and project-based learning; it reflects the theory of action learning (Johnson 1996).

Service learning has also been classified as a form of work-based learning in that it actively engages students in producing goods or providing services. "It differs from school-to-work transition programs in that students receive no financial reward. However, because it integrates classroom learning with community service projects, service learning shares a commitment to the same outcomes as school-to-work" (Brown 1998d, p. 1). The unique feature of service learning that separates it from voluntary community service is that it must engage learners in critical analysis of the service provided. Reflection is a key component of service learning (ibid.).

A service learning program for the professional development of preservice teachers is being piloted at the University of Louisville. This program involves prospective teachers in performing community service in the local area, either in special programs for at-risk youth or with homeless shelters. As a result of their involvement, the program participants were able to observe, many for the first time, people who live in poverty and crisis. They were able to experience the reality of problems that many of their students face in their personal, out-of-school lives and observe how the conditions of life can affect one's disposition to learn (Brown 1998d). By analyzing their patterns and techniques for learning in unfamiliar situations, teachers become more sensitive to the needs of their students and more able to offer their administrators compelling examples of explicit classroom activities that would facilitate service learning.

Work-Based Learning

See related learning activity 3 following page 51.

Work-based learning is another example of contextual learning. "It includes a number of different activities that can be identified along a continuum from shorter-term introductory types of experiences to longer-term, more intensive ones, including paid work experience and formal training. It is part of a three-pronged approach to school-to-work transition that also includes school-based learning and connecting activities" (Naylor 1997, p. 1). Some forms of work-based learning adopted by Michigan's system include career exploration, career internships, and career apprenticeships (ibid.).

Work-based learning, like situated learning, differs from traditional cooperative education in that the practices also emphasize reflection, relate students' work experience to nonvocational subjects, and in many instances, ensure that students satisfy the course requirements for admission to four-year colleges and universities.

Some common elements of work-based learning programs are reported by Naylor (1997, p. 1):

- planned programs of job training and experiences,
- paid work experience,
- workplace mentoring,
- instruction in general workplace competencies, and
- broad instruction in all aspects of industry.

From a constructivist viewpoint, work-based learning, like all contextual learning practices, must involve learners in action learning. It must provide opportunities for learners to construct their own meanings and to convey their meaning making to others. It must engage learners in interpretative interactions with others and in the act of negotiation (Gagnon and Collay 1997). "Unless work-based apprenticeships are deliberately designed for learning, they will have potentially serious holes and inefficiencies" (Berryman 1990, p. 3).

Integrated Academic and Vocational Curriculum

See related learning activities 1-4 following page 51.

Curriculum integration is another strategy through which teachers can incorporate constructivist elements in their teaching/learning practices, thus making instruction more meaningful for students. Curriculum integration promotes the search for self and social meaning by integrating fragmented bits information organized by subject area and emphasizing their interrelatedness in real-world contexts. It connects the curricula of various subjects so that students are able to address in a holistic manner the problems, concerns, and issues of the environments in which they live. Brown (1998a) describes the integration of academic and vocational education as it relates to constructivist-based pedagogy and paradigms (p. 1):

> In its most basic form, curriculum integration involves the infusion of academic content into vocational programs, often referred to as "enhanced academics." The new vocationalism, however, calls for "enhanced relevance," which is achieved when students engage in learning experiences that are situated in real-life contexts and that afford in-depth understanding and the development of higher-order thinking skills (Pisapia and Riggins 1997; Stasz 1997).

> Urquiola et al. (1997) note that curricular integration reflects the process of contextualization by bringing authentic work elements to abstract academic subjects. It contributes to the development of students' critical thinking and collaborative skills as well as those that prepare them for skilled jobs. Learning in context and constructing knowledge through socially based experiences are two teaching/learning concepts that draw upon principles of curriculum integration. When these reformed pedagogical approaches are incorporated in cross-disciplinary, multidisciplinary, interdisciplinary and work-related integration models, they not only help students to see the connections between subject areas, but enable them to recognize the interrelated aspects of all learning and life experiences (Brown and Pritz, in press).

The concept of curriculum integration offered by Beane (1998) illustrates the potential for academic and vocational education to connect students to all aspects of the workplace: "As it is meant to be, curriculum integration involves four major aspects: the integration of experiences, social integration, the integration of knowledge, and integration as a curriculum design" (p. 5). In Beane's explanation, integration as a curriculum design has several features: problems and issues of personal and social significance guide curriculum; learning experiences are designed to integrate knowledge in context of its use; knowledge is developed and used to address relevant issues, not in preparation for future tests; and learning activities involve the application of knowledge in real-life settings where students can experience problem solving and the intricacies of social interaction.

Authentic Assessments

The emphasis on authentic assessment reflects not only the influence of constructivist pedagogy, but also the traditional vocational education requirement for knowledge and skill demonstration through performance. Allenspach et al. (1996) describe authentic assessments as those that "engage students in applying knowledge and skills in the same way they are used in the real world outside of school. They are performance-based and require a student to demonstrate significant worthwhile knowledge and understanding through a product, performance, or exhibition" (p. 8). However, only when authentic assessments lead to in-depth understanding and knowledge construction that is meaningful to the learner do they reflect constructivism.

See related learning activities following page 51: 11 (portfolios); 4, 9 (journals); 3, 5, 7 (peer review); 2, 6, 8, 10, 12 (self-assessment).

"Although they raise concerns about subjectivity, authentic assessments allow multiple human judgments of learning. Teachers, peer reviewers, and community members may all be involved in various performance ratings, and—a critical element—learners evaluate and monitor themselves. Alternative assessments can accommodate varied learning styles and serve the purposes of instruction, not other reasons for evaluating students (comparing individuals, comparing programs, demonstrating accountability, etc.)" (Kerka 1995, p. 1). Examples of alternative assessments include portfolios, journal keeping, peer reviews, and self-assessments facilitated by the use of rubrics.

The new emphasis that state education agencies are placing on standards-based and performance-based assessments does not mean that alternative assessments, such as portfolios, lack value. Rather, as noted by Pierce and Jones (1998), the best assessment models incorporate such constructivist practices as co-learning, investigation, contextual performances, and other demonstrations of constructivist thinking. In keeping with the promotion of engaged learning, learners should be involved in the planning, evaluating, and selecting of assessment forms, including alternative forms of assessment (Jones et al. 1996).

Summary

Most applications of constructivism in academic and vocational education focus on ways to help learners construct knowledge that is meaningful to them and that reflects social representation, experiences, contexts, and authentic tasks (Pierce and Jones 1998). Drawing upon the social nature of learning, constructivist teaching and learning strategies involve interactive investigations, discussions, negotiations, strategizing activities, and so forth. They require a connection with not only the educators and other learners who share their learning perspective, but also with the community in which society-related as well as work-related problems must be solved. Their practices reflect "a way of looking at the world that is broad enough to allow for multiple interpretations and yet, defined sufficiently to allow for a perspective that can explain complex and abstract phenomena and which can guide our actions" (Murphy 1997d).

Murphy (1997d) presents a checklist of constructivist characteristics for educators to use in comparing the "variety of ways in which constructivism could be both interpreted and translated into

practice." Although not all of these characteristics may be present in every application of constructivist theory, they should form the basis for activities, roles and relationships, resources, and types of thinking involved in the effort. The degree to which characteristics are evident cannot be determined by using this checklist. However, knowledge construction should be a key component and collaboration a common project feature (ibid). The checklist compiled by Murphy (1997c) is provided on page 50. It offers a succinct way to guide teachers in their efforts to incorporate constructivist characteristics in their teaching and learning efforts.

How Is Constructivism Being Applied?

Terms

Authentic assessments	forms of assessment that measure learning that is meaningful to the learner and can be applied in real world situations outside the classroom walls
Cognitive apprenticeship	an instructional model that draws upon authentic classroom activities and guided experiences that enable the development of mental skills through reflection, articulation, collaboration, and practice, and that are situated in authentic contexts
Contextual learning	learning that occurs in the context or situation in which knowledge is to be applied
Learner-centered teaching	instruction that focuses on the learner's goals for learning as well as the teacher's drawing attention to the unique qualities each learner brings to the learning environment
Problem-based learning	learning that occurs as individuals strive to solve problems for which there is no set answer, often by working together in small teams
Service learning	a form of contextual learning that involves learning by doing and engages the learner in critical analysis through workplace experiences and reflective practice in a service or nonpaid capacity
Situated learning	a form of contextual learning in which learning is grounded in real-world actions and situations, and that involves the social processing of information within a community environment
Work-based learning	a form of contextual learning in which learning is centered in the workplace and that includes a planned program of formal training and/or mentoring and paid work experience

Questions for Reflection and Discussion

1. What is the common theme in all applications of constructivism?

2. In what way does a learner-centered classroom differ from the traditional teacher-centered, lecture dominated classroom?

3. What value does problem-based learning offer for lifelong learning?

4. What are the distinguishing features of situated learning, cognitive apprenticeship, service learning, and work-based learning?

5. In what ways does the theory of constructivism move the integration of academic and vocational education beyond the blending of subject area content?

6. How could standards-based assessment be considered authentic?

7. What value do school-to-work and tech prep programs have from a constructivist perspective?

How Does Technology Facilitate Constructivist Learning? *(Approaches)*

Technology is increasingly viewed as an "optimal medium for the application of constructivist principles to learning" (Murphy 1997b). Although the advent of the personal computer has streamlined and economized the *processing* of information, new technologies such as e-mail, listservs, synchronized chat, and the World Wide Web have facilitated the *exchange* of information and expanded access to a global environment. The constructivist approach to learning is facilitated by the World Wide Web because "the theory focuses on making connections and making meaning in the learning process. Web-based courses that are designed with a constructivist approach encourage the learners to navigate, create, and construct their unique knowledge base" (Conceição-Runlee and Daley 1998, p. 39). They afford the opportunity to engage learning in creative and collaborative activities that promote knowledge construction. They encourage *self-directed learning, collaborative learning,* and *critical analysis* by expanding the environments from which knowledge is constructed.

Self-Directed Learning

The Internet offers multiple pathways to learning, using hypertext/hypermedia as a constructivist learning tool. Carefully designed materials presented online can assist individuals' construction of knowledge by providing alternative pathways to information and making that information easily accessible from any location that has system facilities.

See related learning activities following page 51: 5 (engagement); 9 (inquiry); 6, 7 (small groups); 12 (reflection).

Farquhar et al. (1996) note that, in the past, computer-based instruction reflected a stimulus-response approach. Material was organized in a linear manner to reflect the author's knowledge structure, thus limiting learners' ability to form their own structures (O'Carroll 1997). In fact, "highly structured and repetitive interactions delivering immediate feedback are still standard features" (Farquhar et al. 1996, p. 212). However, today, the use of hypertext, which organizes information according to discrete elements,

allows learners to control the search for knowledge. It offers learners access to information in ways that are consistent with their individual learning styles and enables them to forge their own linkages between bodies of knowledge. It facilitates a self-directed approach to learning and actively engages learners in higher-order thinking and problem solving (O'Carroll 1997).

Engagement

Hypertext/hypermedia is its own motivator in that it accommodates the diverse learning styles of learners and allows the integration of aural, visual, and textual elements. Kerka (1998) describes two different approaches to using hypermedia: the approach of field independent (FI) individuals (those who perceive details and rely on internal cues) and that of field dependent (FD) individuals (those who use their entire surroundings, including other people, to process information). "FIs perform more efficient searches in shorter times and are more comfortable jumping around ('surfing') in hyperspace. FDs more often report feeling disoriented or lost, navigate more linearly (frequently using Back or Home keys), and tend to follow sequences instead of jumping around, accepting the environment as presented" (ibid., p. 1). FIs tend to be left-brained, analytical thinkers; FDs tend to be right-brained, global thinkers (Brown 1998c, p. 1). However, research shows that in spite of the fact that their approaches are different, both FIs and FDs perform well using hypermedia (Kerka 1998).

Inquiry

As a tool for teaching and learning, the Internet affords the benefits of libraries and publishing infrastructures without the drawbacks of limited hours of operation, fixed location, extensive user time, and high publishing costs. It offers access to vast amounts of information that continue to expand daily. It facilitates inquiry by affording users access to various databases from which they can make their own selection of hits and documents to retrieve. From a learner-centered perspective, hypertext indexes enable learners to take charge of their own learning and self-select the text passages that are uniquely interesting to them and relevant to their purposes (Ryder and Wilson 1996).World Wide Web environments provide opportunities for learner interactions that enable learners to "create new relationships with knowledge and new representations of knowledge" (Conceição-Runlee and Daley 1998, p. 41). In comparison to traditional paper/pencil types of information exchanges, learner interaction with information technology is "more dynamic and the knowledge structures formed are more likely to reflect

reader's unique approach to learning and to the subject matter" (O'Carroll 1997, p. 121).

Collaborative Learning

Collaborative learning is a constructivist strategy in that it actively engages learners in the process of learning and requires interaction with others. "Collaborative work that is learning centered often involves small groups or teams of two or more students within or across classrooms. Although each student's role and tasks may be different, all members of the group collaborate to accomplish a joint goal or project. . . Groups that include males and females and a mix of cultures, learning styles, abilities, socioeconomic status, and age bring a wealth of knowledge and perspective to authentic, challenging tasks" (Jones et al. 1996, p. 10). Technology can facilitate the collaboration process by linking together individuals who share a common interest and goal.

Effective communication is a key to knowledge construction. It must be mutually satisfying to learners to be engaging. Kaye (1996) notes that "communication competence represents the degree to which individuals perceive they have satisfied their goals in a given social situation without jeopardizing their ability or opportunity to pursue their other subjectively more important goals" (p. 61). "Hence, people's interpretations of their relationships and interactions with others form the basis of their future communication and behavior toward those others" (p. 67).

Knowledge Construction

As an instructional tool, the Internet (and World Wide Web) enables distance learning by connecting people separated by time and space. It promotes peer learning by bringing learners together in the same space so that they can share their knowledge and insights, communicating with each other to help each other learn (Kerka 1996a). Chat rooms where synchronous communication occurs, message boards and e-mail where message exchanges are asynchronous, and listservs that enable designated groups to talk collectively with each other are some examples of strategies for connecting learners through online technology. Online conferences, distance learning, and collaborative projects conducted on the Internet are examples of instructional practices that support cognitive skill development from a constructivist perspective. Not only do they expand learners' perspectives of information, but they

also allow learners to adjust and readjust their thinking based on new information.

Concept maps offer a visual way for learners in a group to share meanings. They are a "'metacognitive tool that demonstrates explicit, overt representations of concepts and propositions a person holds; they allow teachers and learners to exchange views on why a particular propositional linkage is good or valid, or to recognize missing linkages between concepts that suggest a need for new learning' (Novak and Gowin 1984, p. 19)" (Conceição-Runlee and Daley 1998, p. 42). In one online course, students were asked to develop a concept map to represent the similarities and differences between the concepts presented in two books they have read. The students then used this map as a format for online discussion of their understandings (ibid.).

Reflection

Articulating ideas in group discussion, debate, and activities offers learners opportunities to reflect about their past knowledge and experiences, and their interest in and purposes for learning. The relative anonymity of online users is one factor that encourages communication from some individuals, especially those who are reluctant to speak in face-to-face situations, and it allows individual contributions to be judged on their own merit, without bias (Kerka 1996a). Peer appraisals of contributions offer additional insight for self-assessment. However, learner participation in reflective practices is not an automatic outcome of technology-related collaboration. It must be fostered through instructional design, delivery, and practices that provide support and encouragement to learners (Imel 1998).

In a project described by Conceição-Runlee and Daley (1998), online discussion groups were established to foster discussions about course concepts, case studies, and course readings. "It was interesting that the online discussion seemed to promote a more in-depth level of analysis and synthesis. The learners' discusssion points and comments were a thoughtful analysis and critique, of not only their course work, but their life experiences as well. Learners reported that they used a constructivist process in preparing for and participating in the online discussions. The learner would read the discussion questions, review some of the material in the text, read and think about the contributions of other students, and then frame their responses. Responses were thoughtfully created and showed many connections to other course work and learning materials" (p. 43).

Critical Analysis

"In this half-century, for the first time in history, the capacity for producing information is far greater than the human capacity to process it" (Kerka 1997b, p. 1). Some believe this condition has resulted in "information overload" but others contend that the problem is too many channels of communication (ibid.). It appears, however, that whatever the source of the problem, the real issue is how to help users cope with the vast amount of information available to them. From the constructivist perspective, inquiry must be grounded in facts and concepts and culminate in an in-depth understanding of a problem or issue. Therefore, issues of quality control and veracity and reliability of technologically transmitted information must be resolved.

Quality Control

Ryder and Wilson (1996) reflect on the quality control of vast amounts of online information—a reflection that is especially suitable to the examination of a constructivism and the Internet as it addresses the issue of helping learners to develop critical thinking skills:

> For the reader (of online information), a fundamental constraint has to do with the accuracy, veracity, and reliability of online information. This is not to say that accurate information can't be found on the Net. The implication has more to do with the shifting role of the reader in assessing the accuracy, validity, and applicability of materials that were heretofore left to editors, experts, and peer professionals.
>
> In more modern times, educators could easily control what their students read and direct how those tender minds might be shaped. The educator's role was largely in the selection of good and proper literature, selecting resources that combined intellectual development with moral edification. The learner's moral edification was directed externally by a teacher, by an editorial committee, or by a school board.
>
> Today, the classics of literature, fine essays, and poetry still abound. They are rapidly finding their way online. There will be a time in the next 10 or 15 years when every essay or poem that was ever published by McGuffey or any other reputable source will be available in digital format for readers who wish to

> partake of these edifying materials. But alongside such uplifting literature will be objectional material, countless resources of questionable value, and some resources of objectionable content. The supreme difficulty in the Information Age will be the ability to restrict a learner's education to a "sanctioned" body of literature. The discipline required of learners in the postmodern age goes beyond that of all previous generations. The role of education in the age of information will be the development of disciplined readers, skilled in the art of abductive logic. Since we can no longer filter and select proper materials for our students, our highest calling as educators will be to support students in developing such discipline for themselves. (pp. 650-651)

Veracity and Reliability

Kerka (1997b) offers insights on the need to verify information obtained online:

> One myth rapidly taking hold is that the World Wide Web is a one-stop source for all information needs and the secret to information management is in knowing how to navigate it. The capacity for speed, quantity, and ease of access make the Web a highly attractive information source, and there is also what Wurman (1989) calls "aesthetic seduction," the graphical display that makes information look good. However, "a piece of information performs when it successfully communicates an idea, not when it is delivered in a pleasing manner" (ibid., p. 125).
>
> The Internet gives the impression that the pace of change has accelerated, but Dvorak (1996) attributes that to the fact that the Web has simply removed natural barriers between people and information they would otherwise never see. It may all have been out there before, but it was not easily accessible. What is often forgotten is that availability does not lend importance, accuracy, utility, or value to the content (Berghel 1997). Because everyone can (and seemingly does) publish on the Web, the responsibility for quality control is now on the receiver. However, "research has shown that many people feel that information gained through a computer screen is more reliable than that from any other source" (Breivik and Jones 1993, p. 29). Kinnaman (1994) tells of companies that published reports on computer printout paper because people were more accepting of their authority.

> On the other hand, the attraction of the Internet for some people is independence from authority (McKenzie 1996). The lack of centralized quality control and the expansion of access may be good for democracy. However, as in any democratic institution the risks of demagoguery are present if people are not able to judge the quality and accuracy of sources (Kinnaman 1994). Sven Birkerts suggests that deep reading and thought are necessary to discover the truth in information (McKenzie 1996), but the Web encourages breadth over depth. As with any information source, critical information literacy is vital, and users must be wary of overreliance on any single information source. (pp. 1-2)

Terms

Collaborative learning	learning that occurs through communication and negotiation with others and involving engagement, inquiry, knowledge development, and reflection
Field dependent learners	learners who use their entire surroundings, including other people, to process information; right-brained, global thinkers
Field independent learners	learners who perceive details and rely on internal cues; left-brained, analytical learners
Self-directed learning	learning that involves the learner in determining what will be learned and how learning will occur

Questions for Reflection and Discussion

1. In what ways does Internet access facilitate construction of knowledge?
2. How does the World Wide Web support learner engagement and inquiry?
3. In what ways does online access to information place greater demands on the learner?
4. How does the World Wide Web enable classroom equity?
5. How does collaborative learning promote knowledge development and reflection?
6. Why does new information technology require learners to become disciplined readers?

What Classroom Activities Reflect Constructivism? (*Activities*)

Translating theory into constructivist-based practices can be guided by a number of key design principles. Murphy (1997a) summarizes Jonassen's (1994, p. 35) eight principles for guiding instructional design as follows:

1. Provide multiple representations of reality.
2. Represent the natural complexity of the real world.
3. Focus on knowledge construction, not reproduction.
4. Present authentic tasks (contextualizing rather than abstracting instruction).
5. Provide real-world, case-based learning environments, rather than predetermined instructional sequences.
6. Foster reflective practice.
7. Enable context- and content-dependent knowledge construction.
8. Support collaborative construction of knowledge through social negotiation

With these guidelines in mind, the following activities are offered to reflect instructional materials that are process oriented, problem based, contextual, interdisciplinary, and metacognitive in nature. They provide examples of ways teachers can incorporate constructivist practices of teaching and learning into their *instruction*, *curriculum*, and *assessment* practices.

Each activity begins with a description of the constructivist pedagogy addressed in the activity, the teaching strategy to be used, the learning activity that describes the problem or situation to be addressed, the evaluation criteria to be conveyed to the students, the operational steps to guide student learning, and a set of reflective practices.

The activities are organized by theme and title (e.g., Curriculum Practices: Applied Learning Designs), not by topic or level of difficulty. The activities span various disciplines. It is the responsibility of the teacher to modify the activities, making them more

simple or complex, to meet learner learning needs and instructional/occupational standards of the school, state, or profession.

Murphy's (1997c) checklist of constructivist characteristics is reprinted here as a guide for reviewing the implementation of these and other activities in the instructional setting. Although not all characteristics may be evident in each activity, the list provides a tool for reflection. Through ongoing collaboration in modifying the constructivist-based activities selected for use in the classroom, teachers can model the behaviors and practices expected of the learners.

Checklist

Characteristic	Supported	Not Supported	Not Observed
Multiple perspectives			
Student-directed goals			
Teachers as coaches			
Metacognition			
Learner control			
Authentic activities			
Knowledge construction			
Knowledge collaboration			
Previous knowledge			
Problem solving			
Consideration of errors			
Exploration			
Apprenticeship learning			
Interrelated concepts			
Alternative viewpoints			
Scaffolding			
Authentic assessment			
Primary sources of data			

Source: Murphy, Elizabeth. "Constructivist Checklist." In *Constructivism: From Philosophy to Practice* by E. Murphy. Summer 1997c. < http://www.stemnet.nf.ca/~elmurphy/emurphy/cle4.html > Reprinted with permission.

Summary of Classroom Activities that Reflect Constructivism

Curriculum Practices

1. Applied learning designs
2. Interdisciplinary integration
3. Field-related experiences
4. School-community linkages

Instructional Practices

5. Experiential learning
6. Problem-based learning
7. Student-directed learning
8. Mentoring

Assessment Practices

9. Journal writing
10. The scoring rubric
11. Portfolios
12. Observation checklists

Curriculum Practices

Applied Learning Design

Constructivist Pedagogy

This activity involves the application of mathematics to the solution of a real world problem. Students direct their own searches for information, incorporating the use of Internet technology. They conduct interviews with people in the social community, analyze information, and engage in the physical construction of a blueprint or model using relevant occupational tools. The principles of applied learning and constructivist pedagogy are used to promote students' understanding and application of math concepts through social, contextual, and experiential methods of learning.

Teaching Strategy

Applied learning strategies are used to lead students to the solving of authentic problems. Teamwork, collaboration, exploration, and negotiation are highlighted learning concepts. Open-ended questions are used to guide inquiry. Small group discussions and interaction are used to facilitate learning.

Learning Activity* Scenario

A local company has contracted with your company to design a prototype deck that could be mass produced at their manufacturing facility, assembled on site, and sold to homeowners in the Sun View subdivision. There are approximately 300 homes in this subdivision and most have east or west exposure. Corner lots are allocated for recreation space.

Your task is to assemble groups of 4-5 learners to prepare group designs for the prototype deck. Each group will need to make a presentation to the client to promote its design. The presentation must include the following:

- A scale drawing or blueprint containing specifications of the deck.
- An explanation of the aesthetic and utilitarian value of the proposed design.
- A justification of the design in regard to the availability of materials and ease of parts assembly.
- A comprehensive materials list, including how the pieces will be identified for final assembly at the site of final installation.
- A cost estimate for materials.
- A description of the process that will be used to assemble the deck.
- An estimate of assembly time and numbers of workers per deck.

*This activity is a modification of the "Deck Design" problem noted in *Applied Mathematics: Targets for Learning*, p. 330 (Vocational Instructional Materials Laboratory 1998).

Note: The company will pay a bonus if the presentation includes a three-dimensional scale model.

Evaluation Criteria

The Applied Math Project Rubric (p. 58) will be used for evaluation. An evaluation of "unacceptable" or "marginal" will result in rejection of the project and a maximum timeline of 1 week to bring the project up to standard.

Operational Steps

STEP 1 Work together with students to assess their qualifications for problem solving by discussing with them—

- prior experiences, knowledge, and/or skills each student brings to the problem situation, and
- new knowledge and/or skills students must acquire to perform the activity, e.g., blueprint drawing, knowledge of the various characteristics of building materials, math calculation skills, and knowledge of construction principles.

STEP 2 Engage student work teams of 4-5 students in discussion and negotiation of strategies to use in preparing the deck design. Have each team prepare a list of steps they will follow in the inquiry process.

Provide access to relevant resources, emphasizing those available on the Internet. Offer guidance on strategies for interviewing local deck builders to learn the standards the deck designs must meet to acquire building approval.

STEP 3 Bring the teams together for a sharing of their plans for inquiry.

Facilitate discussion by writing on a flip chart the inquiry ideas presented by the teams. Ask questions to prompt further thinking. For example, "How could you learn about the deck preferences and requirements of potential homeowners?"

STEP 4 Have the work teams reassemble to discuss and refine their lists.

Circulate among the teams, asking open-ended questions to trigger learners' thinking about any inquiry steps they might have overlooked.

STEP 5 Have each team determine the responsibilities of individual team members. For example, will all members of the team perform the same steps or will each member have an individual activity, such as

finding out what materials are stocked by local suppliers, determining the prices of various materials, locating samples of various deck designs, conducting a survey of customer needs, and so forth.

Observe the teams' delegation of responsibilities to ensure that all learners have a role in the problem solution.

Engage teams in performing the responsibilities they have laid out in preparation for the client presentations. **STEP 6**

Offer guidance as necessary by demonstrating a procedure and helping students to follow your performance model, gradually decreasing your assistance throughout the process.

Have the teams practice their presentations to the client. Circulate among the practicing teams to discern whether or not they are justifying (giving reasons for) as well as describing their deck designs. **STEP 7**

If necessary, ask questions to guide students' reflections and critical analysis.

Host the team presentations. **STEP 8**

Play the role of the client. Ask questions for clarification of ideas as necessary.

Reflective Practices

Have students reflect upon the various resources used for their initial inquiry. How would they streamline or target their efforts should they encounter a similar problem in the future?

Ask students to identify the unique characteristics of group members that contributed to the team product and presentation.

Discuss the transferability of the knowledge acquired through this project by asking students to consider why and how they might modify their deck designs if the subdivision was located in another part of the country, e.g., mountainous areas.

Engage the class in a discussion of qualities about each presentation that they especially liked and any suggestions they might have regarding subsequent presentations.

Make notes of ways you might promote continuing knowledge development among future students based upon the directions the teams have chosen to pursue problem solving.

Evaluation

Have all the teams use the rubric included in this activity as a way to critique their team's as well as the other teams' presentations.

Critique the presentations against the rubric also. Review all comments with each team, providing them with feedback and guidance for that could help them in future efforts.

Applied Math Project Rubric

Difficulty	Unacceptable	Marginal	Acceptable	Exemplary
Depth of Thought	Major gaps are evident. Little or no reasoning is demonstrated.	There are major gaps in reasoning. Reasoning is somewhat apparent, but is flawed.	Reasoning is apparent, but a few minor gaps or flaws exist.	Reasoning is clear, concise, and effectively demonstrated.
Presentation	Oral presentation is characterized by haphazard, sloppy, or missing information.	The presentation lacks major points of emphasis and/or information is not provided in a professional manner.	The presentation is pleasant, pleasing, and informative and is clearly designed around informing the intended audience.	The presentation mimics professional quality. The message is clearly articulated to the intended audience.
Feasibility	The project solution is clearly not possible within the parameters set forth by the problem.	The solution may not be possible within the parameters of the problem, unless modified.	Although the solution is valid, it may not be easily replicated	It is clear that the method of solution is valid and can be easily replicated.
Attention to Detail	The project is generally characterized by superfluous or surface knowledge.	Only a few questions are answered in detail. The work generally does not attend to the underlying detail required.	Most of the questions posed by the problem are directly answered in detail.	Questions are anticipated and addressed. All measures, scales, and other required annotations are documented.
Creativity	The approach to the project is a direct replication of a previous design.	No new ideas are demonstrated; some novelty is shown, however.	The design is similar in approach to others, but unique characteristics make it stand out.	The approach to the design is fresh, novel, and unique

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Interdisciplinary Integration

Constructivist Pedagogy

Interdisciplinary curriculum often uses a problem-centered approach for instruction, which involves students in solving problems that matter to them and/or their community. This activity is designed to help students recognize the broad scope of information required for problem solving, the interrelatedness of academic and vocational skills, and the value of multiple perspectives. It encourages individual initiative, self-directed learning, dialogue, and metacognition. Knowledge is constructed through negotiation in the social community of practice.

Teaching Strategy

Interdisciplinary integration is facilitated through team teaching, inter-departmental planning, and thematic projects. Key ideas from each discipline are addressed collaboratively among teachers whose interactions model teamwork. These ideas are then communicated to students who must pool their strengths to solve the ill-structured problem. Learning is grounded in the context of real-world applications. Manipulating information, critical thinking, and in-depth understanding are learning concepts promoted through inquiry.

Learning Activity Scenario

A local apartment complex is trying to decide whether or not to stock the lake in the middle of the complex with fish that could eat the algae and keep the waters clean. Stocking the lake will cost $3,000-$9,000 more than is currently being spent on algae removal, depending upon the type of fish selected. The cost of stocking the lake will be assessed to the 50 residents of the apartment complex over the next 3 years. The apartment complex is new and survey findings indicate most of the residents will stay at least 3 years. The owners of the complex have requested that your firm submit a proposal that recommends a decision and presents a strategy for implementing it.

Your task is to engage your students (the firm employees) in meeting the owners' request. (You will need to identify a body of water to serve as the lake.) Divide the class into 7 groups and present the groups with their tasks for contributing to the problem solution.

Marketing (English). Write an article about the project for a news release to the local newspaper. Use good grammar. Edit the final copy.

Advertising (Commercial Art). Create a brochure to publicize the issue. Conduct interviews to obtain facts about stocking lakes and the aesthetic value they offer the community. Write the text using

correct English. Lay out and design the brochure using established principles of design.

Civil Engineering (Mathematics). Measure the lake to determine the number of cubic yards or acres. Calculate the number of fish required for the lake. Also calculate the cost per resident for each type of fish under consideration. Prepare a report of this information to share with the other departments of the organization.

Environmental Resources (Vocational Education). Investigate the characteristics of several kinds of algae-eating fish. Analyze the algae and lake water characteristics along with the environmental conditions to determine which fish will be most effective in reducing the algae and able to live in the lake. Also investigate the life span of each type of fish being considered. Prepare a multimedia presentation to share this information with the other departments.

Chemical Engineering (Chemistry). Test the algae and the lake water to determine their characteristics. Illustrate these characteristics on a chart or other visual.

Accounting (Business). Establish a payment plan. Determine whether to offer payment options, e.g., yearly deductions in a lump sum; yearly deductions prorated over 12 months; one single deduction in the first year for the 3-year amount. Investigate the tax benefits of various types of payments. Create a table to explain the information you have gathered.

Data Processing (Computer Technology). Develop a spreadsheet on which to record apartment resident payments.

Point out that none of these tasks can be performed in isolation. Therefore inter-group as well as intra-group collaboration will be required.

Evaluation Criteria

Each student will be required to write a project summary that (1) describes how academic and vocational skills were used to solve the real-world problem and (2) demonstrate skill applications through written, oral, audio, or visual symbols, e.g., spreadsheet, report, table, presentation. The criteria of accuracy, comprehensiveness, clarity of expression, and visual-audio appeal will be applied for summary assessment.

Operational Steps

STEP 1

Have each group (company department) plan its strategy for completing its task, including plans for interacting with other groups to obtain necessary information. The groups should also identify the information they wish to gather from each group.

Provide relevant resources, but also direct students to reflect upon the prior knowledge they bring to the project task, e.g., knowledge of chemistry, knowledge obtained through work-related experiences.

STEP 2

Engage students in task performance.

Ask students to present their ideas about how and from whom they might obtain necessary information and/or guidance. Use student input as a basis for further guidance.

STEP 3

Have students keep journals in which they describe not only their accomplishments and difficulties, but also their feelings and attitudes at different stages of the discovery process.

Circulate among groups when students are in class, coaching them through the process of thinking and reasoning, defining new problems, and crafting solutions. If they need help in developing their visuals for presentations, demonstrate how the task could be done and then help them to create their own designs by asking leading questions.

STEP 4

Bring the groups together to plan their presentation to the customer and to practice their execution of the perspective report.

Engage the entire class in a discussion of the qualities of the presentation that they considered good and those they believe need improvement. These qualities should be generally stated, e.g., more enthusiasm, good description of facts, larger type in visuals.

STEP 5

Conduct the final presentation.

Ensure that all students have an opportunity to present their findings without criticism or other negative reactions from the other "workers."

Reflective Practices

Have students reflect on the scope of information their groups uncovered during their inquiry into the problem.

Ask students to describe how the work of one group facilitated or complemented the work of the other groups. What were the primary concerns, knowledge, and skills of the respective groups?

Have each group of students make a list of the academic and vocational skills they used to complete their tasks and share those lists in an "all-group" session.

As the vocational teacher, describe how students occupational task performance is hampered by lack of basic skills. As the academic teacher, identify the major barriers to students' learning the basic skill, e.g., not realizing the value of learning "school" subjects.

Evaluation

Have students prepare their summaries and lists of commonly used skills in problem solving. Suggest that they include a graphic to illustrate how the knowledge and skills addressed in various academic and vocational classes were used for problem solution. Assess the audio, visual, oral, and written demonstrations of student learning as exhibited in their summaries, using accuracy, comprehensiveness, clarity of expression, and visual/audio appeal as criteria.

Field-related Experiences

Constructivist Pedagogy

In a transdisciplinary or field-based integration model, teachers expand the boundaries of the classroom, creating opportunities for students to learn or practice skills and knowledge in the field or at a worksite. In this activity, students visit a worksite of their choice, make observations, interpret what they see and hear, discuss and debate the on-the-job application of given knowledge and skills, and reflect upon the interrelatedness and value of academic and vocational education in the real world of work. By interacting with workers on the job, students are able to obtain relevant, up-to-the minute information to help them expand their thinking about the workplace and their preparation for work in it.

Teaching Strategy

Seeing first hand what is being done at worksites can enlighten any educator—academic or vocational—who is attempting to prepare students for the future and the workplace. Often, as a form of professional development, teachers visit worksites to learn first hand how skills and theory taught in the classroom are used on the job, which can help them to plan meaningful worksite visits for their students. More importantly, as teachers discover and discuss the connections they see between different content areas, they can better discern the types of questions they can ask to lead their students to make their own connections between school and work. Scaffolding, asking open-ended questions, and actively engaging students in learning are a few of the teaching techniques promoted in this activity.

Learning Activity Scenario

The Madison School District has made a commitment to integrate academic and vocational education in its four high schools. One of its efforts is to expand classroom boundaries. Its administrators have asked you to identify criteria to use in assessing the relevance of field-related experiences that can serve as a prelude to workplace internships. Your task is to engage students in developing a set of criteria to use in assessing the relevance and quality of worksite visits, test the utility of the criteria, and revise the list based on reflection and feedback. As a preamble to this activity, engage in a worksite visit with other academic and vocational teachers and use the information you gather through your visits to mentor and guide student efforts.

Evaluation Criteria

The criteria students establish in conjunction with their teacher at the onset of the activity will be used as a basis for self-reflection and peer review.

Operational Steps

STEP 1 Engage a team of academic and vocational teachers to visit a given worksite with you. Prior to the visit, meet to determine the "who, when, where, and why" of the visit. To help focus your learning at the worksite, develop a set of basic questions to ask the employers and front-line workers regarding their job knowledge and skill requirements, including those that promote employability.

As you observe and talk with workers at the job site, think about the skill standards you address in your curriculum and how those standards are being applied in the workplace.

STEP 2 Immediately after the visit, meet as a team to discuss your observations and share ideas about ways you can modify your curriculum and activities to bring students to an awareness of connections between school and work. Some options might include—

- arranging school visits by one or more of the employees that you and the other team members met during the visit; and
- making arrangements for students to engage in a worksite visit experience.

Engage with colleagues in a discussion of such questions as the following (Norton et al. 1997):

- *How might worksite visits inspire academic and vocational teachers to develop learning activities that will help students to understand the value of school learning?*
- *How might worksite visits motivate students to learn?*
- *What are some positive outcomes of the business/industry relationships established to accommodate worksite visits?*
- *What is one way in which you can adjust a segment of your curriculum to reflect the application of knowledge and skills in the workplace?*
- *What logistics are necessary to infuse an integrated activity in the classroom? Who? What? Where? Why? When?*

STEP 3 Enlist a group of academic and vocational students to participate in a worksite visit experience. Meet with the team and describe their challenge, which is to plan, implement, and follow up a worksite visit.

Share reflections about your worksite experience with the students by describing why the visit was of value to you as a person and as a teacher.

STEP 4

Engage students' help in the development of criteria they can use to assess the quality of their worksite observations and investigations. List these criteria on the chalkboard or flip chart so students can continually refer to them to guide their performance.

Draw upon the criteria you and other teachers developed subsequent to your worksite visit experience as a tool for guiding students. Ask questions to trigger students participation in thinking about and developing the criteria upon which they wish their performances to be assessed.

STEP 5

Have students brainstorm to identify the specific worksite they would like to visit and how that visit might promote their understanding of school and work connections. Help them in the brainstorming process by asking questions similar to the ones you had to answer to set up your own worksite visit.

Examples of questions to facilitate brainstorming:

1. *Who or what worksite should you visit? Why?*
2. *What do you hope to learn at that worksite?*
3. *Where is the worksite located?*
4. *Why should you visit the specific worksite?*
5. *When shall you visit the worksite?*

STEP 6

Lead students to plan their worksite visits. Have them self-select their teams to be composed of 3 or 4 students who share similar interests. Give the teams the following directions:

- Develop a set of basic questions to ask prior to and during the visit.
- Prepare a list of the academic, vocational, and employability skills you expect to see demonstrated in the worksite.

Have students draw upon previous teachings and experiences that have helped them to form opinions about the application of skills in the workplace.

STEP 7

Guide students through their learning experiences, ensuring that they conduct themselves well in the work setting. Provide them with some guidelines for acceptable ways to behave in their roles as observers and interviewers that you have gleaned from your own worksite experience.

Highlight a few of the courtesies students should afford the workers and companies they visit, e.g., following the visit, e.g., students should write letters of thanks to appropriate people at the worksite, also stating why the experience was meaningful to them.

Reflective Practices

Discuss with students their conclusions about the application of knowledge and skills in the workplace. Have them do the following:

- Identify the academic or vocational skills they observed being applied in the workplace.
- Identify the employability skills they saw demonstrated on the job.
- Describe the benefits of partnering with business/industry personnel to enhance learning.
- Describe the connections they observed among the different disciplines or content areas when applied on the job.
- Discuss reasons why separating knowledge and skill development into separate disciplines such as math, English, and vocational education is not a realistic reflection of what happens in the workplace.
- Present their ideas about activities that could be included in an integrated curriculum

Evaluation

Use the criteria established at the beginning of the activity as a basis for student evaluation. Have teams explain ways they met the criteria and offer each other peer reviews of their self-analyses. Offer feedback to students, giving them guidance in ways to improve their learning through observation, questioning, and reflection.

School and Community Linkages

Constructivist Pedagogy

Applying classroom skills to solve real problems of the social community is a critical feature of experiential learning. When reflection is added to the learning process and community service activities are fully integrated into the curriculum, the process is referred to as service learning. Service learning places students in decision-making roles that give them a sense of ownership in the problem, and in service roles that move them from passive receivers of service to active providers of service. Self-esteem, contribution to society, and a sense of self-worth are promoted through constructivist-based service learning activities (Fleckenstein 1997).

Teaching Strategy

Although the purpose of a service learning activity is to enhance student learning through community service, activities must also forge an authentic connection between the school and community. This connection is realized by engaging students in real-life roles that expand their knowledge and skills, and increase their understanding of community issues, problems, and populations. Literacy skills are highlighted in the activity.

Learning Activity* Scenario

A local senior citizen center has contacted you to ask if your students could be enlisted to visit some of their residents and provide them with companionship. Your task, as the English teacher of students with low literacy skills, is to engage your students in providing companionship to these elderly persons in ways that will help them improve their literacy skills. For example, students could elect to talk to the senior citizens, read to them, discuss books they have read, interview them to learn their experiences living in a previous generation, etc. As a means of knowledge construction, ask students to write in journals their reflections about their exchanges with the senior citizens—what they did to provide service, what literacy skills they improved, what they learned about the lives of senior citizens.

Evaluation Criteria

Journal writing will be used as a means of helping students to assess their interactions and performances in ways that are meaningful to them.

*This activity was developed from an idea presented in Rural Clearinghouse for Lifelong Education and Development. *Service Learning Benefits Students, Communities.* Manhattan, Kansas State University, 1995. (ED 391 620)

Operational Steps

STEP 1 Set up the problem situation. For example, ask students to brainstorm ways they can work with senior citizens to improve their literacy skills. Some examples could include reading to the seniors, making checkbook calculations, reading and interpreting guidelines for getting medicare or medicaid reimbursements for medical expen. , and so forth. (Literacy deficiency can be at any level, depending upon your student population.)

Write and post on the chalkboard or flip chart the literacy skills students hope to improve or acquire as a result of their service learning project. Offer suggestions as necessary to ensure that the academic and/or vocational literacy standards established for your state are among those identified.

STEP 2 Ask students to contact senior citizens with whom they have been paired. During the conversations, students should discuss their desire to be helpful, the skills they want to improve upon during their interactions with others, and the services the senior citizens might want them to perform, e.g., reading newspaper, writing letters. These discussions can take place over the telephone or in person, depending upon the desires of the parties involved.

Role play appropriate telephone courtesies by assuming the role of senior citizen as students practice their telephone conversation skills.

STEP 3 Following an established time frame (allow 3-6 months for this activity), have students make regular contacts with their senior citizen partners.

Provide ongoing coaching in the kinds of help students should provide as well as seek from the senior citizens. For example, some students might elect to engage the senior citizens in conversation by interviewing them to learn what it was like growing up in the "older" generation. They could record that information by taking notes or taping their conversations to transcribe at a later date. Activities that encourage mutual contribution (service) and reward (learning) should be encouraged.

STEP 4 Instruct students to make journal entries after each of their contacts to record what happened, what was said, what they learned, problems they encountered, and their feelings about the seniors and their experiences.

Review and provide feedback to students regarding their journal entries and their verbal reports of interactions with their partners. Create scaffolding to help students move through any situations that are difficult and develop new strategies for maintaining good communication with others.

STEP 5

At the end of the designated time frame, have students conclude their programmed involvement with the senior citizens by creating posters to give to their senior partners, illustrating the services they gave to the seniors, the services they received from the seniors, the competencies they have developed through the experience, and things they learned and value about the older generation as a result of their interactions.

Model appropriate courtesies by arranging for the class to visit the senior citizen center some evening or weekend and have a final party for the program participants during which students can share their posters with their partners.

Reflective Practices

Ask each student to write a paragraph describing how this service learning experience has contributed to their knowledge development and to their motivation for further learning.

Allow time for students to discuss their posters with the class, highlighting ways in which their knowledge about and attitudes toward senior citizens in the community have changed as a result of the service learning project.

Evaluation

Have students reread their journal entries and summarize (1) ways in which their communications have improved over time, (2) barriers to learning that they have had to overcome, and (3) new knowledge they have acquired about senior citizens in their community.

Instructional Practices

Experiential Learning

Constructivist Pedagogy

In moving from school to work, the skill of working with others is vital to success. Many companies are embracing the teamwork approach to management and production as part of total quality improvement. Collaboration and teamwork, however, cannot be learned through reading, listening, and memorization. Students must be involved in collaborative experiences to gain a comprehension of the intricacies of personal interactions, group dynamics, and respect for the views of others. This activity involves students in the active construction of knowledge by having them work collaboratively with others to investigate a problem, negotiate solutions through "whole brain" involvement, and justify their recommendations.

Teaching Strategy

Knowing how to work with others and to build upon the knowledge and experiences of diverse groups of people requires two skills crucial to students' academic and career development—creative thinking and problem solving. This activity is designed to help students establish patterns for creative thinking that they can draw upon to solve problems in all aspects of their lives, both in school and out of school. It involves students in a shared responsibility for investigating a problem hypotheses. Working in teams, students pursue various approaches to thinking about a problem and share with each other their multiple perspectives of way to approach it. The value of incorporating different ways of thinking in devising problem solutions are highlighted.

Learning Activity* Scenario

The employees of a local hair salon want their owners to adopt an open floor layout at their salon. (Currently operators have partitions separating their stations.) The salon owners have asked the employees to present an argument in support of the proposed change in 12 working days. Your role is to involve students as "employees" of the company to investigate the open layout design and prepare a presentation to support it, applying different cognitive styles of thinking to the investigation process. Among the interactions required as employees collaborate to come up with a rationale are those of negotiation and conflict resolution.

*This activity was developed from the ideas presented in Leonard, D. and Straus, S. "Putting Your Company's Whole Brain to Work." *Harvard Business Review* 75, no. 4 (July-August 1997): 110-113.

Evaluation Criteria

Criteria developed collaboratively by students and teacher will be used for peer assesssment of successful task performance. A questionnaire will be used to obtain feedback on each group's portion of the presentation.

Operational Steps

STEP 1 Identify the goal of the investigation and state students' roles as follows, dividing the class into four groups of company employees:

Group One: Prepare an argument to support the proposed open layout by using analytical thinking. For example, this group of employees could conduct research to determine the benefits of open architecture and ways to overcome its drawbacks. They could also analyze the cost implications of converting to an open layout floor design.

Group Two: Prepare an action-orientated argument that examines implementation issues. For example, this group of employees could find and present information about how long the office conversion will take, new furniture that might be needed, acoustical issues, and so forth.

Group Three: Prepare a people-oriented or emotional argument to support the proposal. For example, this group could discuss how an open layout might affect interpersonal relationships among operators and clients, how the setup might affect worker morale, and how the concerns of operators who prefer to work in isolated booths could be addressed in an open layout scheme.

Group Four: Prepare an argument from a future-oriented perspective. For example, this argument could include graphics or blueprints of the proposed layout.

Give students a chance to ask questions to clarify their assignments and responsibilities

STEP 2 Involve students in a brainstorming session to explore techniques they might use for their investigations. For example, techniques could include interviewing students, parents, and/or community members who frequent salons to learn their opinions about open store layout; reading research data, technical publications, or

periodicals on salon layouts to learn the latest trends and the rationale for adopting them; and communicating over the Internet to obtain addition information and resources.

Model using the World Wide Web to locate resources. Show students how to locate associations from which they could obtain information and how to link with appropriate listservs. Give students an opportunity to practice Web use while you watch and guide their practices. Then, release the learning responsibility to them.

STEP 3

Establish with students the criteria by which they can assess their arguments for open floor layout.

Give students leadership in brainstorming meaningful criteria, but also provide resources such as established math, drafting, and communication standards that students can draw upon in establishing the performance criteria by which their reports will be assessed.

STEP 4

Engage the employee teams in their respective forms of investigation. Underscore the importance of respecting underlying differences of group members and provide guidelines for intragroup interactions, e.g, everyone has a chance to agree with or object to a point of view, reasons for each perspective must be given.

Keep the goal—preparation of an argument in support of open layout—at the forefront of students' minds. Be available as a reference person, guiding students and asking them questions to help them clarify their thoughts so that they can present them verbally.

STEP 5

Bring together the four groups and have each group select one spokesperson to present its argument. Allow enough time for divergent (brainstorming) discussion to uncover imaginative alternatives and convergent (action planning) discussion to arrive at the best points to highlight in the client presentation.

Facilitate the execution of good group dynamics. Do not allow one approach to dominate the discussion time so that the entire class may arrive at the best rather than the first viable option.

STEP 6

Engage the groups in final collaboration to highlight the points to be included in the client presentation. Remind them that owners of the salon, as well as the salon's customers, reflect the same variety in thinking styles as those demonstrated by the salon employees.

Depersonalize conflict as a means of collaboration and solution building. Intellectual disagreements can cause a great deal of tension in any group, yet successful outcomes require the cross-fertilization of different ideas. Most business projects require collaboration between people who think and perceive information in different ways. Therefore, the presentation will be most effective when it satisfies whole brain thinking.

STEP 7 Have students brainstorm the questions they would like to place on a questionnaire for the salon staff to answer in assessing their presentation. Questions such as "What did you especially like about the presentation?" and "How could the presentation be improved?" will give feedback that students can draw upon for future persuasive arguments.

Support rather than lead students.

STEP 8 Have students make their final presentation before another class. This class should be told their role as "salon staff."

Reflective Practices

Engage students in a discussion of critical thinking by asking them to identify the qualities of a good thinker. Write the qualities on the chalkboard as they are presented.

Ask students to volunteer words that describe what good collaboration looks like and sounds like to them. Fill in the words on a T-Chart as they are given. (See the following example.)

Looks Like	*Sounds Like*
Smiling faces	"That's good!"
Eye contact	"I like that"
Nodding head	"I was thinking . . ."
Questioning looks	"How about . . ."
Handshakes	"How can we . . ."

Discuss how collaboration is demonstrated. For example, does one group talk while the other groups listen? Does collaboration mean that each group does a segment of the work and then put the parts together to form a report or recommendation? Why? Why not?

Ask students to describe ways in which looking at a problem from various frames of reference might help them to arrive at better problem solutions.

Evaluation

Have students review the evaluation forms completed by the salon staff audience and prepare lists of the best qualities of their presentation and the qualities they need to improve upon. Also have them assess their ability to complete their tasks successfully by using the criteria they established at the onset of the activity. Each of these items may be placed in their portfolios of work samples, if desired.

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Problem-based Learning

Constructivist Pedagogy

Little classroom instruction is devoted to solving problems for which there are no definite answers. More typical of instruction is the 2 + 2 = 4 philosophy, which encourages rote memorization rather than critical thinking. Most problems of the real world, however, have any number of possible solutions that are dependent upon available information and the individuals involved. This activity involves students in the actual experiences of solving a problem that has real-world significance beyond school. It affords a connection with constructivist pedagogy in that it contains academic challenges that provide a focus for knowledge development and real life scenarios that cast students in roles they may actually assume or have assumed in real life.

Teaching Strategy

Using ill-structured problems—problems that have no one right solution—is an instructional strategy used to promote critical thinking and problem solving within the context of real world applications. By thinking through ill-structured problems, students are able to expand and refine their knowledge through self-directed searches for information, active discourse with others, analysis of conflicting ideas and appeals, and decision making. "Problem-based learning is apprenticeship for real-life problem solving" (Stepien and Gallagher 1993, p. 26).

Evaluation Criteria

The Performance Checklist included at the end of this activity will be used for student assessment. Post a copy of this checklist in the classroom for students to use as a guide to your expectations.

Learning Activity Scenario

The Randolph Street School Board is interested in offering several high school courses over the Internet. Students would be able to take these courses without attending school, accessing the information from their home computers and communicating with their teachers and other classmates through e-mail. Due to the fact that not all students have access to home computers (although they are available at the library), and because students would not need to be physically present in class, the suggestion is an issue. The parties affected by this decision would be students, parents, school faculty, and the business community. Your company has been asked to investigate the issue and come up with a recommendation to present to the school board.

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Operational Steps

STEP 1 Have students identify an hypotheses for problem solution.

Brainstorming can be used as a strategy for compiling a list of issues relative to the problem.

STEP 2 Identify the roles of problem solving groups. Explain that there will be four teams of investigators to prove or disprove the hypotheses, with each group representing one of the four types of stakeholders—people from business and industry, school faculty, high school students, and parents. One member of each team should be chosen by the team members as the panelist who will represent them at the public forum to be held in 2 weeks at the school board meeting.

Encourage student self-selection of Internet user roles to assume, based on the focus of their interest.

STEP 3 Describe each team's responsibility, which is to gather information in support or rejection of the hypotheses. Each panelist's responsibility is to present his/her team's rationale for or against censorship of Internet usage in the classroom.

Engage in scaffolding by helping students to connect their responsibilities to various methods of application. For example, use questioning to help them clarify their roles and ways to perform them, letting their responses direct the way you offer leadership.

STEP 4 Initiate the research part of the investigation by guiding the four groups to appropriate resources, including the Internet. Additionally, provide the teams with background information on censorship and the students' right to know.

Provide primary sources, along with manipulative, interactive, and physical materials to encourage inquiry.

STEP 5 Brainstorm with students other methods for obtaining information, such as interviewing community members, conducting surveys, and personally soliciting opinions of parents and other students.

Guide students in ways to structure questions to use in interviews. Circulate among and coach students as they attempt to follow your model.

STEP 6

Engage students in critical thinking and reasoning. Have team members work together to identify the facts and values that surround the problem and develop criteria to evaluate the appropriateness of information available on the Internet.

Explain that because social issues are often the basis for ill-structured problems, students should give special attention to values—ethical, economical, moral, legal, environmental, health, and safety-related values—when devising problem solutions. Ask open-ended questions such as "What is important to the students, parents, schools, and community?" "What ethical issues are involved in the decision?"

STEP 7

Facilitate problem resolution by having team members collaborate with each other to identify possible solutions to the problem and prepare a rationale supporting or rejecting the censorship of Internet usage. Prompt students to relate the value principles they used to guide their decisions and offer facts to support those principles.

As leading questions such as "What information is reliable?" "What are some possible options to the issue of Internet courses?" "What will happen if . . . (pros and cons)?"

STEP 8

Direct students to make a decision based on the consensus of the four groups.

Monitor the exchange of information and discussions among students and guide students toward conflict resolution if necessary.

Reflective Practices

Have students discuss the importance of various perspectives on Internet courses obtained through their research. Ask them to identify how the omission of one of those perspectives might alter the decision they made.

Have students identify how values (medical, academic, family) influence decisions about which solutions to ill-structured problems are the "best" ones. Ask them to offer examples of how bias is reflected in the way data are interpreted.

Engage students in a discussion of how each type of information is important to consider in solving an ill-structure problem.

Evaluation

Involve students in debriefings about the team activity:

- "What was most difficult for you in the team activity?"
- "What was one of the most positive things to come from your team interactions?"

Have teams assess their own process of problem solving by responding to the following questions. (See the Performance Checklist.)

Performance Checklist

Part 1: To what extent were the following guidelines for team interactions followed:

Item	Always	Sometimes	Rarely	Never
The specifics of the problem were clearly identified by the team				
Sufficient information was gathered for review				
Several perspectives to the problem were considered by the team				
The pros and cons of each recommendation were presented				
The solution was unanimously selected				

Part 2: Identify the extent to which the following practices were evident in your team interactions:

Practice	Always	Sometimes	Rarely	Never
Demonstration of good listening skills				
Free submission of ideas for group consideration				
Demonstration of respect for the opinions of others				
Active consideration given to all suggestions				
Negotiation with others to reach team agreement				

Student-directed Learning

Constructivist Pedagogy

New approaches to teaching and learning reflect a movement from the traditional teacher-directed classroom to a learner-directed environment of collaborative, participatory, and continuous learning. The self-directed learner is "neither independent or dependent, but interdependent, forming new understandings through dialogue, feedback, and reflection with fellow learners and facilitators" (Kerka 1994, p.2). This small-group activity leads students to develop new understandings of work in a given occupational area by engaging in dialogue about past experiences, obtaining feedback about the value and meaning of those experiences, and reflecting about their learning and the learning process.

Teaching Strategy

Small group learning is sometimes avoided because teachers and students are unfamiliar and/or uncomfortable with a process that engages them in problems and issues of social interaction, conflict, dominance, and gender. The small group, however, has many advantages: it encourages critical thinking, teamwork, and problem solving; it enhances students' self-esteem by helping them realize they have much to offer other group members as a result of their experiences; it broadens the expertise of group members; it helps meet the diverse and complex needs of learners; and it eases the distinction between teachers and learners, creating an environment that is less hierarchical than traditional environments (Imel et al., 1994). Small group learning is the teaching approach highlighted in this activity.

Learning Activity Scenario

Jason Technology has been experiencing a high rate of turnover among its employees. Although all new employees have been screened to show that they have the knowledge and skill required for their positions, they tend to quit or be fired soon after they are hired. The personnel department wants your company to develop a strategy its staff can use to learn about their applicants' employment needs so that they can better match workers to jobs. Your task is to engage your employees (students) in small group activities to produce a document (e.g., questionnaire, survey, table, chart) for Jason's staff to screening applicants. Encourage students to pursue their preferred styles of learning to obtain information: personal interview, Internet or e-mail chats, online literature searches and reviews, and so forth.

Evaluation Criteria

Student-directed goals and objectives will provide the basis for self-assessment and peer review of student achievement.

Operational Steps

STEP 1 Establish small group roles. Divide the class into five groups and present the following group functions. Ask the groups to negotiate among their members to determine if all group members will perform the same role, separate roles, or combinations of roles.

Facilitator (helping the group to work together)
Researcher (finding resources and information to facilitate knowledge and/or skill development)
Writer (describing on paper the process the group follows to develop new knowledge and/or skills)
Presenter (telling other groups what members did to develop the knowledge and/or skill)
Timekeeper (monitoring the time the group spends on each part of knowledge/skill development)

Give students leadership is establishing these roles through negotiation. However, explain that it is acceptable for all students to be the researchers and to also have another function as well, such as researcher and facilitator.

STEP 2 Set group goals and objectives. Direct each group to collaborate in determining one occupational area to investigate, the information they wish to obtain, and the ways in which they will conduct their investigations. Have them state these decisions in goal and objective statements and post them on the wall for ongoing reference throughout the learning experience.

For example, the group may have the goal of learning more information about a career as a "professional golfer." Their objectives may be to (1) identify things about playing competitive golf that they like and dislike; (2) give examples of prior experiences that have led them to their perspectives about competitive golf; (3) list attitudes and values that are consistent with successful golf play; and (4) describe ways in which learning new information about the life of a professional golfer has influenced their decision to pursue the career choice or select another one. Work collaboratively with students in each group to negotiate the final goals and objectives.

STEP 3 *Facilitator:* Guide facilitators to ask leading question to trigger brainstorming and discussion about the information the group hopes to obtain, how the group will obtain that information, and from whom the information will be acquired. For example, students might want to know how a person who works in the chosen occupation combines work and family life; students could interview

workers, read magazine articles, search the Internet, use e-mail to find and communicate with workers through chat groups, listservs, and associations.

Monitor the facilitators' ability to realize the open exchange of ideas among group members and ensure that all members have a chance to speak and be heard.

STEP 4

Researcher: Have researchers engage in various means of investigation to obtain the information the group has agreed to seek, e.g., work-related likes, dislikes, attitudes, knowledge, skills, conflict areas, and so forth.

Provide resources, give suggestions, guide.

STEP 5

Entire group: Engage each small group in finding the information identified by the group, using sources deemed appropriate by the group. Reconvene the groups and have them discuss what each member learned through investigation. After discussion of the findings, have the groups discuss the meaning and value of the information the groups gathered, and determine what information each group will convey to others and how that information will be conveyed.

It will be important to coach the facilitator in his/her role during this period of group interaction. The facilitator should encourage group members to think for themselves, proceed with minimal direction, express their ideas clearly, and engage in reflection to reconstruct their understandings of work in the occupation.

STEP 6

Recorder: Guide the recorder to write descriptions of the group's process for learning, the value of the unique information the group gathered during its investigation, the group's reaction to the workers' comments, and any comments by group members that indicate awareness of the need to continually update skills.

Coach recorders to be attentive to continue recording processes, behaviors, difficulties, conflict, and so forth and to avoid distractions. It is important that all aspects of the group interaction be recorded so that students can later reflect upon their learning processes.

STEP 7

Presenters: Engage presenters in deciding how they will present the information gathered by the group. Offer guidelines regarding the amount of detail expected for the presentation.

Encourage the use of various methods, e.g., use of graphics, audiovisuals, charts,

STEP 8 *All class members:* Engage all class members in a large-group discussion of the categories of information they touched upon in their investigations. Also discuss what information the class believes will be especially useful to them in making career decisions. Discuss how learning about the personal experiences of people in their social environments can influence a person's decision to become involved in various school, family, or other life experiences as well as occupational ones.

Facilitate the small-group discussions.

Reflective Practices

Engage students in discussion of the following questions:

- What was difficult about working in the small groups, e.g., sharing experiences, determining what was to be conveyed to others, giving and receiving feedback? What was the easiest?
- How was learning expanded because of the interactions within their groups?
- How did having specific group roles contribute to the completion of the activities?
- What skills were needed to perform in each group role?
- How was the activity relevant to each student's lifelong learning process?

Evaluation

Have each group of students assess their performance in meeting its goals and objectives. Then, have them gather feedback from others by asking the other groups to assess their group's performance.

Mentoring

Constructivist Pedagogy

Mentoring is not a new concept. Over the years, it has been provided in both informal and formal ways as a technique for improving the quality of learning in social, family, and work environments (Lankard 1996). This activity involves students in the active process of helping others to learn through mentoring relationships. In keeping with the constructivist theory that promotes authenticity in learning, students draw upon their prior knowledge about a subject area and their process for learning, share and test their understandings and strategies through engagement with others, and develop new knowledge about the learning process through social interactions and negotiation with others.

Teaching Strategy

Mentoring offers a way to facilitate students' intellectual, personal, and social maturity as well as occupational development when related to skill development. It can be used as a strategy for helping one perform a task, develop new academic and vocational knowledge and skills, and alter behaviors. Bagley et al. (1994), in describing their "shared-ownership" technology model for restructuring the classroom, promote use of mentoring (reflective classroom management) in combination with cooperative learning, project-based learning, computer use, authentic assessment, and student empowerment.

Learning Activity Scenario

Five retired plumbers were recruited to serve as mentors to students in a vocational education class. They provided mentoring on an informal basis, as needed. However, last week they decided to adopt a more formal approach to mentoring and have asked your advisors to prepare a set of guidelines they could use to help their students reach their learning goals. Your task is to engage your students, as the team of advisors, in developing a mentoring rubric for the plumbers' use. The rubric must include the performance criteria and standards by which mentoring can be assessed.

Evaluation Criteria

The Mentoring Rubric at the end of this activity will serve as a model for evaluation of the students' rubric and of their mentoring performance.

Operational Steps

STEP 1

Introduce the concept of informal mentoring by connecting mentoring to students' social and school experiences. For example, have students identify experiences they have had when a friend, parent, or sibling acted as a mentor to them in helping them

complete a task such as car maintenance. For example, ask the following types of questions:

> How did you learn how to maintain a car? Did anyone give you *advice*? How was that advice given? Did the mentor *list* the things you were required to do to maintain the car? Did the mentor *criticize you* when you forgot to perform a maintenance step such as adding windshield wiper fluid? Did the mentor *compliment* you when you performed a step well? Did the mentor *tell you* how you could improve your car maintenance, e.g., rotate the tires regularly? Did the mentor *show you* a better way to do something, like waxing the car? Did the mentor *take you* to the workplace to show you how auto mechanics perform a task such as changing the spark plugs?

As students share ways in which mentors have helped them learn, write the key terms on the chalkboard, e.g., advising, demonstrating, and encouraging.

STEP 2 Introduce the concept of formal mentoring by describing it as a process by which individuals follow a structured set of guidelines to lead others to indepth knowledge about a concept, rather than one isolated task. Explain that formal mentoring requires a long-term commitment of time and on-going involvement of a qualified person whose purpose is to help learners achieve certain learning goals.

Give students an example of a long-term mentoring relationship that you have observed in school or on the job as a means of helping them connect to the concept.

STEP 3 Engage students in a discussion of the kinds of ongoing activities that mentors engage in to provide guidance, support, and coaching. Following a constructivitist classroom practice, ask students to elaborate on their views before presenting your own.

Consider ways to elicit the following ideas that should be considered by students:

- *Meeting with the person you are mentoring over breakfast or lunch to discuss his/her progress in learning or understanding an issue.*
- *Exchanging notes of encouragement and progress with the person you are mentoring.*
- *Having the mentee visit your place of work or a place that reflects the student's career or special interests.*

- *Inviting the person you are mentoring to go to a professional meeting with you.*
- *Helping the person you are mentoring with a special project.*
- *Providing resources that the student can use to find out more about a subject.*

STEP 4

Engage students in a discussion of the criteria they would use to evaluate successful mentoring. As recommendations are given, record them on the chalkboard or flip chart. When students have exhausted their ideas on the subject, have them make a final selection of the criteria to include on a rubric. Also have them distinguish three levels of performance.

Use the l toring Rubric on the last page of this activity for guidance.

STEP 5

Engage students in a mentoring experience by pairing them with students from another class (in a lower grade) who require help in their academic or vocational knowledge and skill development.

Collaborate with another teacher who shares an interest in this activity and establish the goals for each student's mentoring, e.g., developing skills for applying technology principles of electricity, fluid dynamics, and thermo dynamics to solve problems of the real world.

STEP 6

Have the mentors work independently and with the student they are to mentor to plan the mentoring experience. For example, the mentor may decide to—

- write notes of encouragement to the student on a regular basis,
- ask the student to study with him/her periodically, and
- design exercises the student can use to practice an application.

The mentor and student may decide to—

- meet regularly to review learning progress,
- schedule times for special tutoring, and
- locate resources for use in learning.

Facilitate but do not lead students in their decision making. Encourage self-directed learning.

STEP 7

Have students participate in the mentoring activity. Give them a time frame for their involvement as mentors, e.g., 1 month. Allow time for student mentors to share their practice and progress at mentoring.

Serve as a mentor yourself, giving the student mentors encouragement and recognition for their efforts.

Reflective Practices

Gather the mentors together in a group to discuss the following questions:

- Why is mentoring mutually beneficial to the mentor and to the person receiving mentoring?
- How can mentoring lead to improved self-image and self confidence?
- In what ways could mentoring help students to link school to work?

Prompt student to provide personal examples to support their answers

Evaluation

Have mentors complete the mentoring rubric to assess their performance. Also, have the students who received mentoring complete the rubric to indicate ways in which their mentors helped or failed to help them. Discuss the two completed rubrics with each student as a form of feedback to guide learning.

Mentoring Rubric

	Levels of Performance		
Criteria	Poor	Good	Excellent
Maintained regular mentor/student meetings	Met only if asked	Met at least once a week	Met 3 times a week at set time and place
Showed personal interest in the student	Asked questions that involved a yes/no response	Asked a mix of yes/no and open ended questions	Asked open-ended questions
Discussed issues of importance to the student	Told your views only	Shared viewpoints about issues	Focused on student's interests
Used relevant personal experiences to make a point or provide explanation/example	Talked about other students	Used examples of nationally known figures	Used examples from personal life
Demonstrated a process for doing something, e.g., performing a math calculation, when appropriate	Referred student to the textbook	Performed steps yourself while students observed	Led student step-by-step through the process
Visited a work-related site with the student	Observed workers at site	Shadowed a worker at site	Interviewed a worker at site
Provided help/ assistance in performing a task	Performed the task yourself	Discussed ways to perform the task	Offered suggestions to guide student
Offered support and encouragement	Complimented only on final product if done well	Complimented on successful steps only	Complimented on some aspect of each effort

Assessment Practices

Journal Writing

Constructivist Pedagogy

Reflective journal writing is an effective tool for self-assessment in that it engages students in thinking about certain ideas and experiences and envisioning new ways of responding to them. This activity combines journal writing with the use of technology as a means of extending constructivist learning in the classroom. It engages students in working on an Internet-based project that is meaningful and challenging, places them in control of their learning, enables them to work collaboratively with a diverse community of learners, and connects them with expert workers.

Teaching Strategy

Journal writing as an authentic tool to guide reflection, self-assessment, and learning. It provides students with an opportunity to record what is happening in their lives and clarify their feelings, attitudes, beliefs, and values so as to develop self-knowledge and inspire self-directed learning. The teacher's role in promoting reflective journal writing is that of coach and mentor, helping students to focus on the what is happening in the moment and using that information to guide future participation in life events.

Learning Activity* Scenario

The local Chamber of Commerce wants to produce a publication describing some of the top careers in the local area. Your task is to engage students in developing this publication by having each of them focus on a specific occupation of interest. Information for this project must be acquired, synthesized, interpreted, reviewed, revised, and presented in final form through use of Internet technology, e.g., listserv exchanges, e-mail communication, private journal writings, and public postings on the Internet.

Evaluation Criteria

Evaluation of students' performance will be based on their demonstrated ability to—

- plan, organize, and monitor the collection of relevant information about a self-selected occupation;
- work collaboratively with others to gain multiple perspectives about problem issues and solutions; and
- reflect new understandings through journal writings that convey thoughts, assumptions, and arguments.

Evaluation of the publication will be based on its acceptability to the Chamber of Commerce. A rejection of the publication will require writers to revise it within a 1-week period.

*The idea for this activity evolved from reading Ravitz (1997).

Operational Steps

STEP 1 Have students select the occupations they wish to investigate.

Provide resources of occupations common in the community. Include company brochures, yearly reports, and so forth.

STEP 2 Help students establish their teams. For example, a student may select mentors, teachers, students with similar interests, members of relevant associations, and parents to be part of his/her interactive learning team.

Help students to use communication technology to locate individuals to serve on their teams.

STEP 3 Introduce students to several kinds of communication channels they can use in their project work:

- Listserv exchanges through which team members can share their research findings and ideas with each other;
- E-mail exchanges between the student and teachers and/or other mentors through which students could present their work for review and feedback;
- Private journal writings in which students can record their thoughts and feelings about their experiences, including frustrations, insights, and issues to address sometime in the future; and
- Public postings on the Internet that can be read by all Internet users.

Demonstrate the use of these four channels of communication available through Internet technology. Coach and guide students, helping them to make use of all four channels as they engage in project activities.

STEP 4 Ask students to begin their projects by publicly posting requests for resources over the Internet and World Wide Web. These information searches should be for human as well as print resources, e.g., names of subject matter experts, professional organizations, and/or colleagues.

Encourage students to interact with resource people other than those on their listservs, or to add others to their listservs as interested parties are discovered. For example, an applied science teacher could be consulted for information about new technologies in the field, mathematics or statistics teachers could be valuable resources for data related to the field, e.g., growth figures, stock performances of small and large businesses in

the field. Also prompt teams to share their planning, learning, and development approaches across teams.

STEP 5

Encourage students to share their research findings, including names of contact persons, with the people on their listservs. Ask them to make entries about their processes for inquiry to share with others and to solicit feedback.

Observe students as they work, providing "scaffolding" to help them engage in listserv exchanges. Help them to connect what they are learning to what they already know.

STEP 6

Have students use e-mail to communicate with their teachers and other mentors/learners. Their exchanges can consist of ideas for performing the project activity, problems they are encountering, and any other information or questions for which they would like to receive feedback.

As the facilitator, it will be easier for you to communicate one on one with students over the Internet than it is during a classroom session. Immediate feedback is important to enable students to make adjustments to enable them to advance in their learning. It also gives you an opportunity to compliment and encourage students so that they are motivated to continue learning.

STEP 7

At regular intervals or key points in the investigation, remind students to write entries in the personal journals they have created in their program files. Encourage them to record descriptions of problems they have encountered, solutions they have tested, lessons they have learned, plans they have changed, and new directions they are taking. Also ask them to reflect on their feelings, attitudes, and perspectives about these issues.

Stress the importance of documenting these experiences thoroughly and regularly as a way to retain opportunities for reflection, dialogue, and feedback.

STEP 8

Offer continuing guidance and support as students move forward in their investigations of relevant information, decisions about what data to include in the publication, and their strategies for developing and distributing the final publication.

Although students must be encouraged to direct their own learning process for this project, offer ongoing support and encourage them to interact with classmates in large and small groups.

STEP 9 Have students publicly share via electronic communications various portions of their writings and to ask for feedback from those Internet users.

In presenting the product for review, guide students to include the objectives of the project and the type of feedback they seek so they can revise as necessary.

STEP 10 After students have reviewed and revised their writings, engage the entire class in preparing the final publication for the Chamber of Commerce and in distributing it to the public through an Internet entry or through linkage to the Chamber of Commerce website.

Facilitate students in their attempts to do this. Enlist a member of the Chamber of Commerce to conduct the review.

Reflective Practices Divide the class into five groups. Ask each group to formulate an answer to its assigned question and present that answer to the class:

Group 1:	In what aspects of my life can I follow a similar process for learning by using new communication technologies?
Group 2:	What learning concerns did the experience bring to mind?
Group 3:	In what way were values reflected in the experience?
Group 4:	What new insights about myself did the experience trigger?
Group 5:	How did (or didn't) reflection about the experience change the way I think?

Ask students to reflect upon interpersonal communications and social interactions over the Internet. Use the following questions to guide this reflection:

- In what ways did you feel comfortable (or uncomfortable) exchanging ideas over the Internet?
- What channels of communication did you use most frequently to communicate your feelings? Why?
- Was it possible to assemble a geographically, socially, and culturally diverse team? If yes, explain how this was accomplished. If not, describe the factors that prevented this from happening.

Point out to students that journal writing can be assigned criteria against which assessments can be made. These criteria could be

specified in a rubric, for example, and related to the following (Allenspach et al. 1996, p. 80):

- Reflectiveness
- Depth of response
- Number of entries
- Originality
- Use of concrete images
- Length of response
- Descriptive words
- Evidence of thoughtfulness
- Creativity
- Connections to other subjects
- Responses to posed question or lead-in statements
- Connections to a life experience

If desired, have students link performance standards to journal writing. Have students create a rubric to assess their reflective journal writing, using criteria like the ones listed and identifying the varied levels of performance. (Assigned weights are optional, depending upon the intent of the experience.)

Evaluation

Conduct assessment of the project objectives by determining the extent to which they demonstrated achievement of the process objectives. Public sharing and Chamber acceptance of the document meets the criteria for successful evaluation. Offer feedback regarding both process and product so that students will be directed to learn from their experiences and be able to transfer that knowledge to other situations and project work.

The Scoring Rubric

Constructivist Pedagogy

Constructivist learning requires students to demonstrate in-depth knowledge of a concept and an ability to apply that knowledge in real-world situations and practices. This activity involves students in developing resumes, discussing the relevance of key components, preparing drafts for purposes of testing appropriateness and obtaining meaningful feedback, revising the resume based upon relevant input, and preparing the resume for final presentation. The performance-based rubric is used as a tool for authentic assessment, helping students to evaluate how well they have met the criteria for acceptance, determine where they are in the learning process, and what they need to do to move forward.

Constructivist Pedagogy

The scoring rubric aids the assessment process by providing to students at the onset of a learning activity clearly defined performance targets for reaching agreed-upon standards. "A scoring rubric consists of fixed scales related to a list of criteria describing performance. Each scale is composed of anchors that describe the various levels of performance complexity. Assigned weights, which give the relative value of each criterion, are used in the process of scoring to ascertain whether the standards have been met" (Allenspach et al. 1996, p. 10). To the extent possible, rubrics focus on the characteristics of understanding, rather than on fragmented bits of information. They are designed to aid in evaluating the quality of a student's work, not the quantity of work performed. The scoring rubric is a strategy for connecting all aspects of the learning process—instruction, performance, and assessment. The purpose of this activity is to engage students in using the scoring rubric to guide their task performance and self-assessment of their learning progress and performance.

Learning Activity Scenario

The Ellison Local High School has invited the Get It Together Employment Agency to hold a workshop session on resume preparation for the school district's annual "Career Week." As the training director for Get It Together, you have been asked to help students who register for the session to develop resumes that will be well received by future employers. Your task is to engage students in the construction of a rubric by which they can assess their resumes for acceptability to potential employers, preparation of their individual resumes, and subsequent assessment of their completed resumes using the criteria they identified in the rubric.

Evaluation Criteria

A resume writing rubric will be constructed by students with assistance from the teacher and used to evaluate their self-prepared resumes.

Operational Steps

STEP 1 Describe to students the task they are to perform and ways their performance will be assessed for this activity so they can visualize the attributes required of the final product.

For example: post where visible to the class the following performance objective: Prepare a resume to use in a job search according to the standards established by the class. Also post the knowledge and skills to be assessed as follows: "Given a list of information typically required on a resume, the student will—

- *compile the information,*
- *select a type of resume to prepare,*
- *prepare a draft copy of a one-page resume,*
- *edit the resume to correct any errors, and*
- *prepare the final copy of the resume.*

STEP 2 Ask students to discuss "What makes a good resume?" Then, have them brainstorm criteria for assessment and the standards by which they will determine their levels of progress toward the performance standard.

By using open-ended questions, lead students to an awareness of the following criteria and ratings:

Criteria:	*Neatly typed* *Attractive format* *Accurate information* *Complete content* *Well organized* *Correctly edited*
Standard Levels:	*Excellent as presented* *Requires corrections* *Must be redone*

STEP 3 Engage students in assigning weights to the criteria, e.g., the highest number should be assigned to the most important criterion for successful task performance. Allow time for student discussion of recommendations so all points of view are able to be considered. Promote the use of negotiation skills to help students arrive at a consensus about the weight to be assigned to each criteria.

Use the following example to guide your manner of facilitating student learning, being careful to guide students so that they devise an example similar to the one that follows rather than having that example presented to them for acceptance:

Criteria	*Weight*
Neatly typed	*3*
Attractive format	*1*
Accurate information	*4*
Complete content	*4*
Well-organized	*2*
Correctly edited	*3*

STEP 4

List on a flip chart or chalkboard the types of information typically presented on a resume and describe each category. For example:

- Personal Data. This includes name, social security number, mailing address, telephone number (including area code).
- Career Objective. The career objective should be a one-sentence statement that indicates the job desired (e.g., sales), the desired responsibility (e.g., sales person), and the relevant skills (e.g., communication)
- Formal education and training. This includes the names and locations of schools attended, the dates you entered and left the school, special courses of study, grade point average
- Special skills. Job-related skills should be noted here along with any other relevant skills. (Point out that people get paid for *using* knowledge, not *having* knowledge.)
- Work experiences. This list should provide information about specific jobs the applicant has held and the job duties he/she has performed, and tools and technologies used.
- Special awards and memberships in professional organizations.

Distribute completed copies of resumes as samples for students to review.

STEP 5

Direct students to compile the information they need to prepare their personal resumes.

Serve as a mentor, helping students to determine where they can find the information they need and who they might need to talk with to locate information about which they are unclear.

STEP 6

Once students have gathered the information for the resumes, ask them to select a format to use and direct them to put the information in draft form.

Provide students with examples of resume formats or direct them to the appropriate resources.

Reflective Practices

Engage students in a discussion of the value of using a scoring rubric to assess other school work and using that assessment to help them plan where to direct their future efforts.

Have students discuss the advantages of developing rubrics for self-assessment of performance in occupational task areas, e.g., repairing lubrication and cooling systems for an auto mechanics occupation.

Evaluation

After all students have prepared draft copies of their resumes, have them critique their own copies using the rubric they prepared. Allow time for students to continue working on their resumes to improve them and to obtain constructive feedback from other students to guide their efforts.

Portfolios

Constructivist Pedagogy

Assessments from a constructivist perspective focus on generally defined outcomes that are constructed by teachers and students as they advance through the process of learning. This activity engages students in using the portfolio as a tool by which to construct meaning. It engages students in the compilation and selection of items to include in the portfolio. Because the portfolio represents the processes of learning over time, it is a record of learning itself. Meaning is individually constructed by students through review and analysis of its varied contents and purposes for inclusion. "The constructivist approach puts a premium on the selection of items that reflect learning from the student's perspective" (Paulson and Paulson 1994, p. 1).

Teaching Pedagogy

Portfolios represent a new model for assessment in which the student is a full stakeholder in the process. They offer the teacher a strategy for helping students to determine their own purposes for various demonstrations of learning and a resource from which to make informed instructional decisions that are consistent with student needs. Because they can be used to promote student/teacher collaboration in developing criteria and standards for work evaluation, portfolios represent a total learning environment, forging a connection between instruction and assessment (ibid.).

Learning Activity Scenario

The election of officers for a professional association will take place in 6 weeks. The candidates for the offices will be asked to submit evidence to support their qualifications for the positions. Your task is to engage students as potential candidates and ask them to determine the qualities about themselves that they would like to highlight and collect evidence that they possess those qualities.

Evaluation Criteria

Evaluation will be based on students' interpretations of the value of their portfolio contents in demonstrating their leadership qualities. An election of officers will serve to provide feedback on peer review of the campaign.

Operational Steps

STEP 1

Involve the class in discussion of the qualities they would seek in those elected for office. As suggestions are given, write them on the chalkboard. Require students to give a rationale supporting the value of each quality in regards to leadership. For example, "Why is 'enthusiasm' important for the person in an officer position?"

Facilitating discussion so that all students feel free to submit ideas without judgment or critique from others is a key function for the teacher.

STEP 2 Next, have the class brainstorm the characteristics and behaviors that reflect each of the qualities they noted. For example, a person who has enthusiasm may be characterized as being "fervent," "passionate," "spirited." He/she may demonstrate this quality by volunteering time and energy to work on special projects for the association. Note the characteristics and behaviors suggested for each quality listed on the chalkboard.

Ask various open-ended question to encourage the presentation of ideas or ask students to role-play how a person could physically display a quality.

STEP 3 Ask each student to make a list of the four or five qualities he/she would like to highlight in his/her campaign and to prepare his/her own definitions of those qualities.

Encourage students to come up with words and definitions that are meaningful to them.

STEP 4 Engage students in their interpretations of evidence they could compile to reflect the qualities they have decided to publicize.

Use open-ended questions and scaffolding to help students identify the kinds of evidence that could use, e.g., feedback about oral presentations, posters designed to promote a class function, etc. As each student will have his/her own unique skills and abilities, the evidence should reflect that uniqueness.

STEP 5 Have students, over the next 6 weeks, select products, photos, projects, drawings, and evidence of applied technology such an electrical circuit board to include in their portfolios to reflect the qualities and characteristics they have identified.

Be available to give input and feedback during this period of time and offer encouragement to prompt students' enthusiastic engagement in the portfolio experience.

Reflective Practices Have students describe ways in which portfolios present a more comprehensive and complex picture of learning.

Ask students to debate the value in evaluating all parts of the portfolio rather that each item individually.

In this activity, assessment guided instruction. Engage students in brainstorming to identify ways this practice is demonstrated in a business organization.

Evaluation

Have students share the portfolios they have assembled and describe the rationale they used to select contents they believe illustrate their qualifications as officers. (The interpretation and reflection phase of this activity is especially important as it engages students in the process of making meaning of what they have done and learned.) Then have the class actually vote for officers based on the evidence that has been presented.

Observation Checklists

Constructivist Pedagogy

Observation is a significant way to learn what is happening—what the classroom is like, what students are doing, and what learning is taking place. In keeping with constructivism, observation checklists provide a tool for self-reflection and self-assessment. Their authenticity is dependent upon their use as a method of recording observations through which students can discern where they are on a continuum of knowledge and skill development. This activity will involve students in the development of an observation checklist they can use to determine what skills they have acquired and the extent to which they have mastered the skill based on observable criteria so that can engage in planning for improvement.

Teaching Pedagogy

Reflection is a key part of knowledge construction. It provides a point from which change can be made. However, reflection requires focus that allows the individual to shift gears from what is known to how that knowledge can be operationalized or applied, to the development of new knowledge and testing its viability. Observation checklists highlighted in this activity are used to provide a guide for future development, engaging students in a strategy that will help them learn ways to assess their own performance before they acquire or retain bad habits.

Learning Activity Scenario

You have been asked to develop an observation checklist that teachers, business managers, and community groups can use to determine the extent to which the physical arrangement of the rooms in which they conduct education and training classes facilitate learning. Your task in this activity is to engage students in developing this checklist of physical characteristics that facilitate learning and using it to assess the extent to which education and training rooms reflect these.

Evaluation Criteria

A student-developed checklist of the characteristics of physical environments of classrooms that promote student involvement and participation in the learning process will be used for assessment and serve as a guide for continued learning.

Operational Steps

STEP 1

Involve students in brainstorming ways in which the physical arrangement of a classroom can promote learning,. Ask questions to draw from students suggestions such as the following (Marlowe and Page 1998):

- promoting student participation,
- motivating learning,
- encouraging interaction and collaboration,
- instilling pride in work,
- encouraging participation, and
- modeling of skills.

Clarify the meaning of these learning outcomes if necessary. Emphasize that the suggestions must refer to items that are observable, e.g., learning tools relevant to the learning concept, such as leveling instruments to use in surveying, are available for use.

STEP 2 After the brainstorming, have the students refine the list acquired through brainstorming. Have them synthesize the suggestions on the list, analyzing their value as guides for self-reflection and self-assessment.

Ask students to justify their reasons for the suggestions they give and to provide an example of how the observable item contributes to learning.

STEP 3 Engage students in determining the standards by which they want their performance to be assessed. For example, do they demonstrate each performance "all the time," "most of the time," "seldom," "never."

Review the following example of an observation checklist for classroom physical environment (Marlowe and Page 1998, p. 46).

Environment	All the time	Most of the time	Seldom	Never
The walls are filled with student's work				
The furniture is arranged to facilitate learning				
Everyone has a clear view of the teacher				

Environment	*All the time*	*Most of the time*	*Seldom*	*Never*
Furniture is moved according to the activity				
Students have a say in arranging the classroom				

STEP 4

Allow small groups of students to practice their skill at arranging the physical environment of the classroom. Establish four or five groups and give each group 1 day to be in charge of the physical environment of the classroom.

To help students in their planning, explain the classroom agenda for the days they will be practicing classroom arranging so they will know what activities to arrange for.

Reflective Practices

Have students discuss reasons that some arrangements are more conducive to discussion (for example) than others. Ask them to give examples from their own experiences. For example, do family members eat around one table or in line on separate tables? Why?

Evaluation

As a tool for self-reflection and self-assessment, have each group use the checklist to assess the classroom environment it has arranged. Then, compare the self-assessments of the first group with the last group and note the learning progress that has occurred as the last group of students learned from the arrangements set by all previous groups.

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