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Indicators of Constructivist Principles in Internet-Based Courses

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Indicators of Constructivist Principles

in Internet-Based Courses

(TITLE)

BY

Karen M. Partlow

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THESIS

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Indicators of Constructivist Principles in Internet-Based Courses

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ABSTRACT

The purpose of this study was to provide greater assurance of quality in Internet-based courses. Current literature supports the assumption that the inclusion of constructivist principles in online courses adds to course quality. Therefore, identifying indicators of constructivist learning theory is important to the development of online courses. A peer-nominated panel of national experts in constructivism and instructional technology participated in a 3-round Delphi web survey. Through the iterative process, panelists assigned a mean rating of importance of 4.0 or higher (on a 5-point Likert scale) to 40 indicators of constructivist principles in online courses. Three implications for course design were identified; (1) one size (of learning model) does not fit all, (2) the six identified categories and their related indicators provide a framework for course development, and (3) indicators of constructivist principles transcend technology.

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I am thankful to Dr. Butler for his encouragement to "take the road less traveled," and write a thesis. It has proven to be one of my most valued educational experiences.

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CHAPTER 1

Introduction

During the past 5 to 7 years, there has been rapid and significant growth in the number of Internet-based distance education courses offered by colleges and universities. A recent survey by the U.S. Department of Education's National Center for Educational Statistics (NCES, 1999) found that from 1994-95 to 1997-98 the number of distance education programs using a variety of technologies increased by 72 percent. The survey also indicated that 58 percent of all distance education courses provided by institutions of higher education in 1997-98 used asynchronous Internet instruction as their primary mode of instructional delivery. Furthermore, institutions that offered distance education courses in 1997-98 or that planned to offer distance education in the three following years reported that they intended to start using or increase the use of Internet-based technologies and two-way interactive video more than any other type of technology. Clearly, these surveys suggest that the growth of Internet-based courses will continue aggressively for the next several years if not longer.

Three reasons have been proposed as catalysts for this rapid growth in Internet-based courses including (Sherron and Boettcher, 1997):

1. The growth and convergence of telecommunications technologies and computing technologies. As these two industries have grown and merged, new hybrid technologies have been developed that extend the capability to

communicate instantaneously with others from a distance without sacrificing quality.

2. Changing student demographics due to Information Age workers' need to become life-long learners. Increasingly the students of the Information Age comprise a set of diverse demographics. In addition to traditional college and university students who are primarily full-time learners aged 18 to 22 years, more of today's students are older, employed men and women who must stay current with their fields or are preparing to enter new and emerging fields, but are unwilling or unable to become full-time resident students.

3. The need to reduce the cost of education. As budgets for educational institutions continue to be challenged to meet the changing needs of present and future students, there is a need to reduce the cost of education. There is a common belief that online course delivery can reduce the cost of teaching and learning in higher education markets. However, Sherron and Boettcher (1997) state that often the savings on brick and mortar building space and maintenance are quickly offset by the upfront development and implementation costs of Internet-based courses.

Literature indicates that the "race" for colleges and universities to produce and deliver online courses and degrees is being sparked by competition from for-profit organizations that have recently entered the education arena via the Internet, challenging what has been the mostly exclusive domain of colleges and universities for centuries (Bridwell, et. al., 1996). Many institutions of higher education have and are reacting to this sense of economic pressure to not only seize market opportunities presented by delivering education over the Internet, but also to thwart competition for "market share" by quickly developing and delivering online courses.

Along with this rapid increase in the availability of Internet-based courses come issues related to their educational quality. Some are concerned that important quality assurance procedures are being bypassed (Phipps, Wellman, and Merisotis, 1998). In fact, a recent survey involving 44 states, conducted by the Institute for Higher Education Policy for the Council on Higher Education Accreditation (1999) involving 44 states, investigating state policies regarding approval policies of distance education programs revealed that only 6 states had separate policies for approving new degree programs offered through distance education technology. In 23 of the responding states, institutions must go through additional processes to offer an existing course or program at a distance. Yet in 15 states, no state policies existed at all for approval of distance education programs.

Others see this rapid growth in Internet-based courses as a way to step up the pace of reform in all of education (including both traditional and distance delivery) to better meet the needs of the students of the new millennium (Ehrmann, 1997). Education reform initiatives of the past two decades called, mostly unsuccessfully, for an alternative to the traditional teacher-centered model of education that emphasized rote learning and memorization. Many believe that the popular alternative educational paradigm, referred to as "constructivism", is aimed at better meeting the needs of today's and tomorrow's learners (Riel and

Harasim 1994, Carr, et. al., 1998). Supporters of constructivist reform are calling for schools to teach students to "construct" their own knowledge by learning how to access information, recognize and solve problems, comprehend new phenomena, set learning goals, and regulate their own learning (Jonassen, Peck, and Wilson, 1999). Some education scholars believe that the use of learning technology is the essential missing ingredient for turning the education reform rhetoric of the past two decades into a reality (Wise, 1997; Rakes, et. al., 1999). In many ways, constructivist learning theory is suitable for Internet-based courses. Students need to be self-directed and active participants in learning, which are important tenets of constructivism. Unlike many face-to-face lecture-dominated classes, instruction in an online environment is not delivered to students. Students must actively seek out and study the instructional content. Additionally, the delivery medium (the Internet) can provide instructors and students learning materials and experiences that are multi-dimensional, complex, and rich with information and media.

To date, however, there has been little conclusive research published on the effectiveness of Internet-based courses (Phipps and Merisotis, 1999) or on the validation of quality indicators of Internet-based courses (Phipps and Merisotis, 2000), specifically as the indicators relate to applying constructivist principles to course development. So, while Internet-based and other distance education courses are increasing in their availability and popularity to the students of the new millennium, there is little to no conclusive evidence or assurance of their quality or effectiveness in better preparing these students for the challenges of the millennium ahead.

Statement of the Purpose

The purpose of this study was to assist educators and educational institutions in providing greater assurance of quality in Internet-based courses by identifying indicators that reflect the application of the principles of constructivist learning theory to the development of Internet-based courses. If it can be assumed that online learning is amenable to constructivist learning principles and such courses can be markedly improved by adherence to this construct, then defining related indicators is important.

Statement of the Problem

The intention of this study was to establish indicators of constructivist principles applied to the development of Internet-based courses as identified by nationally recognized experts in instructional technology and constructivist learning theory.

Definition of Terms

For the purpose of better understanding this research, the following terms have been clarified.

Asynchronous Internet-based courses: Courses that use the Internet in a time-independent manner as their primary means of instructional delivery to off-campus students.

Authentic learning opportunities: Learning tasks that are real-world in nature or simulated in some case-based environment that provides meaning and context for the learner.

Collaborative learning: Learners learning with and from each other, sharing ideas, and shaping beliefs.

Constructivism: A teaching/learning paradigm based on the belief that knowledge is constructed by the learner, and not instructed by the teacher.

Cooperative learning: A form of collaborative learning where learners work together toward a common goal, project, or assignment.

Course development: The teaching and learning elements, approaches, and methods used to design and deliver a course.

Critical thinking skills: These cognitive skills typically refer to the three higher levels of learning in Bloom's (1956) Taxonomy of Learning Objectives (analysis, synthesis, and evaluation), which is a widely known and accepted classification framework among the academic community for learning objectives consisting of six levels of learning—three lower levels and three higher levels.

Ill-structured learning problems: Learning tasks that are real-world in nature and do not have one correct answer. These may have multiple correct answers or no correct answer.

Indicators: Observable and measurable elements, methods, and procedures.

Instructional technology: Refers to designing a learning environment that combines educational theory and technology of all forms resulting in an enhanced learning experience.

Learning technology: Tools, mostly electronic in nature, which support, enable, and/or extend student learning.

Objectivism: A teaching/learning paradigm based on the belief that knowledge is present outside of the learner and must be transferred to the learner by the knowledgeable teacher. Also, Instructionism.

Assumptions

In this research, the following was assumed:

Based on a review of current literature (Becker and Riel, 2000, Carr, et.al., 1998, Jonassen, Peck, and Wilson, 1999, Jones, 1996, Rakes, et.al., 1999, Ravitz, Becker, and Wong, 2000, Wise, 1997), the inclusion of constructivist learning principles in Internet-based courses adds to course quality, in general.

Nationally recognized experts in instructional technology and constructivism will have the knowledge and professional experience to accurately identify observable and measurable elements, methods, and procedures in Internet-based course development whose presence or absence indicates the application of constructivist principles.

Limitations

This study was limited by the following parameter:

The validity of the indicators of constructivist principles applied to Internet-based courses will be established by nationally recognized experts from the United States in instructional technology and constructivist learning principles and methods. By limiting the experts to only U.S. citizens, the researcher hopes to avoid any possible cultural differences in the interpretation of applied constructivist principles.

Delimitations

This study was delimited to the following parameter:

Only indicators that relate to constructivist principles applied to Internet-based course development will be identified.

CHAPTER 2

Literature Review

The institution of education has been slow to respond to the fact that the American society is transitioning out of the Industrial Age and into the Information Age. This slow response to change is characterized by the continued use of a no longer justifiable agrarian calendar, curricula comprised of separate subjects presented in an unrelated, non-real world fashion, and an emphasis on lower level rote learning and memorization. Today's Information Age learners and their expectations about learning are changing drastically and rapidly.

Changing Skill Set Needs

The dawning of the Information Age in the mid-1970s marked by the development of the first personal computer, brought about a gradual and then later profound upsurge of highly technical jobs. This increase in "high tech" jobs coincided with increasingly frequent replacement of factory and other low-skilled positions by new technology. Those concerned with and responsible for the education of young people began to realize that a 19th and 20th century factory-style approach to education is, in many ways, inadequate or inappropriate for preparing the citizen and worker of the 21st century. Although the 3 R's (reading, writing, and arithmetic) are still recognized as very important skills, the Secretary of Labor's Commission on Achieving Necessary Skills (Whetzel, 1992) rated "knowing how to learn" as one of the most important thinking skills (see Table 1 for other important basic skills needed for today's workplace). The report also listed workplace competencies based on both the identified essential academic skill and behavioral or personal characteristics (see Table 2 for a list of essential competencies for today's workers). Today's learners and tomorrow's workers and citizens need to know how to add to their own knowledge and skill-base in meaningful ways so that they can continue to learn, adapt, and integrate new knowledge, skills, and competencies throughout their lifetimes.

Table 1

Basic Skills Needed for Today's Workplace

Basic Skills	Thinking Skills	Personal Qualities
1. Reading	1. Knowing how to learn	1. Responsibility
2. Writing	2. Reasoning	2. Self-esteem
3. Arithmetic	3. Decision-making	3. Sociability
4. Speaking	4. Creative thinking	4. Self-management
5. Listening	5. Problem solving	5. Integrity
	6. Conceptualizing	6. Honesty

From Whetzel, D. (1992). The Secretary of Labor's Commission on Achieving Necessary Skills. http://www.ed.gov/databases/ERIC_Digests/ed339749.html, page 1.

Table 2

Essential Workplace Competencies

Categories	Specific examples
Resources	Identifying, organizing, planning, allocating time, allocating money, allocating materials and workers.
Interpersonal skills	Negotiating, exercising leadership, working with diversity, teaching new skills to others, serving clients and customers, participating as a team member.

Information skills	Using computers to process information, using computers to acquire information, using computers to evaluate information, using computers to interpret and organize information, using computers to maintain information, using computers to communicate information.
Systems skills	Understanding systems, monitoring system performance, correcting system performance, improving systems, designing systems.
Technology utilization skills	Selecting technology, applying technology, maintaining technology, and troubleshooting technology.

From: Whetzel, D. (1992). The Secretary of Labor's Commission on Achieving Necessary Skills. http://www.ed.gov/databases/ERIC_Digests/ed339749.html, page 1.

Education scholars Jonassen, Peck, and Wilson (1999) have said this about the role of schools in our society:

> While schools play a variety of important social, custodial, and organizational roles in communities, we assume that their primary obligation should be to help students to learn how to recognize and solve problems, comprehend new phenomena, construct mental models of those phenomena, and, given a new situation, set goals and regulate their own learning (learn how to learn). (p. 7)

The general perception among education scholars is that the 19th century factory-style education system emphasizing rote learning and memorization has not and cannot deliver on these obligations (Airasian and Walsh, 1997).

Educational paradigms most commonly used in the past and present are simply no longer meeting today's learners' needs. As a result, education is slowly shifting from the traditional teacher-centered approach where the teacher transmits knowledge to students as if they were empty vessels needing to be filled, to a more learner-centered approach where the teacher coaches or facilitates the student's construction of his or her own knowledge. As learners' needs change, educators must be flexible, capable, and willing to assume these different roles, including that of facilitator and collaborator (Bridwell, et. al., 1996). Educators must recognize that learners learn from each other and not only from the teacher and, in fact, *need* to learn how to learn collaboratively if they are to be successful in today's world.

Education Reform Through Constructivism

For centuries teachers have been trained to transmit their content knowledge and expertise to their students in a didactic and often de-contextualized manner. The role of teacher has traditionally been the authority figure that instructs or presents knowledge to the student. This transmitted knowledge reflects what the teacher knows and is based on the teacher's own experiences, education, textbooks, and other resources she or he has studied (Jonassen, Peck, and Wilson, 1999). Learners are considered to be mostly passive, retaining information primarily to pass a test for a grade, and are infrequently required to apply the information in meaningful, real-life situations. This approach to teaching and learning does not promote experiential learning and can inhibit meaningful understanding (Caine and Caine, 1991).

Constructivism

Constructivism offers an alternative learning paradigm to more traditional approaches. Cognitive science research and the education reform literature of the late 20th century about how learners learn strongly support it (Rose and Nicholl, 1997). Constructivism represents a definitive move away from a traditional behaviorist orientation to learning, which stresses observable changes in performance through a teacher-initiated stimulus-response approach. Alternatively, a cognitive/constructivist approach focuses on how the brain functions during learning (Rakes, et. al., 1999). Constructivists essentially believe that knowledge is *constructed* by the learner, not *instructed* by the teacher. They hold that teaching is not a process of transmitting knowledge from instructor to learner, but, rather, a process of helping learners to construct or create their own meaning by providing the learner with authentic learning experiences and guiding them through the meaning-making process. Learning theory has been said to be experiencing a revolution, and cognitive orientations such as constructivism, collaboration, cooperative learning, and feminist pedagogy, are being identified by many as meeting the needs of today's and tomorrow's learners (Riel and Harasim 1994, Carr, et. al., 1998).

Primary characteristics of constructivist learning, as described by Jonassen, Peck, and Wilson in their book *Learning with Technology* (1999), are as follows:

1. Learning is active. It requires learners to integrate new information and experiences with their existing knowledge bases and mental models to create their own knowledge, as opposed to passively receiving knowledge from the teacher.

2. Multiple perspectives are valued and necessary. In constructivism, learners are asked to develop their own views or knowledge in a particular domain. That view will likely be formed after examining perspectives presented by the teacher, other experts, and peers. In order to synthesize a personal viewpoint, a learner must consider multiple perspectives.

3. Learning is collaborative and cooperative as opposed to competitive. Constructivist learning is both collaborative and cooperative. Collaborative learning involves learners learning with and from each other, sharing ideas, and shaping beliefs. Cooperative learning involves collaborative learning toward a common end of making meaning together. This is contrasted with traditional approaches where learners independently compete with one another for grades or class standings given by the teacher.

4. Control and responsibility for learning in the hands of the learner. This represents a fundamental shift in classroom power dynamics from the teacher to the learner. The learner, who is active and collaborative, is likely to be more responsible for his or her learning than one who sits passively while the teacher lectures. In constructivism, the teacher adjusts her or his role from that of instructor to that of learning guide, facilitator, and coach.

5. Learning is authentic and real-world based. Knowledge that is taken out of context during instruction is not authentic and may not be meaningful to

learners. In traditional approaches, instruction is often simplified and consists of well-formed problems with definitive "right" answers. When learning is connected to real-world experiences, including complex and often ill-structured problems to solve, as constructivists suggest, learners can more easily re-apply what they have learned to new real-world situations.

Indicators of constructivist-compatible teaching practices. When characteristics of constructivism manifest themselves in the classroom, they can be observed as specific student behaviors and teaching practices. Ravitz, Becker, and Wong (2000) in their national survey funded by the National Science Foundation entitled "Constructivist-Compatible Beliefs and Practices Among U.S. Teachers," state that a teacher creates a constructivist learning environment when students are expected to:

1. identify their own issues and problems to be solved rather than having questions defined for them,

2. decide how to explore an issue or solve a problem rather than having these procedures defined by the teacher,

3. reflect further and make sense of what they have experienced, and

4. interact with peers by presenting their solutions, describing how solutions were reached, and receiving feedback.

Further, Ravitz, Becker, and Wong (2000) state that indicators of constructivist-compatible instructional practices can be grouped in the following categories:

1. Project-based learning. Particularly projects that involve tasks that require the learner's development of an understanding of important content.

2. Group work. Where students are interdependent on other students to accomplish a learning goal and discuss the work together.

3. Problem-solving. Tasks that require higher order thinking skills and may, in fact, be defined by the students.

4. Reflective thought. These activities include things like writing a reasoned argument to a given problem situation, self-monitoring of progress, and considering multiple valid perspectives.

More recent research completed by Becker and Riel (2000) suggests other, although related, sub-components of constructivist-compatible pedagogy. They include (1) an emphasis on cognitively challenging tasks as opposed to routine low-level exercises with examples such as reflective writing activities, teacher questions calling for deep thinking, problem-solving tasks, and organization of classroom time to promote meaning-making among students, and (2) an emphasis on active engagement in learning versus a more limited and passive role for students. Becker and Riel found that the "active learning" dimension of constructivist practice sub-divides into three empirically identifiable elements:

1. the use of student projects;

2. small group work; and

3. an *in*frequent use of direct instruction activities.

The two approaches to categorizing constructivist-compatible pedagogies cited above are in general agreement with each other and with other research in the literature review related to constructivism teaching and learning (Jonassen, Peck, and Wilson, 1999; Rakes, et. al., 1999; Wise, 1997).

Constructivism: Support for Development of Basic Skills and Competencies of the New Millennium

Education reform through constructivism supports the development of basic skills and competencies as identified by the SCANS report (Whetzel, 1992) in three primary ways:

1. preparing learners to be lifelong learners,
2. preparing learners who are proficient communicators, and
3. preparing learners who have higher order critical thinking skills.

Preparing learners to be lifelong learners. Those who are successful in the 21st century workplace will be effective lifelong learners, able to learn quickly and independently as new information and technology continue to develop rapidly. A constructivist approach supports lifelong learning by focusing on the learner actively learning, as opposed to passively being instructed by the teacher. Learning in a constructivist learning environment produces learners who are responsible for their own learning and take control over its direction and pace, setting their own personal and professional goals along the way. This is essential in a world where information is said to be doubling every two years (Scheidlinger,

1999) and technologies are evolving faster than they can be effectively implemented.

Preparing learners who are proficient communicators. In our country's increasingly racially, ethnically, and economically diverse communities, which in some cases through technology have expanded into global communities, multiple and complex perspectives are the norm. It is critical that tomorrow's learners and workforce collaborate with others to seek, integrate, and negotiate multiple perspectives when making decisions or solving problems. As stated earlier, constructivism supports the valuing and sharing of multiple perspectives. Constructivists believe that meaning is constructed by the learner out of new information when it is combined with the learner's previous experiences and perceptions, thus creating a perspective unique to the learner. Constructivists also believe that just as the physical world is shared by all of us, so is some of the meaning we make of it also shared (Jonassen, Peck, and Wilson, 1999). Constructivism encourages the sharing of perspectives with others in what is referred to as collaborative knowledge-building communities (Jonassen, Peck, and Wilson, 1999). As learners talk, write, listen, and negotiate within these communities, that discourse becomes yet another experience that impacts and influences each participant's understanding and meaning of knowledge. Since collaboration is an inherently social activity, the foundation of successful collaboration includes sound communication skills such as oral communication, written communication, listening, negotiation, teamwork, and leadership.

Preparing learners so that they possess higher order critical thinking skills. Twenty-first century learners and workers must be able to think critically and make meaning from rapidly expanding bodies of information and changing technology. This means that they must be able to apply new knowledge to real-world experience and critically evaluate, analyze and adapt as necessary. A constructivist approach helps develop critical thinking skills, which are generally agreed to include the evaluation of the worth, accuracy, or authenticity of various propositions, leading to a supportable decision or direction of action (Jones, 1996). Constructivism is based on the premise that for learning to be meaningful, it must be authentic and based on real-world scenarios that often include ill-structured learning problems as opposed to well-formed problems with pre-determined "correct" answers (Jonassen, Peck and Wilson, 1999). A constructivist approach to education requires learners to go well beyond memorizing and rote learning to higher order learning, such as comparison, application, synthesis, analysis, and problem solving to make meaning out of new information. For example, a constructivist approach to teaching students about the American Civil War might include having learners *compare* the causes and outcomes of the American Civil War with the causes of other countries' civil wars today, and then *predict* outcomes of those wars. To take this a step further, a constructivist might ask learners to identify potential causes of future civil wars and develop political strategies that might prevent them.

Supporting Constructivist Principles with Technology

Although at least two failed attempts to reform education this past century have centered on constructivism, reform may fare better in terms of implementation by combining it with current technology (Wise, 1997). There is some evidence, in fact, that the availability and use of technology may actually provide a tool that facilitates classroom teachers' use of constructivist approaches (Rakes, et. al., 1999). Rakes, et. al. (1999) reported that as the amount of technology available, the use of technology, and the teachers' and students' technology skill levels increased, so did the use of constructivist practices in the classroom. This apparent connection between technology and constructivism further increases the importance of technology funding and training in schools.

Constructivists believe that technologies should not be used to replace the teacher as provider of knowledge, but, rather, should be in *partnership* with the learner and the teacher in the learning process. Some tenets of constructivism regarding educational technologies are outlined by Jonassen, Peck, and Wilson (1999) below:

1. Technology is more than hardware. Technology can be more broadly defined to include designs, techniques, or methods that facilitate learning. Constructivists argue that technologies are any methods, activities, or environments that are active, constructive, intentional, authentic, and cooperative in nature and foster *meaningful* learning.

2. Technologies are not simply the conveyors of meaning. Technology should not prescribe or control all of the learners' actions. The constructivist argues that learners must create their own meaning.

3. Technologies should function as intellectual tools that allow learners to build more meaning and deeper understanding of their world. For example, visualization or simulation software can be used by learners to represent and simulate meaningful real-world problems and create a safe, controllable space for solving those problems.

4. Technologies should work in partnership with the learner, performing the part of the learning that it performs best. Computers are best at storing and recalling information and should be used in this way. Rather than learners being asked to memorize or "store" great amounts of information in their brains, they should be encouraged to use computers for that purpose so that they can focus on the part of learning that humans can best do, such as using the storage and retrieval functions of the computer to analyze relationships, solve problems, and create new perspectives.

Jonassen, Peck, and Wilson (1999) provide several ways that technology complements and supports constructivism:

1. The Internet. Technology, such as computers linked to the Internet, helps learners assume control over their learning—a fundamental tenet of constructivism. The Internet provides students access to information that once was only available to and controlled by the teacher. Through the use of the Internet, for example, students can explore and find information to solve a

problem, resolve an argument, or construct their own interpretation to a given situation, often without leaving their home or classroom.

2. Networked learning communities. Technology in the form of networked computers encourages a variety of different interactions among students and between students and teachers. Participating in a group project as a learning community where different participants are responsible for researching, reporting, critically reviewing the product and comparing it against the group's common learning goals, requires higher order collaboration like discussing, arguing, and group consensus building. Through networked learning communities, this process is made not only possible, but also fast and efficient.

3. Web-page development, video production, & semantic networks. Technology such as web page authoring software, video cameras, and semantic networks provide students with an opportunity to demonstrate or *construct* their understanding or make meaning of new knowledge. For example, after researching and analyzing a particular topic, a student, instead of writing a paper, might develop a web page linked to pertinent web sites that demonstrates his or her knowledge and understanding. Video production can also be an excellent way for students to demonstrate learning since developing video projects requires students to research, organize, visualize, and interpret information in an active, collaborative manner. Semantic networks, also called "mind maps", are excellent tools to help students make connections and determine relationships between different items and information. A semantic network or mind map is a visual map of concepts connected to each other via lines. These maps show the semantic

structure among different concepts within a particular domain (Jonassen, Peck, and Wilson, 1999). A mind map, therefore, provides an accurate representation of the meaning the student has constructed out of the information.

4. Hypermedia. Hypermedia, which is the marriage of multimedia and hypertext, is a presentation of ideas in text, video, and audio linked together in a web-like manner allowing non-linear, complex connections to be made by the learners. Research by Chuckran in 1992 as cited in Jonassen, Peck, and Wilson (1999) has shown that the use of a webbed hypertext design with multiple nodes to move between actually results in greater content acquisition than traditional linear approach to learning. Learners can use designer-developed hypermedia simulations or they can construct their own hypermedia simulations to solve complex learning problems.

5. Database and spreadsheet software. Software such as databases and spreadsheets, which have been mostly used as productivity software, can also facilitate higher order learning in a constructivist fashion. Jonassen, Peck, and Wilson (1999) refer to these computer applications as "mindtools" when they are used to develop or facilitate critical thinking and higher-order learning. Learners can use these applications to analyze phenomena and data, interpret and derive understanding based on their personal knowledge and present their analyses and findings to others. For example, a learner interested in identifying social and economic indicators of progress in different countries could create a database consisting of many fields of descriptive data such as population, gross national product, average income, literacy rate, infant mortality, TVs per person, and so

on. By using the database functions to sort and search these fields, the learner can determine relationships between some of these indicators and begin predicting which indicators might lead to others.

Although instructional technology and constructivism as a learning and teaching paradigm existed for several decades, they evolved to a point where their marriage is inevitable. In fact, a third attempt at education reform with constructivism has a greater chance of succeeding due to this essential marriage (Wise, 1997; Rakes, et. al., 1999).

Quality Indicators of Internet-Based Courses

Only recently has research become available that identifies benchmarks, or institutional behaviors that contribute to ensuring overall quality in Internet-based education (Phipps and Merisotis, 2000). Phipps and Merisotis divided the 24 benchmarks for success in Internet-based distance education courses into the following seven general categories:

1. Institutional support benchmarks.
2. Course development benchmarks.
3. Teaching/learning benchmarks.
4. Course structure benchmarks.
5. Student support benchmarks.
6. Faculty support benchmarks.
7. Evaluation and assessment benchmarks.

Of these 24 benchmarks, this author believes that only six benchmarks from the teaching/learning category address the issue of applying constructivist principles. They are as follows (Phipps and Merisotis, 2000):

Teaching/learning process benchmarks.

- Student interaction with faculty is facilitated through a variety of ways.
- Student interaction with other students is facilitated through a variety of ways.
- Each module/segment requires students to engage themselves in analysis, synthesis, and evaluation as part of their course assignments.
- Class voice-mail and/or e-mail systems are provided to encourage students to work with each other and their instructor(s).
- Courses are designed to require students to work in groups utilizing problem-solving activities in order to develop topic understanding.
- Course materials promote collaboration among students. (pg. 11)

Although these benchmarks are helpful as general guidelines to instructors and developers of Internet-based courses, they are insufficient support for those who genuinely wish to transform the education process through the use of constructivist principles and Internet-based technology. A need exists to identify additional and more specific indicators of the application of constructivist principles to the online learning environment and associated learning activities.

Delphi Survey Method

Internet-based education is a new and rapidly evolving approach to teaching and learning. As such, there is insufficient research available that identifies quality indicators of Internet-based courses, particularly as they relate to applying constructivist principles. The Delphi Survey Method was developed specifically for the purpose of forecasting and estimating unknown parameters in the absence of complete knowledge.

The purpose of the Delphi. Named after the Greek oracle at Delphi, to whom the Greeks visited for information about their future, the Delphi Method was created by Olaf Helmer and Norman Dalkey in 1953 at the RAND Corporation to address future military issues (Turoff and Stiltz, 1996). The Delphi Method recognizes human judgment as legitimate and useful in generating forecasts. However, the Delphi also takes into consideration that single experts sometimes suffer biases and group meetings can suffer from "follow the leader" tendencies and reluctance to abandon previously stated opinions. The Delphi Method was developed to overcome these shortcomings of individual and group judgment.

The Delphi process. The Delphi Survey Method is based on a structured process for collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback (Turoff and Stiltz, 1996). Turoff and Stiltz (1996) describe the Delphi Method as having four basic features: structured questioning, iteration, controlled feedback, and anonymity of responses. Structured questioning is achieved through the use of questionnaires. Questionnaires keep a clear focus on the study and enable the moderator to control the process and channel it into a compact product. Iteration is the process by which the questionnaire is presented over a number of rounds to enable participants to reconsider and refine their responses. Controlled feedback is achieved by feeding back to the panel members the responses of the whole group as well as their own response for their reconsideration. This means that all the responses of the panel are taken into account. Anonymity is achieved through the questionnaires ideally giving group members the freedom to express their opinions without feeling pressured by the wider group.

Clare (1994) describes a typical Delphi sequence as follows:

1. Develop the Delphi question or initial broad concern.
2. Select and contact recognized experts.
3. Develop questionnaire #1 and distribute it.
4. Analyze responses to questionnaire #1.
5. Develop questionnaire #2 and distribute it.
6. Analyze responses to questionnaire #2.
7. Repeat rounds as necessary.
8. Prepare final report and distribute to survey participants.

Using this basic approach, the Delphi Survey Method has been widely used to generate forecasts in technology, education, and other fields (Turoff and Stiltz, 1996).

Summary

Today's Information Age learners have different education needs from those of Industrial Age learners. The traditional emphasis on education through rote learning and memorization from the past century and a half is not adequately preparing today's learners, the citizens of the new millennium. Information Age workers need critical thinking skills, written and oral communication skills, and the ability to "learn how to learn." Learning opportunities are becoming more accessible through the use of Internet-based courses and trends point to a continued growth in distance education for the next several years. Tremendous opportunity awaits teachers, course developers, and education policy makers who embrace the need to reform education and augment or replace instructional approaches that emphasize lower level leaning and rote memorization with a higher order constructivist-based learning orientation delivered on the Internet. However, before this opportunity can be realized, a well-founded set of indicators that identifies constructivist principles in Internet-based must be developed; thus substantiating a need to collect and aggregate expert opinion regarding the identification and validation of such indicators.

CHAPTER 3

Methods

The research method selected for this study was a three-round Delphi Survey Method using email and a web page designed to request, collect, and submit all survey responses electronically.

Selection of Experts

By a review of literature and the "Who's who in instructional technology" website, the researcher identified 20 individuals from the U.S. who were experts in constructivist theory and instructional technology. The website (http://hagar.up.ac.za/catts/learner/m1g1/whointro.html) lists researchers who published articles about constructivism and instructional technology in the past five years. The researcher contacted each of these twenty individuals through email. The email message presented a brief explanation of the study, and asked the recipient to identify 10 of the top experts in the United States in the areas of constructivism and instructional technology. Self-nomination was accepted.

Of the 20 individuals contacted, seven responded and provided a total of 35 names (9 of whom received more than one "vote"). Of the 35 names, one was dropped because he did not have an email address and another was dropped because he was not from the United States. Two more names were dropped because the individuals indicated that although they would nominate themselves, they would not be able to participate in the actual survey. This resulted in a total of 31 distinct names of nominated experts.

Twenty of these 31 nominees were initially invited to participate in the web survey. These included the 9 experts who received more than one vote plus the first eleven that received only one vote in order of submission of the nomination, from earliest to latest.

Of the nine experts who received multiple nominations, one accepted the invitation to participate, one accepted but only if the researcher could wait until the next month to begin (which was not possible due to established time constraints), five rejected the invitation, and two did not respond. Of the other eleven experts, three accepted the invitation, 5 rejected it, and 3 did not respond.

The researcher sent out a second wave of emails to the remaining eleven experts on the list of nominees. One individual could not be contacted because a current email address was unavailable. Of the other 10 experts, one accepted the invitation, two rejected it, and seven experts did not respond. The researcher sent follow-up emails to the 12 experts from the first and second waves who did not respond to the invitation. This follow-up attempt yielded an additional three rejections, and there were nine individuals who did not respond.

This selection process resulted in 5 expert panelists who completed all the requirements of the study. Table 3 summarizes the panel selection results.

Table 3

Selection of Expert Panel

	Accepted	Rejected	N/R	Total
Experts w/multiple nominations	1	5	3	9

Experts w/single nomination	4	7	11	22

Procedures

The researcher conducted all survey rounds online. The experts completed the three rounds of surveying over a one-month period.

Round 1. In the first round of the web survey, the panel received a list of four general categories of indicators of constructivist-compatible instructional practices (see Appendix 1). This list, created by the researcher, was based on a review of over 25 related research articles and included four general categories that reflected the application of principles of constructivist learning theory. The purpose of providing these categories was to help organize the responses of the expert panel as well as to check their level of agreement with the current literature. The expert panel rated the importance of each category on a scale from 1 to 5 (with 1 being not important to 5 being very important), and listed 5 or more indicators of constructivist principles for each category. Indicators were defined for the panelists as statements that describe observable and measurable elements, methods, and procedures whose presence or absence indicates the use of constructivist principles in an Internet-based course. Panelists could add additional categories with at least five related indicators, if they felt it necessary to do so. They could also type general comments about the study in a comment box on the web survey.

The results from the first round were aggregated and reviewed by the researcher and another professional educator who was familiar with constructivist principles. The reviewer assisted the researcher in determining which, if any, items and/or new categories should be discarded as duplicates. The researcher and the reviewer first examined the indicators and new categories independently, noting any indicators and categories that appeared to be duplicates. They discussed each item identified as a possible duplicate and came to consensus about it. All items determined to be duplicates were discarded. The reviewer was not consulted in subsequent survey rounds.

Round 2. In Round 2, the web survey presented the categories from Round 1 with their mean ratings along with any new categories and associated indicators identified in Round 1. In Round 2, experts did not rate categories but only indicators. Round 2 of the web survey asked the panel to indicate their level of agreement with each item as an indicator of constructivist principles in Internet-based courses using a 5-point Likert Scale. Experts selected the numerical value (1 through 5) that best represented their level of agreement with the item as an indicator. A low score indicated a low level of agreement and a high score indicated a high level of agreement. The survey also asked the experts to provide any comments about the categories, indicators, and the study.

Round 3. In Round 3, the panel indicated their level of agreement with each item as an indicator. However, this time the panelists' rating from the prior round along with the response means and panel commentary (about each item) were made available, although anonymity was maintained. This approach allowed all participants to see how they responded in the previous round relative to the responses of other participants.

All participants submitted their web survey responses for each round to the website established for the study (see Appendix 2). The items rated with high levels of agreement (4 and higher) after the final round were considered indicators of constructivist principles in Internet-based courses that the expert panel thought to be important.

CHAPTER 4

Results

Five panelists who were experts in constructivist learning theory and instructional design completed the 3-round Delphi web survey. Over the three rounds, the survey yielded 110 unique indicators from 10 categories. Of these identified indicators, 40 received a mean rating of 4.0 or better in the final survey round. The researcher considered these items to be those of most importance to the panel. These indicators are listed in Appendix 3 by category and with their mean rating.

Findings from the Rounds

The panel rated three out of the four initial categories selected by the researcher as important. Table 4 presents the mean ratings for these categories.

Table 4

Ratings of Researcher-Identified Categories

Categories of Constructivist-Compatible Practices	Mean Rating
1. Project-based learning tasks	4.4
2. Collaborative and cooperative small group work	4.5
3. Tasks that require higher order cognitive skills	4.2
4. Infrequent use of direct instruction activities	3.0

The category of "Infrequent use of direct instruction activities" received the lowest mean rating and drew several comments from the panel. One panelist said, "Let me be clear: infrequent use of direct instruction is very important", while others responded, "I don't like the inclusion of 'frequency' of direct instruction as a criterion for considering a course constructivist. I think that certain categories of learning tasks (lower levels on the hierarchies) can and should be handled via direct instruction...I don't think that inclusion of direct instruction is a liability, but the absence of constructivist activity is" and "Constructivist learning assumes some building blocks are available for the learner to use! Mostly, those building blocks are a by-product of direct instruction." Despite the apparent disagreement with this category, it is interesting that the panel rated three of the indicators from this category with an average of 4.2 or better.

The panel identified seven additional categories of indicators, including two duplicate categories, which were collapsed into one by agreement of the researcher and reviewer. These new categories are listed in Table 5 along with a description, when provided by the experts.

Table 5

New Categories of Indicators Identified by Expert Panel

New Categories	Description
1. Tasks that are authentic, relevant, and meaningful	Students should engage in activities that are authentic or relevant to the

	practices of a real group or community. Students should get practice doing what real people do.
2. Safe environment	Students should be able to work within a safe, nurturing environment that encourages respect for diversity, risk-taking, and self-directed learning.
3. Tasks that allow learner choice and control	(no description provided)
4. Assessment of learning	(no description provided)
5. Interactivity	Students are engaged in active learning through interactive elements within the materials; discussion, interactive applets, generating new materials.
6. Requirement to "discover" relationships	(no description provided)

One of the new categories had only two indicators listed and another had only one indicator listed. One might question whether these items represent true categories and whether their respective indicators should instead be folded into another category. In fact, after further thought, one panelist who had suggested the new category of "Interactivity" with only two indicators, commented that he felt it should be folded into another new category. Although other panelists' responses indicated support and interest in the "Interactivity" category, no other items were generated in successive rounds for this or any other category.

From the 10 categories, the panel identified a total of 112 items. Together the researcher and the reviewer agreed that there were two sets of duplicate indicators and removed the two duplicates from the list to bring the total number of indicators to 110. The 110 indicators are listed in Appendix 4 by category along with the rating means from Rounds 2 and 3.

Many of the rating means for the indicators changed through the iterative process. The average rankings of the indicators and related comments for Rounds 2 and 3 are presented together in Appendix 4 for comparison purposes.

The five indicators that received the highest mean rating of importance were rated at 4.75 or higher. All five of these indicators' mean ratings improved a minimum of .15 from Rounds 2 to 3, suggesting that the panel was moving toward strong consensus on these items. A summary of these indicators is shown in Table 6.

Table 6

Indicators With Highest Mean Rating of Importance

Indicator	Mean Rating	Δ R-2 to R-3
1. Opportunities to revise or modify work.	5.0	+.5
2. Students construct, build, or enact something that is representative of an abstract theory or idea.	4.8	+.4
3. Students explore nontrivial problem areas and ask questions, debate ideas, make predictions, and draw conclusions while creating relevant artifacts.	4.8	+.2
4. Examples of collaborative and cooperative small group work would include: threaded discussions (internal); discussions with outside experts; synchronous chats, small-group exercises; projects and papers with multiple authors.	4.8	+.2

5. Projects are shared with peers during development and completion, thus supporting knowledge construction in social learning settings.	4.75	+.15

The five indicators that received the lowest mean rating of importance scored at a level of 2.2 or lower. Similar to the pattern of change seen between rounds with the highest rated indicators, all of these indicators' mean ratings moved downward toward low importance with the exception of one indicator whose mean rating remained the same from Round 2 to 3. A summary of these indicators is shown in Table 7.

Table 7

Indicators With Lowest Mean Rating of Importance

Indicator	Mean Rating	Δ R-2 to R-3
1. Students can actively listen to their teachers!	1.8	-.7
2. Knowledge gains are measured through tracking remediation needs, pathways, and assessments.	2.0	-.8
3. Students are not asked to answer comprehension questions about their text materials.	2.0	0.0
4. The "solution" works (solves the problem).	2.2	-.6
5. Projects meet or exceed rubric levels thus demonstrating students' involvement with the project.	2.2	-.6

General commentary included comments and questions about the definition of constructivism, disagreements and agreements with the selection of some categories, concern about how to write indicators, and concern about resultant indicators not being observable and measurable and not providing a tight conceptual framework. Panelists were encouraged to respond to the comments of others throughout the rounds but the researcher observed little interaction in this regard. It was not possible to tell if the limited number of comments was a result of the time constraints of the study (each round took about one week), a failure on the part of the researcher to facilitate and accommodate responses better through the web survey interface, or if the experts simply chose not to respond to others' comments.

CHAPTER 5

Discussion

The 40 indicators the expert panel strongly agreed upon could offer helpful guidance to educators interested in applying constructivist principles to Internet-based courses. However, the researcher concurs with one panelists who stated (see Appendix 5), "This isn't yet a tight conceptual framework. I hope the ratings help you formulate some promising points, which still need to be reduced down to a tighter set of principles and indicators." The remaining discussion identifies and addresses aspects of the findings that need "tightening." It presents general observations about the study and its results and draws implications for using the identified indicators for Internet-based course development. Finally, recommendations for further related research are discussed.

Unimportant or Too Small Categories

The categories of constructivist-compatible principles appear "loose". Panelists rated the importance of three of the four researcher-identified categories as 4.2 or higher. Although the six new categories generated by the panel were not formally rated during the study, comments about category were solicited each round. Each category included at least one statistically important indicator although some categories had many more than others.

One way to "tighten" the framework of the indicators would be to eliminate categories deemed unimportant by the expert panel and those comprised of only a single indicator. Displaced indicators would be incorporated into other closely related categories. Following this approach, the categories of "infrequent use of direct instruction," "allowed learner choice and control," "interactivity," and "requirement to discover relationships" would be eliminated leaving the remaining six categories. It is the opinion of the researcher that the most closely related category for the displaced indicators under "infrequent use of direct instruction" is the category of "authentic, relevant, and meaningful"; that the displaced indicator from the "tasks that allow learner control choice" category also be placed in the category of "authentic, relevant, and meaningful"; that the displaced indicator under "interactivity" be moved to "collaborative and cooperative small group work"; and that the displaced indicator from "requirement to discover relationships" be moved to "assessment of learning." These adjustments are summarized in Table 8. It is important to mention that this redistribution of indicators to other categories must be validated by additional research.

Table 8

Important Indicators per Category: Before and After Adjustment

Categories of constructivist-compatible principles	Indicators	
	Before	After
1. Project-based learning	6	6
2. Collaborative/cooperative small group work	5	6
3. Higher order cognitive skills	11	11
4. Infrequent use of direct instruction	3	0
5. Authentic, relevant, and meaningful	4	8
6. Safe environment	4	4

7. Allow learner choice and control	1	0
8. Assessment of learning	4	5
9. Interactivity	1	0
10. Requirement to "discover" relationships	1	0

Many Indicators Not Observable or Measurable

In the opinion of the researcher (and several panelists, as indicated by their comments), many indicators were not written as true indicators; e.g., observable and measurable elements, methods, or procedures. This is another aspect of the findings that needs "tightening". Two logical approaches to resolving this problem would be to either remove the items generated by the expert panel that don't conform to the given definition of an indicator, or edit them so that they are observable and measurable. Since these 40 indicators received such strong agreement by all panelists, it would be the recommendation of the researcher to edit them so that they are observable and measurable rather than removing them from the list. However, after such an editing process, it would be necessary to subject the indicators to further rounds of review by the expert panel to ensure that they remain in agreement about their importance.

Despite this seemingly "loose" interpretation of an indicator, it is the researcher's opinion that these indicators still provide a clear and helpful framework for online course developers and educators interested in applying constructivist principles. In fact, it may not be advisable or even possible to edit some of these indicators to be *both* observable and measurable terms without losing or distorting their core idea and intent.

Limitations With Delphi Web Survey

The process of using a Delphi web survey presented some unanticipated limitations to the development of the indicators. The Delphi survey is well suited for identifying and rating items in an effort to develop consensus, but doesn't typically allow for the revision or refinement of the original items through editing. This presented a problem in this study when the panel supported the indicator, but the indicator itself wasn't observable and measurable as written.

Also, despite the efficiency of a Delphi web survey, the researcher had difficulty getting individuals to nominate persons to the expert panel (which required a simple and quick electronic response) or to serve on the panel (which required a 4-week commitment). The response rate of the individuals requested to nominate others (7 out of 20) as well as the acceptance rate of the experts invited to participate on the panel (5 out of 35) was low. Of those experts who rejected the invitation to participate, most indicated that they did not have the time to participate in the study and a few indicated that they had just completed a Delphi web survey (and weren't ready or eager to enter into another one). It is possible that experts are inundated with requests for their time and expertise due to accessibility fledgling (and full-fledged) researchers have to them through the Internet. With this in mind, the researcher felt quite fortunate to have 5 participants of prominent national recognition complete all three rounds of this study, although the intention of the study was to have an expert panel of 10.

Indicators for Internet-Based Not Much Different Than for Traditional Courses

Indicators identified in this study appear to have few distinguishing features that set them apart from indicators of constructivist principles discussed in the literature for traditional face-to-face courses (Becker and Riel, 2000, Ravitz, Becker, and Wong, 2000). Only occasional references to things like "threaded discussions" or "saved (archived) chats" were different for the indicators related to Internet-based courses. This observation is actually consistent with other recent research that compared the effectiveness of Internet-based courses to traditional face-to-face courses and found "no significant difference" (Phipps and Merisotis, 1999). It would seem that, similar to this comparative research, it is the approach or pedagogy that is far more important than the technology used to deliver it. However, Perkins (1992) warns of a common fallacy of looking for a "silver bullet" method or pedagogy. He believes that *what* we teach is more important than *how* we teach—suggesting that learning goals of the curriculum are the most important factor in determining quality or effectiveness of instruction. The selection of a teaching method, then, should be closely tied to these learning goals.

Implications for Developing Internet-Based Courses

The results of this study provide some implications for consideration in online course development and instruction.

1. One size (of learning model) does not fit all. As evidenced by the panelists' comments about the appropriateness of direct instruction under certain circumstances, constructivism is not always the right or best choice of learning model. This is especially true when learners need core knowledge on which they will build a more in-depth understanding later. Educators should take care to not simply "apply" constructivist principles without first considering what the learning objectives are and what method will best accomplish those objectives.
2. The six categories and their related indicators of constructivist principles provide a helpful framework for course development. When using constructivist principles is appropriate for accomplishing specific learning objectives, educators may be guided by these six categories with their composite 40 indicators (see Appendix 6).
3. Indicators of constructivist principles transcend technology. From the results of this study, it appears that the indicators of constructivist principles applicable in a traditional classroom can also be used with Internet-based courses. There may be some necessary technological adaptations, but the basic indicators remain the same.

Recommendations for Further Study

Research in assessment and evaluation, particularly as it relates to determining the relationship between Internet-based and face-to-face courses developed on constructivist principles, and students' attainment of the essential workplace competencies outlined in Table 2 is important. Transforming education so that it meets the needs of today's Information Age learner will be achieved once educators consistently teach in manner that applies constructivist principles and learners can demonstrate the attainment of essential competencies as a result of the transformed teaching and learning.

A second area of research pertains to exploring the role of the researcher/facilitator in online Delphi survey research process. Increasingly researchers are using the web to conduct surveys and so more must be understood about the role of the researcher in facilitating and accommodating responses and dialogue through a web survey interface. It would be important to understand the point at which the researcher's facilitation or moderation of dialogue (specifically for the Delphi survey) fosters or interferes with the survey process.

REFERENCES

Airasian, P.W., and Walsh, M.E. (1997). Constructivist cautions. Phi Delta Kappan, 79, 444-449.

Becker, H.J., and Riel, M. (2000, December). Teacher Professional Engagement and Constructivist-Compatible Computer Use [Online]. Available: http://www.crito.uci.edu/tlc/findings/report_7/startpage.html.

Bloom, B., ed. (1956). Taxonomy of Educational Objectives: Handbook I: Cognitive Domain. New York: David McKay Co.

Bridwell, C., Bretz, R., DeVries, H., King, J. and White, B. (1996) Instructional Design for Distance Education. In: Communicator's Handbook: Tools, Techniques and Technology (Third Edition). Gainsville, FL: Maupin House Publishers, Inc.

Caine, R.N., and Caine, G. (1991). Making Connections: Teaching and the Human Brain. Alexandria, VA: Association for Supervision and Curriculum Development.

Carr, A. A., Jonassen, D. H., Litzinger, M. E. and Marra, R. M. (1998). Good Ideas to Foment Educational Revolution: The Role of Systemic Change in Advancing Situated Learning, Constructivism, and Feminist Pedagogy. Educational Technology, 38(1), 5-15.

Clare, M. (1994, January). Adapted from Working with Our Publics, Module 7 [On-line]. Available: http://www.cce.cornell.edu/admin/program/documents/delphi.cfm.

Ehrmann, S. C. (1999, Sept). Technology's Grand Challenges. Academe: Bulletin of the American Association of University Professors, 42-46.

The Institute for Higher Education Policy (1999). Distance Education in Higher Education. Prepared for the Council for Higher Education Accreditation [On-line]. Available: http://www.chea.org/Commentary/distance-learning-2.cfm/.

Jonassen, D. H., Peck, K. L., and Wilson, B. G. (1999). Learning With Technology. Columbus, OH: Prentice Hall.

Jones, D. (1996). Critical Thinking In An Online World. Untangling the Web [On-line]. Available: http://www.library.ucsb.edu/untangle/jones.html.

National Center for Education Statistics (1999). The Condition of Education: 1999, Education Statistics Quarterly, 1(3), 84-89.

Perkins, D.N. (1992). Smart schools: From training memories to educating minds. New York, NY: Free Press.

Phipps, R. A. and Merisotis, J. P. (1999). What's the Difference? A Review of Contemporary Research On the Effectiveness of Distance Learning In Higher Education. Washington, D.C.: American Federation of Teachers and National Education Association.

Phipps, R. A., Wellman, J.V., and Merisotis, J. P. (1998). Assuring Quality in Distance Learning: A Preliminary Review. Washington, D.C.: Council for Higher Education Accreditation.

Phipps, R. A. and Merisotis, J. P. (2000). Quality On the Line: Benchmarks For Success In Internet-based Distance Education. Washington, D.C.: The Institute for Higher Education Policy.

Ravitz, J. L., Becker, H. J., and Wong, Y. (2000, July). Constructivist-compatible Beliefs and Practices Among U.S. Teachers [On-line]. Available: http://www.crito.uci.edu/TLC/FINDINGS/REPORT4/startpage.html.

Rakes, G. C., Flowers, B. F., Casey, H. B., and Santana, R. (1999). An Analysis of Instructional Technology Use and Constructivist Behaviors in K-12 Teachers. International Journal of Educational Technology [On-line], 1(2). Available: http://www.outreach.uiuc.edu/ijet/v1n2/rakes/index.html.

Riel, M. and Harasim, L. (1994). Research Perspectives on Network Learning. Machine-Mediated Learning, 4(2&3), 91-113.

Rose, C. and Nicholl, M.J. (1997). Accelerated Learning For The 21st Century. New York, NY: Bantam Doubleday Publishing Group, Inc.

Sherron, G.T. and Boettcher, J.V. (1997). Distance Learning: The Shift to Interactivity [On-line]. Available: http://www.educause.edu/ir/library/pdf/pub3017.pdf.

Scheidlinger, Z. (1999). Education Calls For a New Philosophy. Educational Technology & Society [On-line], 2(3). Available: http://ifets.ieee.org/periodical/issues.html.

Turoff, M. and Hiltz, S.R. (1996). Computer Based Delphi Processes [On-line]. Available: http://eies.njit.edu/~turoff/Papers/delphi3.html.

Whetzel, D. (1992). The Secretary of Labor's Commission on Achieving Necessary Skills [On-line]. Available: http://www.ed.gov/databases/ERIC_Digests/ed339749.html.

Wise, A.E. (1997). Technology and the New Professional Teacher: Preparing for the 21st Century Classroom [On-line]. Available: http://www.ncate.org/accred/projects/tech/tech-21.htm/.

APPENDIX 1

Categories of Constructivist-Compatible Instructional Practices From Literature Review

Tasks that Require Higher Order Cognitive Skills. Tasks that require higher order thinking skills and may, in fact, be defined by the students. Examples of indicators in this category include problem-solving tasks, activities that require reflective thought, and teacher questions calling for deep thinking involving analysis, synthesis, and evaluation (Bloom, 1956).

Project-based learning tasks. Particularly real-world or authentic projects that involve tasks requiring the learner's development of an understanding of important content.

Collaborative and cooperative small group work. Where students are interdependent on other students to accomplish a learning goal and discuss the work together.

Infrequent use of direct instruction activities. Infrequent use of activities that result in mostly passive learning where the student is instructed by the teacher as opposed to being actively involved in constructing his or her own knowledge. Examples of direct instruction activities include lecture, well-defined problems, recitation, and recall.

APPENDIX 2

Web Page for Delphi Web Survey

Indicators of Constructivist Principles in Internet-based Courses

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Purpose of Study: The growth in higher education course delivery over the Internet in the past five years in the United States has been explosive and exponential. Primary reasons behind this growth include:

- the growth and convergence of telecommunications technologies and computing technologies,
- changing student demographics due to Information Age workers needing to become life-long learners,
- the need to reduce the cost of education, and
- greatly increased competition for student "market share" from for-profit education providers.

This rapid increase in the availability of Internet-based courses has far outpaced policy development as it relates to ensuring the quality of the courses' development, structure, and delivery. A growing body of literature favors constructivist learning theory as a basis for reforming education, whether it be delivered online or face-to-face. However, many educators and other Internet-based course developers are currently left to develop courses without clear direction or indicators of constructivist principles applied to Internet-based course development, structure, or delivery.

Therefore, the purpose of this study is to assist educators and other course developers in providing greater assurance of quality and education reform in Internet-based courses by identifying indicators that reflect the application of principles of constructivist learning theory to the development, structure, and delivery of Internet-based courses.

For the purpose of this study, Internet-based courses refer to courses that use the Internet in a time-independent manner as their primary means of instructional delivery to off-campus students, and indicators refer to observable and measurable elements, methods, and procedures.

The following list of items provides you with links to all additional information about the study and to Round 1 of the survey.

Study Methods

About the Researcher

Go to Round 1

Go to Round 2

Go to Round 3

Study Methods: The study will use a Delphi Web survey with a panel of experts in the area of instructional technology and constructivism. The Delphi research method seeks to reach consensus of participant opinion through three rounds of questioning.

Selection of Expert Panel: The researcher compiled a list of 20 experts in instructional technology and constructivism from the review of related research literature and the Who's Who in Instructional Technology Web site. The researcher asked these individuals to identify who they believe to be the top 10 experts in the United States in the combined area of constructivism and instructional technology. Self-nominations were accepted. The resulting nominees were ranked by frequency of nominations. The researcher then contacted those nominees who received the most nominations, explained the research project, and request their participation in the study. The first 10 nominees who agree to participate in the study will comprise the expert panel, with the 11th nominee to accept serving as the alternate.

Round 1: In the first round of the electronic Web survey, the panel will be presented with a list of categories of indicators of constructivist-compatible instructional practices gleaned from the researcher's review of literature. These categories are:

- Tasks that require higher order cognitive skills. Tasks that require higher order thinking skills such as problem-solving tasks, activities that require reflective thought, and teacher questions that call for deep thinking involving analysis, synthesis, and/or evaluation.
- Project-based learning tasks. Particularly real-world or authentic projects that involve tasks requiring the learner's development of an understanding of important content.

- Collaborative and cooperative small group work. Where students are interdependent on other students to accomplish a learning goal and discuss the work together.

- Infrequent use of direct instruction activities. Infrequent use of activities that result in mostly passive learning where the student is instructed by the teacher as opposed to being actively involved in constructing his or her own knowledge. Examples of direct instruction activities include lecture, well-defined problems, recitation, and recall.

The expert panel will be asked to list 5 or more indicators under each category. They will also be invited to add additional categories with related indicators as they deem necessary as well as any comments they might have. Each indicator will be a statement that describes observable and measurable elements, methods, and procedures whose presence or absence indicates the use of constructivist principles in an Internet-based course.

Round 2: The results from the first round will distributed in the Round 2 electronic Web survey, which will ask the expert panel to indicate their level of agreement with each item as an indicator of constructivist principles in Internet-based courses using a 5-point Likert Scale. The experts will also be asked to provide any comments they may have on each item.

Round 3: The panel will again be asked to indicate their level of agreement with each item as an indicator. This time the response frequencies, means, and comments (of each item) of the other experts on the panel will be made available, although anonymity will be maintained.

All participants will submit their electronic Web survey responses anonymously for each round to the Web site established for the study. The items rated with high levels of agreement (4 and higher) after the final round will represent validated indicators of constructivist principles in Internet-based courses.

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APPENDIX 3

Indicators of Constructivist Principles in Internet-Based Courses Identified as Important by Expert Panel

Category	**Indicators identified by expert panel**	**Mean**
1. Project-based learning	1) Examples of project-based learning tasks would include: design and development projects; research and evaluation projects; analysis and critique projects; scenario and case responses; knowledge-base development projects.	4.4
	2) Students are given some general guidelines as to possible projects to complete, but they decide what is relevant and meaningful to them.	4.4
	3) Project "assignments" are purposefully under-designed to allow a large degree of flexibility in interpretation which is in keeping with the construction of new knowledge.	4.6
	5) Students explore nontrivial problem areas and ask questions, debate ideas, make predictions, and draw conclusions while creating relevant artifacts.	4.8
	6) Projects are authentic (takes place in a real world setting with real world participants).	4.4
	15) Projects are shared with peers during development and completion, thus supporting knowledge construction in social learning settings.	4.75
2. Collab & coop small group work	1) Examples of collaborative and cooperative small group work would include: threaded discussions (internal); discussions with outside experts; synchronous chats; small-group exercises; projects and papers with multiple authors.	4.8
	2) There is negotiation and consensus building in online discussion forums.	4.4
	6) Teams post progress reports and react to the progress reports or final products of other teams.	4.0
	11) Individuals have an opportunity to provide feedback to each other on the quality and progress of their work in the collaboration during the collaboration.	4.0
	22) Conversations among students are rated as important to the learning process by students in a post-activity survey and/or interview.	4.0
3. Higher order cognitive skills	1) Sample types of tasks or methods include: reflective journal entries; threaded discussions; rationales and reflections on projects; projects requiring high levels of self-directed work and organization; evaluation of others' work.	4.8

	2) Students exhibit creative uses of knowledge.	4.5
	3) Students critically evaluate own (and others') work.	4.4
	6) Students analyze online case situations and react to the posts of their peers' case solutions.	4.0
	8) Students demonstrate adaptation of theory to local situations and problems.	4.0
	9) Students participate in "what if" discussions that require them to extrapolate from ideas to real world application.	4.6
	13) Students construct, build, or enact something that is representative of an abstract theory or idea.	4.8
	14) Students revisit work to improve or modify their effort.	4.4
	15) Students describe their work or their perspective/beliefs in terms of theoretical or abstract ideas from course work.	4.4
	16) Students participate in teaching or mentoring others on the subject.	4.6
	23) Multiple alternatives are proposed and considered.	4.4
4. Infrequent use of direct instruction	5) Special guests are brought in to discuss an emerging field or hot topic and their online chats are saved and posted to the web.	4.0
	9) Student-initiated threads/topics predominate.	4.4
	11) There is evidence of responsiveness to students in syllabus modification.	4.0
5. Authentic, relevant, and meaningful	1) Example methods of authentic practices include: making or building things; analyzing problems; designing solutions; trying out solutions; testing and evaluating solutions.	4.6
	2) Reported or perceived relevance/utility of the tasks.	4.6
	3) Rationale connecting learning task to a worthwhile practice.	4.4
	7) Assessments are performance-based or related to real work settings.	4.4
6. Safe environment	2) Students are involved in the creation and enforcement of these rules.	4.4
	3) Instructors avoid public humiliation or unneeded social comparison of students.	4.6
	4) High levels of trust and support (which in turn will allow greater levels of public criticism) are maintained.	4.6
	5) Open channels of communication are maintained.	4.4
7. Learner choice and control	2) Students can decide which groups or projects they want to join.	4.0

8. Assessment of learning	1) Shared rubrics, created jointly by students and instructors.	4.0
	2) Opportunities to revise or modify work.	5.0
	3) Communication of the high value placed on student participation.	4.4
	4) Communication of the high value placed on the quality of the learning process in collaborative project work, not just on its outcome.	4.6
9. Interactivity	2) Students actively engage in peer-to-peer discussion and sharing.	4.6
10. Requirement to "discover" relationships	1) Expectation that students may (will?) develop understandings that differ from what the teacher(s) had anticipated.	4.0

APPENDIX 4

110 Panel-Identified Indicators, Rating Means, and Comments
From 3-Round Survey

Category	Indicators identified by expert panel	Mean R-2	Mean R-3
1. Project-based learning	1) Examples of project-based learning tasks would include: design and development projects; research and evaluation projects; analysis and critique projects; scenario and case responses; knowledge-base development projects.	4.2	4.4
	2) Students are given some general guidelines as to possible projects to complete, but they decide what is relevant and meaningful to them.	4.0	4.4
	3) Project "assignments" are purposefully under-designed to allow a large degree of flexibility in interpretation which is in keeping with the construction of new knowledge.	4.4	4.6
	4) Learners choose interdisciplinary or theme-based projects to complete and tasks are subdivided to the participants based on interest and motivation while the learner is a co-learner and potential collaborator in the process.	3.0	2.8
	5) Students explore nontrivial problem areas and ask questions, debate ideas, make predictions, and draw conclusions while creating relevant artifacts.	4.6	4.8
	6) Projects are authentic (takes place in a real world setting with real world participants).	4.4	4.4
	7) Rubrics are developed and available to the students prior to starting the project.	3.2	3.4
	8) Student work is held up on display for peers, experts, and consultants to browse through and offer feedback.	4.0	3.6
	9) Student discusses project using ideas and language from course.	3.6	3.6
	10) Student formally reports on activity regularly throughout the duration of the project.	3.4	3.6
	11) Student formally reflects on project process at regular intervals throughout the duration of the project.	3.4	3.6
	12) Data, even as simple as realia, are collected during the project and referenced in reporting and reflecting activity mentioned above.	2.8	2.6
	13) Projects meet or exceed rubric levels thus demonstrating students' involvement with the project.	2.8	2.2

	14) Small group work of students results in a final product that is posted to the web or presented in an online panel presentation.	3.8	3.4
	15) Projects are shared with peers during development and completion, thus supporting knowledge construction in social learning settings.	4.6	4.75
	16) Final product or outcome is evaluated for its: originality, depth, substance, clarity, reasoning, structure, adherence to defined structure and style requirements.	3.2	3.2
	17) The project process is evaluated for its: use of information resources, explicit rationale and support, fulfilling stated objectives, growth or progression from start to finish, and link to class objectives.	3.8	3.6
	18) Students' questions demonstrate a struggle to understand.	3.4	3.6
	19) Student-to-student communications reveal attempts to reason.	3.4	3.6
	20) The time needed to complete the project/problem reveals that no existing solutions were simply applied (the problem was really a problem.)	2.6	2.6
	21) The "solution" works (solves the problem).	2.8	2.2
	22) Students can explain why the solution works.	3.4	3.2
Comments from R-2	Perhaps I misunderstood the assignment. In my opinion, most of the indicators listed were not "observable and measurable elements, methods, and procedures." On numbers 21 and 22...I don't think the solution needs to 'work' to be a profound learning experience for the student. In fact, student work often DOESN'T work, and it is in the revision that the true understanding occurs.		
Comments from R-3	On numbers 10-12, I'm clearing an outlier. Here's my thinking…it's online, it's at a distance. Students need to have contact with peers and the instructor as they work through their constructivist project. Posting work-in-progress seems like a good idea.		
6. Collab. & coop. small group work	1) Examples of collaborative and cooperative small group work would include: threaded discussions (internal); discussions with outside experts; synchronous chats; small-group exercises; projects and papers with multiple authors.	4.6	4.8
	2) There is negotiation and consensus building in online discussion forums.	4.2	4.4
	3) Using online mentoring and tutoring, the online	3.2	3.4

	class fosters a sense that anyone can be brought in any day to help students understand concepts or work on projects.		
	4) Students subdivide work based on expertise and interest.	3.0	3.2
	5) Feedback on weekly work is offered through email pals or critical friends activities which might be structured or semi-structured.	3.2	3.4
	6) Teams post progress reports and react to the progress reports or final products of other teams.	4.2	4.0
	7) Evidence of students responding to feedback or work by other students (e.g., direct reference to others).	3.8	3.8
	8) Group members meet with faculty member, as a group, at least once during the collaboration.	3.0	3.0
	9) Group produces a "paper trail" that makes it possible to track who did what, including e-discussions, drafts, and other tasks or sharing.	3.4	3.6
	10) Groups may also elect to meet face-to-face or over phone lines. Such meetings are documented in group reports.	3.2	3.4
	11) Individuals have an opportunity to provide feedback to each other on the quality and progress of their work in the collaboration DURING THE COLLABORATION.	3.6	4.0
	12) Individuals have an opportunity to provide feedback to each other on the quality and progress of their work in the collaboration AFTER THE COLLABORATION.	3.6	3.6
	13) Group work is evaluated on sound cooperative learning principles based on observations, peer reports, and individual accountability.	3.6	3.6
	14) Evaluation includes audit or record of e-participation.	3.0	2.6
	15) Evaluation includes peer ratings and comments.	3.2	2.6
	16) Evaluation includes instructor ratings of participation quality.	3.0	3.2
	17) Evaluation includes holistic ratings of resulting products.	3.6	3.6
	18) Evaluation includes analytic or feature-specific ratings or products.	3.2	3.6
	19) Evaluation includes reported "sense of community" by group members.	3.2	3.6
	20) Conversations among students are relevant to the task at hand.	3.0	3.4
	21) Conversations among students reveal ideas	3.8	3.6

	contributed by several group members, rather than a single individual.		
	22) Conversations among students are rated as important to the learning process by students in a post-activity survey and/or interview.	3.8	4.0
	23) Students who do not participate in group activities do not perform as well in assessments of learning.	3.0	3.0
	24) Learning appears to be fun at times.	3.4	3.4
Comments from R-2	I think #23 is critical but I also think it's darned hard to guarantee. I am not sure why #23 and #24 are considered as indicators.		
Comments from R-3	Good heavens, these are hard to observe, but... I'm curious about my distance from the pack on item #23. I'm thinking, if this is a group activity we're talking about in section 2, then gosh, wouldn't lack of participation HAVE to result in lower valuation?		
3. Higher order cognitive skills	1) Sample types of tasks or methods include: reflective journal entries; threaded discussions; rationales and reflections on projects; projects requiring high levels of self-directed work and organization; evaluation of others' work.	4.2	4.8
	2) Students exhibit creative uses of knowledge.	4.4	4.5
	3) Students critically evaluate own (and others') work.	4.6	4.4
	4) Students critique literature and theory.	3.8	3.8
	5) Students analyze or critique the readings for the week in an online discussion forum.	3.6	3.6
	6) Students analyze online case situations and react to the posts of their peers' case solutions.	4.2	4.0
	7) Students demonstrate awareness of limitations and appropriate use of rules and principles.	3.8	3.0
	8) Students demonstrate adaptation of theory to local situations and problems.	4.2	4.0
	9) Students participate in "what if" discussions that require them to extrapolate from ideas to real world application.	4.2	4.6
	10) Students summarize or weave discussion for the week, while pointing out ideas or concepts misunderstood or ignored.	3.4	3.2
	11) Students create a visual representation of the flow of online discussion for a week or a span of weeks within a course.	2.8	2.8
	12) Students link a discussion topic, problem, or case to a visual representation on the web.	3.4	2.8
	13) Students construct, build, or enact something that	4.4	4.8

	is representative of an abstract theory or idea.		
	14) Students revisit work to improve or modify their effort.	4.2	4.4
	15) Students describe their work or their perspective/beliefs in terms of theoretical or abstract ideas from course work.	4.2	4.4
	16) Students participate in teaching or mentoring others on the subject.	4.2	4.6
	17) Students develop new understanding by designing projects or writing papers that demonstrate new knowledge gains in action.	3.8	4.0
	18) Students elect to engage in increasingly difficult interaction with the Internet as a learning environment (may contact authors, artists, other students, etc.) as a means of furthering their understanding beyond the requirements of the course.	3.4	3.8
	19) Students spend time breaking the problem down (analysis).	3.4	3.4
	20) Students express and use relevant information not provided in the problem statement (synthesis).	3.8	3.6
	21) Students consider and then discard unproductive proposals (evaluation).	3.4	3.4
	22) The "solutions" solve the complex problem.	3.0	3.6
	23) Multiple alternatives are proposed and considered.	4.4	4.4
Comments from R-2	My answers may reflect my belief that I am not transmitting information that has "right" and "wrong" applications and interpretations. I don't get #18. It seems irrelevant. You can study a simple diagram on a web page and be operating at a "higher cognitive" level than if you've participated in an online discussion with a stranger. One thing we didn't (any of us) mention that might be relevant to #18 is the sophistication that the student does or doesn't display in assessing the quality of information culled from the web.		
4. Infrequent use of direct instruction	1) Instructor adds concept-related comments at the end of an online discussion for the week when he or she notices that students forgot or ignored a key issue or idea.	3.8	3.6
	2) Instructor links discussion to an online glossary, experiment, simulation, or visual representation while perhaps cataloguing online resources and videos by concept or theme.	3.2	2.8
	3) Instructor provides a list of 4-5 key web sites that have useful information related to class for that week.	3.6	3.2

	4) Instructor reviews student self-test scores and notices that students are not grasping a key concept and offers to have a live chat on the topic or asynchronous discussion.	3.8	3.2
	5) Special guests are brought in to discuss an emerging field or hot topic and their online chats are saved and posted to the web.	4.2	4.0
	6) Students can actively listen to their teachers!	2.5	1.8
	7) Students are not asked to answer comprehension questions about their text materials.	2.0	2.0
	8) Instructor talk takes up less than 25% of the synchronous chat or asynchronous discussion threads.	3.8	3.6
	9) Student-initiated threads/topics predominate.	4.4	4.4
	10) Syllabus is presented as a negotiable or dynamic planning tool.	3.8	3.8
	11) There is evidence of responsiveness to students in syllabus modification.	4.2	4.0
	12) Direct instruction is used as foundation building information. Testing/practice with this information is critical to knowledge construction.	2.6	2.8
	13) Analysis of how time is spent reveals little time is engaged in structured instruction.	3.6	2.8
	14) Analysis of how time is spent reveals students engaged in autonomous activities.	3.6	3.6
Comments from Round 2	I just find this category horribly confusing. It's a case of double negatives in some instances. Also, what does it mean for #6 to be a characteristic or indicator of direct instruction? That doesn't make sense to me.		
Comments from Round 3	I agree with the earlier comment... This is a very confusing category. If the category is "infrequent use of," how do we rate a statement that involves direct instruction? I'd consider abandoning this category.		
6. Authentic, relevant,& meaning-ful	1) Example methods of authentic practices include: making or building things; analyzing problems; designing solutions; trying out solutions; testing and evaluating solutions.	4.6	4.6
	2) Reported or perceived relevance/utility of the tasks.	4.4	4.6
	3) Rationale connecting learning task to a worthwhile practice.	4.2	4.4
	4) Online discussions relate student field observations to weekly class readings.	3.2	3.4
	5) Students decide on online guest experts based on interest areas and current events.	3.0	3.0
	6) Online expert practitioners offer feedback on student work.	3.6	3.2

	7) Assessments are performance-based or related to real work settings.	4.6	4.4
Comments from R-2	The problem with #6 is that the guest hasn't been in the game that long. There will be things s/he just doesn't get. I'd hate to make a guest speaker do all that back up work to provide feedback to every student. It's also why we like to rely on "critical friends" from the workplace to provide feedback to the student-worker.		
Comments from R-3	Hmmm, okay, on #4 I'm thinking that's sort of the whole point: relating theory to practice. If you don't have students doing something in the real world then you just get static, book-learning. And, if you rely too heavily on experience, you get cult-like		
6. Safe environment	1) Rules and norms for appropriate behavior are set.	3.5	3.4
	2) Students are involved in the creation and enforcement of these rules.	4.0	4.4
	3) Instructors avoid public humiliation or unneeded social comparison of students.	4.5	4.6
	4) High levels of trust and support (which in turn will allow greater levels of public criticism) are maintained	4.5	4.6
	5) Open channels of communication are maintained.	4.25	4.4
Comments from R-2	The thing with #1 is that those norms evolve out of the interaction. The instructor, or more likely the program culture or dept culture, offers some initial boundaries. This is more of a given for any classroom, is it not? How is this related only to constructivist environments?		
Comments from R-3	I think #1 depends on who's doing the setting.		
7. Allow learner choice and control	1) Students are given 2 to 3 tasks each week to pick from that might reflect different learning preferences or modalities.	2.8	2.6
	2) Students can decide which groups or projects they want to join.	3.8	4.0
	3) Students have general guidelines on when, where, and how much to post but they can make the ultimate decisions.	3.2	3.8
	4) Students choose which of the many discussion topics, online debates, or readings to react to online.	3.2	3.6

	5) Since it is an online class, students can work during typical holidays, vacations, or breaks (i.e., spring break) and take the equivalent time off when and where they want.	3.2	2.8
	6) Materials provide individualized pathways through learning objects, lessons or other print-based materials. Level of learner control needed is measured through tracking paths through materials.	3.0	2.6
	7) Knowledge gains are measured through tracking remediation needs, pathways, and assessments.	2.8	2.0
Comments from R-2	Well, this category separates us by curriculum. My students aren't working through a "curriculum" in the classic K-12 sense of that (i.e., preset content). I think choice is important, but I think the students should be making choices about enactments of assignments not whether or not or even how much to participate online. I don't happen to endorse the multiple intelligence, learning modalities stuff that seems to get interpreted as "let's offer lots of modality options to learners." No, you can't do an interpretative dance to show me you've learned how to think about school leadership, though you could do a voice over narration of a videotape of a relevant scene from your school. We are biased toward the use of language (written, spoken, read, and listened to). Number 5 does not fit. That is again more of a "given" and not something we actually design.		
8. Assessment of learning	1) Shared rubrics, created jointed by students and instructors.	4.0	4.0
	2) Opportunities to revise or modify work.	4.5	5.0
	3) Communication of the high value placed on student participation.	4.0	4.4
	4) Communication of the high value placed on the quality of the learning. Process in collaborative project work, not just on its outcome.	4.0	4.6
	5) Opportunities for student collaborators or project-relevant outsiders to participate in the assessment practice.	3.75	3.4
Comments from R-2	This should be combined with category 5 above.		
Comments from R-3	On #5 I'm thinking, feedback is good, but grading is mine.		

9.	1) This indicator is measured by log-in status,	2.8	2.6

Interactivity	reactions to interactive simulations, demonstration of knowledge gains through learning by doing.		
	2) Students actively engage in peer-to-peer discussion and sharing. (This is probably measured like group work.)	4.0	4.6
Comments from R-2	Good category. I'd like to see us develop this a bit more as it relates to indicators of constructivism. I'm not sure these two characteristics have captured it. I was thinking it might refer to the design of the course...the extent to which it offers real interactivity for students (with materials, with each other, with "experts" and so on). This one can also be combined with category 5. I proposed it and I see it would be best under the assessment category.		
Comments from R-3	I agree. The category is an important one, but the indicators do not begin to address it. I agree with whomever it is that said we need to build this category out. It has huge implications for interface design for online learning environments and we should be able to do a better job defining it than this.		
10. Requirement to "discover" relationships	1) Expectation that students may (will?) develop understandings that differ from what the teacher(s) had anticipated.	4.0	4.0
Comments from R-2	Hmmm... requirement to discover... I don't like the sound of that. However, students who DO discover or diverge from the faculty member's expectations are usually very engaged in the topic. This might be an indicator for another category. This is very fuzzy. Do you mean I should assume that when a student disagrees with me that student has constructed new knowledge?		
Comments from R-3	I see this as part of the basic constructivist philosophy – the expectation that students will create (construct) structures and understandings that differ from those help and anticipated by their teachers. This shouldn't be a requirement, but it's okay.		

APPENDIX 5

General Comments on Study From Expert Panel

Round	Comments
1	I'm concerned about the definition of "constructivist" as opposed to "constructionist." There is a difference, and in the field of education it matters. Given your use of the phrase "higher order cognitive skills," I'm assuming you know the difference and really do mean constructivist, i.e., a cognitive term, rather than social constructionist (a social learning term). Perhaps you could clarify in the next round.
1	I'm a bit unclear about how the "indicators" should be written: are they the indicators I use under each category? Are they how students are measured or are they how I would measure the success of a constructivist environment (the instructional design) under each category? You will see my answers are mixed and that I did not write 5 for each.
1	I don't like the inclusion of "frequency" of direct instruction as a criterion for considering a course "constructivist". I think that certain categories of learning tasks (lower levels on the hierarchies) can and should be handled via direct instruction. That doesn't mean I'm not a constructivist, just practical. Wouldn't constructivists use direct instruction in teaching their children about dangers in the environment (crossing the street, avoiding fans and stoves, etc)? I don't think that inclusion of direct instruction is a liability, but the absence of constructivist activity is. (does that make sense?)
2	More categories make me feel better. Thanks to all who added them.
2	The last comment above [see comment below] is very important for to include or keep in mind, in the write up of this study. I bet most of us would agree with it, and the study seems to be leaning in the direction of black and white, good and evil. Thank you anonymous colleague. ---- I don't like the inclusion of "frequency" of direct instruction as a criterion for considering a course "constructivist". I think that certain categories of learning tasks (lower levels on the hierarchies) can and should be handled via direct instruction. That doesn't mean I'm not a constructivist, just practical. Wouldn't constructivists use direct instruction in teaching their children about dangers in the environment (crossing the street, avoiding fans and stoves, etc)? I don't think that inclusion of direct instruction is a liability, but the absence of constructivist activity is. (does that make sense?) ----
2	Constructivist learning assumes some building blocks are available for the learner to use! Mostly, those building blocks are a by-product of

	direct instruction. Most novices in ANY field must start with some direct instruction for even basic things such as terminology (verbal information), basic rules, and so on. Yes, adults move through this phase quickly, however, when learning completely new materials we usually start with some direct instruction: flying a plane is knowledge I would not want to construct on my own based on my experience flying in cattle class or on my observation of cloud patterns! Later, once I have some skills, then yes, I DO need to learn how my body, hand, and eye react to the movement of the plane and how I handle situations: Things that cannot be taught through direct instruction.
3	This isn't yet a tight conceptual framework. I hope the ratings help you formulate some promising points, which still need to be reduced down to a tighter set of principles and indicators.

APPENDIX 6

Framework of Categories and Related Indicators of Constructivist Principles in Internet-Based Courses

Project-Based Learning

1. Examples of project-based learning tasks would include: design and development projects; research and evaluation projects; analysis and critique projects; scenario and case responses; knowledge-base development projects.
2. Students are given some general guidelines as to possible projects to complete, but they decide what is relevant and meaningful to them.
3. Project "assignments" are purposefully under-designed to allow a large degree of flexibility in interpretation, which is in keeping with the construction of new knowledge.
4. Students explore nontrivial problem areas and ask questions, debate ideas, make predictions, and draw conclusions while creating relevant artifacts.
5. Projects are authentic (takes place in a real world setting with real world participants).
6. Projects are shared with peers during development and completion, thus supporting knowledge construction in social learning settings.

Collaborative and Cooperative Small Group Work

7. Examples of collaborative and cooperative small group work would include: threaded discussions (internal); discussions with outside experts; synchronous chats; small-group exercises; projects and papers with multiple authors.
8. There is negotiation and consensus building in online discussion forums.
9. Teams post progress reports and react to the progress reports or final products of other teams.
10. Individuals have an opportunity to provide feedback to each other on the quality and progress of their work in the collaboration during the collaboration.
11. Conversations among students are rated as important to the learning process by students in a post-activity survey and/or interview.
12. Students actively engage in peer-to-peer discussion and sharing.

Higher Order Cognitive Skills

13. Sample types of tasks or methods include: reflective journal entries; threaded discussions; rationales and reflections on projects; projects requiring high levels of self-directed work and organization; evaluation of others' work.
14. Students exhibit creative uses of knowledge.
15. Students critically evaluate own (and others') work.
16. Students analyze online case situations and react to the posts of their peers' case solutions.
17. Students demonstrate adaptation of theory to local situations and problems.

18. Students participate in "what if" discussions that require them to extrapolate from ideas to real world application.
19. Students construct, build, or enact something that is representative of an abstract theory or idea.
20. Students revisit work to improve or modify their effort.
21. Students describe their work or their perspective/beliefs in terms of theoretical or abstract ideas from course work.
22. Students participate in teaching or mentoring others on the subject.
23. Multiple alternatives are proposed and considered.

Authentic, Relevant, and Meaningful

24. Example methods of authentic practices include: making or building things; analyzing problems; designing solutions; trying out solutions; testing and evaluating solutions.
25. Reported or perceived relevance/utility of the tasks.
26. Rationale connecting learning task to a worthwhile practice.
27. Assessments are performance-based or related to real work settings.
28. Students can decide which groups or projects they want to join.
29. Special guests are brought in to discuss an emerging field or hot topic and their online chats are saved and posted to the web.
30. Student-initiated threads/topics predominate.
31. There is evidence of responsiveness to students in syllabus modification.

Safe Environment

32. Students are involved in the creation and enforcement of these rules.
33. Instructors avoid public humiliation or unneeded social comparison of students.
34. High levels of trust and support (which in turn will allow greater levels of public criticism) are maintained.
35. Open channels of communication are maintained.

Assessment of Learning

36. Shared rubrics, created jointly by students and instructors.
37. Opportunities to revise or modify work.
38. Communication of the high value placed on student participation.
39. Communication of the high value placed on the quality of the learning process in collaborative project work, not just on its outcome.
40. Expectation that students may/will develop understandings that differ from what the teacher(s) had anticipated.